



Building a Healthy MQ-1/9 RPA Pilot Community

Designing a Career Field Planning Tool

Tara L. Terry, Chaitra M. Hardison, David Schulker, Alexander C. Hou,
Leslie Adrienne Payne

For more information on this publication, visit www.rand.org/t/RR2018

Library of Congress Cataloging-in-Publication Data is available for this publication.

ISBN: 978-0-8330-9874-0

Published by the RAND Corporation, Santa Monica, Calif.

© Copyright 2018 RAND Corporation

RAND® is a registered trademark.

Limited Print and Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law. This representation of RAND intellectual property is provided for noncommercial use only. Unauthorized posting of this publication online is prohibited. Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Permission is required from RAND to reproduce, or reuse in another form, any of its research documents for commercial use. For information on reprint and linking permissions, please visit www.rand.org/pubs/permissions.

The RAND Corporation is a research organization that develops solutions to public policy challenges to help make communities throughout the world safer and more secure, healthier and more prosperous. RAND is nonprofit, nonpartisan, and committed to the public interest.

RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

Support RAND

Make a tax-deductible charitable contribution at
www.rand.org/giving/contribute

www.rand.org

Preface

Remotely piloted aircraft (RPA) and the personnel that operate them are well understood to be crucial to mission success in today's Air Force, and demand for skilled pilots continues to grow rapidly. However, recent studies have suggested that personnel in the RPA pilot career field are dissatisfied with aspects of the job and are experiencing stress as a result. Although those studies suggest that a variety of workplace factors are leading to the stress and dissatisfaction, a large portion of them relate to issues associated with career field planning.

These career field planning issues exist, in part, because of the newness and rapid growth of the RPA enterprise. The 18X RPA pilot force (those whose first and only rated job is as an RPA pilot) is only six years old, and plans for the future of the career field are still evolving. Moreover, as the rapid growth in demand for 18X pilots has outpaced the Air Force's ability to produce them, the Air Force is now struggling to train and retain enough personnel to meet the demand. As a result, Air Force leadership has recognized that a more thoughtful and stable plan for how to manage the career field is needed to ensure the health of the force in the future. The Director of Training and Readiness (AF/A3T) therefore asked RAND Project AIR FORCE to assist in building a long-term field planning model that addresses those force health issues and the timeline required to build a healthy and sustainable career field. This report documents RAND's efforts to develop that long-term career field planning model; explains its main features, underlying content, and data inputs; and describes key technical aspects of the model.

More specifically, this study (1) used input from Air Force leadership, stakeholders, and subject-matter experts to define what a healthy and sustainable RPA pilot career field shape across commissioned years of service (CYOS) might look like in the long term in terms of desired end-state requirements that incorporate aspects meant to improve satisfaction within the career field, and (2) built a linear programming model that specifies the number and type of RPA pilots that should be produced annually from the training pipeline to achieve that end-state career field shape across CYOS. Using this linear programming model, the RAND team then explored the implications of a few pilot production and retention scenarios for the long-term health of the career field when compared with this set of desired end-state requirements.

This report is intended to provide information about the development of the model. It should also be of interest to those concerned with the technical modeling aspects of career field health planning.

This research was commissioned by the U.S. Air Force and conducted within the Manpower, Personnel, and Training Program of RAND Project AIR FORCE as part of a fiscal year 2016 project, Building a Healthy and Sustainable RPA Career Field Using 18X, ALFA Tour, and 11U/12U Pilots.

RAND Project AIR FORCE

RAND Project AIR FORCE (PAF), a division of the RAND Corporation, is the U.S. Air Force's federally funded research and development center for studies and analyses. PAF provides the Air Force with independent analyses of policy alternatives affecting the development, employment, combat readiness, and support of current and future air, space, and cyber forces. Research is conducted in four programs: Force Modernization and Employment; Manpower, Personnel, and Training; Resource Management; and Strategy and Doctrine. The research reported here was prepared under contract FA7014-16-D-1000.

Additional information about PAF is available on our website:

<http://www.rand.org/paf/>

This report documents work originally shared with the U.S. Air Force on June 7, 2016. The draft report, issued in September 2016, was reviewed by formal peer reviewers and U.S. Air Force subject-matter experts.

Contents

Preface.....	iii
Figures.....	vi
Tables.....	viii
Summary.....	ix
Acknowledgments.....	xvii
Abbreviations.....	xviii
1. Introduction.....	1
Overview of the Types of Pilots Flying MQ-1/9s.....	1
The Importance of Long-Term Career Field Management.....	2
Our Approach.....	3
Organization of This Report.....	6
2. RPA Career Field Model Overview.....	7
Characteristics Defining a Healthy Career Field.....	7
Initiatives to Make the RPA Enterprise Healthy.....	8
Model Inputs and Assumptions.....	10
RPA Model Objective Function and Constraints.....	24
3. Comparison of Two Production Tempos.....	28
ASAP Production Tempo Results.....	29
Balanced Career Field Management Approach.....	34
Summary.....	40
4. The Impact of Growth in Desired End-State Requirements on Production and Inventory	
Levels.....	41
Overview.....	41
How Long It Takes to Meet Desired End-State Requirements.....	42
Annual Production Numbers Required to Meet Desired End-State Requirements.....	45
Impact on Numbers of Unassigned RPA Pilots.....	48
Impact on Inventory Composition.....	49
Conclusion.....	49
5. How the Model Can Be Used to Support RPA Policy Analysis.....	51
Appendix A. Interview Participants, Themes, and Questions.....	54
Appendix B. Senior Leader and Subject-Matter Expert Perspectives.....	58
Appendix C. Complete Details on the Model Inputs and Assumptions.....	69
Appendix D. RPA Model Formulation.....	90
Appendix E. Optimal Mix of 18X, 11U/12U, and ALFA Tours.....	100
Appendix F. Alternative Assignment Patterns and Desired End-State Requirements.....	104
References.....	110

Figures

2.1. Theoretical RPA Requirement for Different Community Benchmarks	17
2.2. End-State Requirement by Aggregate Duty Category.....	17
2.3. Cumulative Continuation Rates Used in the Model	20
3.1. Annual Production in the ASAP Scenario (Low Losses)	31
3.2. Unfilled Desired End-State Requirements Versus Unassigned RPA Pilots in the ASAP Scenario (Low Losses).....	31
3.3. Unfilled Desired End-State Requirements by Duty in the ASAP Scenario (Low Losses)....	32
3.4. Experience Levels of Unassigned RPA Pilots in FY 2021 in the ASAP Scenario.....	33
3.5. Annual Production in the Balanced Scenario (Low Losses)	35
3.6. Unfilled Desired End-State Requirements Versus Unassigned RPA Pilots in the Balanced Scenario (Low Losses).....	36
3.7. Unfilled Desired End-State Requirements by Duty in the Balanced Scenario (Low Losses)	37
3.8. Annual Production in the Balanced Scenario (Medium Losses)	39
3.9. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots in the Balanced Scenario (Medium Losses)	39
4.1. Unfilled Desired End-State Requirements by Duty Category, Baseline Scenario Versus 55 Active Duty Lines with Low Losses.....	44
4.2. Unfilled Desired End-State Requirements by Duty Category, Baseline Scenario Versus 55 Active Duty Lines with Medium Losses	45
4.3. Optimal Level of Production for Low and Medium Losses, Baseline Scenario Compared with 55- and 65-Combat Line Scenarios	46
4.4. Annual Number of Unassigned Career RPA Pilots for Different Numbers of Active Duty Combat Lines Under Low and Medium Losses	49
4.5. Inventory Over Time by Pilot Type, Baseline vs. 65 Active Duty Combat Lines, Low and Medium Losses	50
C.1. Exemplary MQ-1/9 Operations Squadrons.....	71
C.2. Desired End-State MQ-9 Positions at New Wing and OG at Base X.....	73
C.3. Desired End-State MQ-9 Positions at New OG at Base Y	73
C.4. Desired End-State MQ-9 Positions at Future 432 WG and 432 OG.....	75
C.5. Desired End-State MQ-9 Positions at Future 732 OG	75
C.6. Desired End-State MQ-9 Operations Squadron Positions at Future 27 SOW	77
C.7. Desired End-State MQ-9 Positions at Active Associate FTU Squadrons.....	78
C.8. Initial Inventory of MQ-1/9 Pilots by CYOS and Career Field	80
C.9. CYOS Distribution for New RPA Pilots.....	87

C.10. Maximum Number Out of 100 RPA Pilots in Each CYOS Assigned to Each Duty Under the Traditional-Pilot Benchmark.....	88
E.1. Annual Production with a Higher 11U Crossflow Limit in the Low-Loss Scenario	100
E.2. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots with Higher 11U Crossflow Limit in the Low-Loss Scenario	101
E.3. Effect of Increasing Crossflow on Unfilled Desired End-State Requirements by Duty (Balanced Scenario with Medium Losses)	102
E.4. RPA Pilot Inventory with Increased Crossflow vs. Baseline (Balanced Scenario with Low Losses)	103
F.1. Annual Production Using ABM Patterns and Desired End-State Requirements (Balanced Scenario with Low Losses).....	105
F.2. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots with ABM Assignment Patterns and Desired End-State Requirements (Balanced Scenario with Low Losses)	105
F.3. Unfilled Desired End-State Requirements by Duty Using ABM Assignment Patterns and Desired End-State Requirements (Balanced Scenario with Low Losses)	106
F.4. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots Using ABM Assignment Patterns and Desired End-State Requirements (Balanced Scenario with Medium Losses).....	107
F.5. RPA Pilot Inventory Under ABM Assignment Patterns (Balanced Scenario with Low Losses)	108

Tables

2.1. Elements Captured in the RPA Model.....	11
2.2. RPA Model Duty Categories	13
3.1. Assumptions Under Two Career Field Planning Scenarios.....	29
4.1. Total Desired End-State Requirements for Planning Scenarios	42
4.2. Annual Unfilled Desired End-State Requirements with Low and Medium Losses When Increasing the Number of Lines, Crew-to-Line Ratio, and Combat-to-Dwell Ratio.....	43
4.3. Steady-State Production Level for Varying Desired End-State Requirement Scenarios with Low and Medium Losses	47
A.1. Interview Participants	54
A.2. 18X Health and Sustainability Schema.....	56
C.1. Desired End-State Requirements for New Wing by Duty	74
C.2. Desired End-State Requirements for Future 432 WG by Duty.....	76
C.3. Desired End-State Requirements for Future 27 SOW MQ-9 Operations Squadrons by Duty.....	77
C.4. Desired End-State Requirements for Active Associate FTU Squadrons by Duty	78
C.5. Desired End-State Requirements from FY 2016 Baseline by Duty	79
C.6. Duty Categorization Rules for RPA Pilots and Traditional Pilots	82
C.7. Benchmark Proportions for Selected Duties	84
C.8. Historical Crossflow Proportions in Traditional Pilot Communities	85

Summary

Remotely piloted aircraft (RPA) and the personnel that operate them are well understood to be crucial to mission success in today's Air Force, and demand for skilled pilots continues to grow rapidly. However, recent studies have suggested that personnel in the RPA pilot career field are dissatisfied with aspects of the job and experiencing stress as a result—in large measure, a result of issues related to career field planning.

These career field planning issues exist, in part, because of the newness and rapid growth of the enterprise. At the time of this study, the 18X RPA pilot force (personnel whose first and only rated job is as an RPA pilot) was only six years old, and plans for the future of the career field were still evolving. Moreover, as the rapid growth in demand for 18X pilots outpaced the Air Force's ability to produce them, the Air Force was struggling to train and retain enough personnel to meet the demand, which has put incredible stress on RPA pilots.

In August 2015, Air Combat Command launched its Culture and Process Improvement Program (CPIP) for the RPA community—an effort that produced 140 actions that will be taken to improve RPA operations and improve quality of life for the force. As these many initiatives began to be implemented, Air Force leadership recognized the need for a more thoughtful and stable plan for managing the career field to ensure the health of the force in the future. Thus, the Air Force Directorate of Training and Readiness (AF/A3T) asked RAND Project AIR FORCE to assist them in building a long-term career field planning model. This report explains the inputs, constraints, and model formulation and provides a few examples of the excursions that were explored during model development.

The RPA Career Field Model

This study sought to develop a linear programming model to project the short-term (over the next five years) and long-term (10 or 20 years down the road) consequences of career field planning decisions on the health of the active component MQ-1/9 RPA force. The model best matches the pilot inventory to the desired end-state requirements by determining the annual production and crossflow needed. The model factors in retention patterns and assignment patterns and opportunities similar to those of traditional manned-aircraft pilots.

We defined the majority of the model constraints, inputs, and desired end-state requirements by (1) interviewing Air Force senior leaders and stakeholders to define what a healthy and sustainable MQ-1/9 RPA pilot career field might look like in the long term; (2) analyzing existing data, including manpower authorizations and personnel data files; and (3) meeting with RPA subject-matter experts (SMEs).

Our approach to building an RPA career field management model was informed by past RAND work developing rated force management models, but it differs from those models in meaningful ways. Rated force management models typically use a framework (referred to as red-line/blue-line) in which the number of personnel in the current inventory over time is compared with the number of personnel required to run the enterprise. When the total inventory equals the total requirements, the enterprise is fully staffed. While these models are useful for many purposes, they have not typically included the level of granularity needed to address many of the issues of interest to the Air Force in defining a healthy RPA career field—issues such as whether the experience levels of personnel in the inventory match the experience levels needed to fill certain requirements and whether personnel are receiving the opportunities for developmental assignments at the same points in their career as in other rated communities. The goal of this research effort was to provide such a model.

How We Designed the Model

While demand for RPA pilots is outpacing current production levels, the Air Force is using personnel from other rated career fields, which the model takes into consideration. Some of these personnel were reclassified permanently as RPA pilots and are designated as 11Us (former traditional manned-aircraft pilots) or 12Us (former combat systems operators). Others have been provided on loan temporarily; these assignments are referred to as ALFA tours.

Our optimization model forecasts how career field dynamics such as production, assignment patterns, and retention might unfold over time. Thus, the modeling decisions that simplify the real context of career field planning are critical to the accuracy and usefulness of the model, as are the data analyses from which the model inputs are created.

Characteristics of a Healthy Career Field

A priority in developing the RPA career field model was to incorporate assumptions and model inputs that would support the development and sustainment of a healthy career field. The RAND team spoke to senior leaders in the Air Force to better understand their view of characteristics that are essential for ensuring a healthy RPA pilot career field. These characteristics include lowering operational tempo, developing stable deployment schedules, reducing the use of ALFA tour pilots, and establishing crossflow similar to that in other rated career fields. Other important factors include job satisfaction, adequate professional development, good retention, positive quality of life, and opportunities that are attractive to potential rated candidates. The Air Force's long-term goal is to create a career field experience for 18X personnel that mirrors that of traditional pilots. These and many other details about how the RPA career field should look in the future factored heavily into our design of the model and its inputs.

Model Inputs and Assumptions

Put simply, the model is initialized with the active component current inventory of each type of MQ-1/9 RPA pilot (18X, 11U, 12U, and ALFA tour) at the end of FY 2015 and a set of MQ-1/9 manpower requirements that represent the desired end state. The main goal of the model is to increase the initial inventory to ultimately match the desired end-state requirements while limited by some real-world constraints. Important considerations are the composition of the inventory over time, the time it takes to attain an inventory that matches the desired end-state requirements, and whether or not the path to attain this inventory is sustainable. The model provides a solution that best matches the inventory to the desired end-state requirements by determining the production and crossflow needed, while factoring in retention patterns of each type of RPA pilot and assignment patterns that provide traditional pilot-like assignments, career paths, timing, and opportunities.

The main elements captured in the model are the following:

- *Desired end-state requirements.* The information gathered on the desired direction for the MQ-1/9 portion of the RPA career field is translated into a set of desired end-state requirements summed by duty that approximates the types of jobs that RPA pilots should fill if this were a mature and healthy career field. We specified 17 types of duties RPA personnel perform, which fall into the following broad categories: line flying, training instructor, leadership, development and support for RPA operations, and other development and support duties.
- *Maximum production capacity.* The model increases MQ-1/9 RPA inventory through production, measured as the number of officers who successfully graduate from formal training units (FTUs) annually. Without constraints, the model maximizes production to meet desired end-state requirements as quickly as possible, but boundaries are set based on inputs from RPA career field representatives to ensure reasonable production levels each year.
- *Retention.* Retention patterns are defined for each specialty (11U, 12U, 18X, and ALFA tour). For 11U and 12U, retention is calculated based on historical data for manned-aircraft pilots and combat systems operators; ALFA tour pilots exit the career field at the end of a fixed four-year term. Because the RPA career field is new, the first cohort of RPA pilots is just nearing completion of their six-year active duty service commitment, so actual retention patterns are not known. These retention patterns are therefore estimated from econometric forecasts made in earlier RAND research (Hardison, Mattock, and Lytell, 2012).
- *Assignment patterns.* The prime difficulty for career field planners lies in the variation of experience levels across job requirements and the fact that it often takes many years to build the experience required for certain duties, such as more senior-level leadership positions. We capture this dynamic by imposing maximum percentage limits on how

RPA pilots can be assigned to requirements by commissioned years of service, according to norms in other rated communities.

- *Crossflow levels.* In the past, the Air Force has exploited the use of crossflows to fill personnel shortfalls in the RPA pilot community. In the future, the Air Force wants crossflows to the RPA community to align with those to other rated career fields. We therefore developed benchmarks based on historical crossflow patterns (averaged over a 10-year period) in the rated community, aggregated over grade and commissioned years of service.

One additional point to note about the model is that we use the term *requirements* in an unconventional way. Unlike the typical definition of requirements in the Air Force, our definition does not refer to requirements currently listed in existing manpower documents, either funded or unfunded. Instead, the requirements are an ideal, a desired end state to aim for, not burdened by current budgetary processes and end-strength limitations. The desired end-state requirements we specify in our model represent not only the personnel needed to accomplish the mission, but also those needed to incorporate healthy career field aspects (such as combat-to-dwell and crew-to-line ratios), along with developmental opportunities similar to those in the traditional manned-aircraft pilot communities—all of which are important elements in leadership’s vision for the future of the career field. This more-inclusive definition of future requirements (one that aims to fill positions related to career field health as well as mission requirements) is key to eventually building a healthy career field years down the road; however, we acknowledge that it is a departure from the way career field planning models (and many Air Force personnel) typically define requirements.

How the Model Works

The model determines an optimal solution by finding the best match of inventory to annual desired end-state requirements while simultaneously determining the needed production and crossflow each year and accounting for retention patterns, assignment patterns, and career opportunities. To ensure that the model reaches this solution as efficiently as possible, a number of priorities are encapsulated in the objective function. In general, the model minimizes

- The number of unmet desired end-state requirements
- The number of RPA pilots in excess of desired end-state requirements
- The number of produced RPA pilots
- The number of crossflows into the RPA career field.

In addition, to ensure that the results are representative of reality in the RPA communities, these elements are not all factored equally. Instead, they are weighted to reflect the career field priorities we learned from the RPA leadership. These include policy preferences on limits to the number of crossflows and priorities among individual duties (which may change over time).

Many other constraints are incorporated into the model to best reflect real-world limitations that should be taken into consideration.

What We Explored with the Model

Once initial development was complete, the RAND research team conducted many model excursions that demonstrate how the model functions. Two of these excursions illustrate those functions. One examines two types of production tempos, and the other examines the impact of growth in desired end-state requirements. These excursion scenarios address some of the issues that decisionmakers are currently grappling with as part of ongoing efforts to reduce stress among RPA pilots and improve the health of the career field.

Two Pilot-Production Tempos

The philosophy in the RPA community is to maximize production to build up personnel in the RPA career field as quickly as possible, while introducing an ambitious set of initiatives to enhance the health of the career field. With that in mind, we considered two scenarios that affect the pilot-production tempo: (1) one imparts the sense of urgency to fill desired end-state requirements to achieve Air Force goals quickly (the ASAP [as soon as possible] scenario); (2) the other takes a more holistic, long-term look at career field planning, balancing the need to fill mission-essential desired end-state requirements in a timely manner against being mindful of the fact that production decisions made now will have other lasting effects on the shape of the force years into the future (the balanced scenario). These scenarios were tested under two different loss profiles: low losses and medium losses.¹

In the ASAP scenario and assuming low losses, most desired end-state requirements are met by fiscal year (FY) 2021, with the introduction of ALFA tour pilots in the early years to fill shortages. Remaining desired end-state requirements, most of which are development and support positions, are filled by FY 2030. But this high production tempo comes at a cost. Over time, by placing a high priority on meeting near-term desired end-state requirements as quickly as possible, the model creates a large population of unassigned RPA pilots, even though desired end-state requirements remain unfilled. This occurs because the unassigned pilots, most of whom have only a few years of service, lack the experience to be assigned to the more senior-level development and support positions. Thus, producing high numbers of pilots in the short term without factoring in potential overages could quickly create a glut of inexperienced personnel. If

¹ Retention profiles from past work reported in Hardison, Mattock, and Lytell (2012) were used in this study. Given that retention and losses are opposites, knowing one rate ensures that you can calculate the other. We chose to implement loss rates in the model. The implemented *low losses* correspond to expected retention if civilian pay is similar to military pay, while *medium losses* correspond to expected retention if civilian pay is 125 percent of military pay.

losses are higher, there is little change in the pattern of results: We find a delay in filling desired end-state requirements (it is not achieved until FY 2040) and a similarly high inventory imbalance.

In comparison, the balanced scenario shows promising findings for the RPA community. The model results indicate that it is possible to build a healthy career field with fewer RPA pilots produced per year, provided retention policies can control RPA pilot losses. Additionally, this solution reaches the desired end-state requirements within a year of those achieved by the ASAP scenario. Producing more RPA pilots in the ASAP scenario does little to reduce the overall timeline to fill desired end-state requirements because it takes time for newly minted pilots to gain the experience appropriate to fill most of the development and support duties. However, these results also show that if retention is poor, the Air Force is unlikely to be able to fill all desired end-state requirements in the long run and will have fewer pilots available for more-senior developmental duties. To be clear, these unfilled development and support duties are not true requirements listed on the manpower documents that are going unfilled; rather, they represent the gap between the current inventory and the ideal future of the RPA career field. This gap highlights that certain duties require experience and maturity in the RPA force, which the Air Force cannot hurry along and will eventually fill once the more junior cohorts gain experience and maturity over time.

Growth in Requirements

Growth in operational requirements and greater-than-expected manning needs would lead to substantial increases in the long-run size of the RPA pilot community. And many of the SMEs interviewed for this study indicated that they believe operational requirements are likely to increase in the future. Thus, we examined how growth in desired end-state requirements affects pilot production, inventory levels, mix of RPA pilots, and the timeline to meeting the desired end state. We explored three growth scenarios—increasing combat-to-dwell ratios, crew-to-line ratios, and the number of active duty combat lines—using the assumptions of the balanced scenario.

Despite the fact that the number of personnel required is significantly higher in these scenarios, the increases do not translate into longer timelines to meet requirements relative to the baseline scenarios—requirements are largely filled by 2031 in all scenarios. Overall, our exploration of these growth scenarios showed that the RPA career field has the capacity to grow far beyond the baseline desired end-state requirements fairly quickly and still achieve a large career field that mirrors the patterns among traditional pilots, provided retention is closely monitored and annual production numbers take into account the anticipated growth far in advance of the actual need.

More specifically, if 18X retention levels turn out to be slightly better than those of 11U pilots (low losses), the community could be capable of flying 10 or even 20 more lines than it is currently responsible for by 2031 and could have healthy proportions of personnel in

developmental and leadership assignments at higher grades, assuming that production numbers now are set appropriately. However, 18X retention that is substantially worse than historical 11U retention requires even higher production and does not retain enough experienced officers to fill developmental assignments proportionally to the retention of traditional pilots. These results indicate that Air Force planning should maintain the right level of production, given the desired capacity of the RPA career field, while also ensuring that sufficient numbers of experienced pilots are retained. Without both pieces, the RPA career field is unlikely to reach traditional pilot benchmarks of normal career field health.

How the Model Can Be Used to Support RPA Policy Analysis

The model was designed first and foremost to address the following question: *What is the best way to ramp up personnel to bring the active component MQ-1/9 portion of the RPA career field to a healthy, sustainable state where operational tempo, retention, recruitment, job satisfaction, career development, and training become more comparable to other established, healthy career fields?* The model results described in this report begin to address the question by exploring issues that affect growth in the career field over time—production tempo, crossflow policies, possible impacts of retention incentive policies, and assignment patterns and desired end-state requirements.

The model as it stands reflects the best available data and information about the MQ-1/9 community and the best approximations of the Air Force's priorities for the active component community, but policymakers may wish to change the information in the model in the future. For example, although many elements in the model were decided on the basis of leadership's views for the career field, those views may change. In addition, as the career field matures, the Air Force will have new, different, and in some cases more accurate information on which to base inputs that can be substituted for the information currently in the model, or the Air Force may wish to expand this modeling across all RPA platforms or across the total force (active and reserve components). Anticipating that various types of changes to the model will be needed, we have ensured that the model can be adjusted and edited to accommodate these changes so that it will be useful to policymakers not only today, but for years to come.

The overarching purpose of the model and of the results it produces is to allow policymakers to visualize the impact of relevant issues on the shape of the future RPA career field and, accordingly, make decisions about policies for managing the career field that are informed by projections of the policies' impacts 10 or 20 years down the road. The ability to vary assumptions in the model to depict alternative policy scenarios or reflect current realities and analyze their effects can provide valuable information to Air Force leadership as new initiatives are being considered prior to implementation. As changes in desired end-state requirements are anticipated, the model can help estimate levels of production that will be needed in future years—information that can inform planning for future training needs. Understanding the

implications of different retention patterns provides insight into the importance of monitoring retention, being proactive in assuring good retention, and devising appropriate incentives to develop enough seasoned officers and enlisted personnel to fill leadership positions within and outside of the RPA community. These and other analyses can be conducted using the RPA career field model² to inform Air Force decisionmaking along the path toward developing a healthy RPA career field.

² The model as described in this report does not contain any information regarding enlisted requirements or enlisted personnel. While there is no reason the model could not also address enlisted personnel/requirements and the interactions within the officer career field, it would need to be modified to include this capability.

Acknowledgments

We are grateful to a number of Air Force personnel who have assisted in this study. Maj Gen Martin Whelan (then AF/A3X, now AF/A3T), who served as our project sponsor, provided invaluable direction and guidance throughout the course of the project, and Brig Gen B. Chance Saltzman (then AF/A3X, now AF/A3T) took over for him when the project was nearing completion. Lt Col Calvin (PT) Powell and Maj Steven (Rhino) Mwesigwa (AF/A3TC) served as our points of contact for the sponsoring office, and both were instrumental in facilitating access to subject-matter experts and key Air Force leaders for our interviews. They also provided useful feedback on the model at various points in the project.

In the early stages of the project, Gen Herbert Carlisle, Commander, Air Combat Command (ACC), shared his views on the RPA enterprise. Those views drove some of our initial thinking regarding the end-state targets for the model. Lt Col Landon Quan and Charles Hayworth of ACC/A3MU also worked with us throughout the project to detail a set of manpower requirements that would account for the future changes ACC has planned for the MQ-1/9 enterprise. Air Force Special Operations Command staff also provided their vision of how the enterprise should be structured in the future. Both sets of requirements provided the foundation of the operational requirements part of our model's end state.

In addition, several senior leaders and other key Air Force subject-matter experts graciously participated in interviews, offering their vision for the future of the force. The participants we targeted for those interviews are cited by name in Appendix A. We also thank the members of their staffs who attended the interviews and contributed their thoughts and those who assisted in scheduling the interviews.

We would also like to thank several RAND researchers who assisted in the work. Barbara Bicksler worked tirelessly to help prepare summaries, briefings, and the final write-up of the work. Al Robbert, Lisa Harrington, and John Crown provided insightful reviews of early versions of the model and output. We thank Al Robbert for the advice he provided the study team throughout the project on various aspects of the data analysis and model formulation. We ultimately produced a much improved model as a result of all of their comments, questions, and suggestions. Finally, we thank John Crown and Bart Bennett for providing useful and critical reviews of this report, which further strengthened our work and results.

Abbreviations

11U	remotely piloted aircraft pilot (former traditional manned-aircraft pilot)
12U	remotely piloted aircraft pilot (former combat systems operator)
18X	remotely piloted aircraft pilot
ABM	air battle manager
ACC	Air Combat Command
ADSC	active duty service commitment
AETC	Air Education and Training Command
AF/A3T	Directorate of Training and Readiness, Deputy Chief of Staff for Operations
AF/A3TC	Combat Air Force Division, Directorate of Training and Readiness
AFSC	Air Force specialty code
AFSOC	Air Force Special Operations Command
ALO	air liaison officer
ANG	Air National Guard
ATKS	attack squadron
CAP	combat air patrol
CC	Commander
CPIP	Culture and Process Improvement Program
CSO	combat systems officer
CT	continuation training
CYOS	commissioned years of service
DNIF	duty not involving flying
DO	Director of Operations
FTU	formal training unit
FTUI	formal training unit instructor
FY	fiscal year

IQT	initial qualification training
LE	line examiner
LI	line instructor
LNO	liaison officer
LP	line pilot
LR	launch and recovery
LRE	launch and recovery element
LREI	launch and recovery element instructor
MCE	mission control element
MPES	Manpower Programming and Execution System
MQT	mission qualification training
OG	operations group
OPTEMPO	operational tempo
OSS	operations support squadrons
PME	professional military education
RL/BL	red-line/blue-line
RPA	remotely piloted aircraft
RS	reconnaissance squadron
SME	subject-matter expert
SOC	squadron operations center
SOS	Special Operations Squadron
SOW	special operations wing
TFBL	Total Force Blue Line (model)
UPT	undergraduate pilot training
URT	undergraduate RPA training
URTI	undergraduate RPA training instructor
WG	Wing
WOC	wing operations center

1. Introduction

Remotely piloted aircraft (RPA) and the personnel that operate them are well understood to be crucial to mission success in today's Air Force, and demand for skilled pilots continues to grow rapidly. However, recent studies have suggested that personnel in the RPA pilot career field are dissatisfied with aspects of the job and experiencing stress as a result (see Hardison et al., 2017; and U.S. Government Accountability Office, 2014). Although those studies suggest that a variety of workplace factors are leading to the stress and dissatisfaction, a large portion of the issues relate to career field planning.

These career field planning issues exist, in part, because of the newness and rapid growth of the enterprise. At the time of this study, the 18X RPA pilot force (personnel whose first and only rated job is as an RPA pilot) was only six years old, and plans for the future of the career field were still evolving. Moreover, as the rapid growth in demand for 18X pilots outpaced the Air Force's ability to produce them, the Air Force was struggling to train and retain enough personnel to meet the demand for the day-to-day mission. As a result, Air Force leadership recognized the need for a more thoughtful and stable plan for managing the career field to ensure the health of the force in the future. The Air Force Directorate of Training and Readiness (AF/A3T) therefore asked RAND to assist in building a long-term career field planning model that will allow the Air Force to visualize the consequences of various career field management decisions and issues (such as retention problems) for the ability to meet a healthy end state (and the timeline required to do so) and identify the appropriate active component MQ-1/9 pilot production numbers going forward to anticipate future needs.

Overview of the Types of Pilots Flying MQ-1/9s

Pilots who started their rated career flying RPA and have been flying RPA ever since belong to one of the Air Force's newest career fields (the 18X RPA pilot Air Force specialty), which was established in 2010 (Air Force Personnel Center, 2016). As a result, at the time of this study, most 18X RPA pilots had fewer than six commissioned years of service.¹

However, 18X RPA pilots are not the only pilots flying MQ-1/9 RPA. As the demand for skilled pilots was outpacing the ability to produce 18X RPA pilots, the Air Force sought to address the shortfalls by using personnel from other rated career fields (e.g., mobility pilots, bomber pilots, and combat systems operators). Some of these personnel were reclassified permanently as RPA pilots and are designated as 11Us (former traditional manned-aircraft

¹ Although a small number of officers transfer in from nonrated career fields, the majority of the 18X population entered the training pipeline right after commissioning.

pilots) or 12Us (former combat systems operators). Others have been provided on loan temporarily, serving in three- to four-year developmental career-broadening assignments. When such assignments are up, some individuals may return to their original rated jobs. Personnel on these assignments, referred to as ALFA tours,² retain their original rated Air Force specialty code (AFSC). At the start of this study, about 40 percent of the MQ-1/9 pilot force consisted of ALFA tour pilots, more than 30 percent were 11Us and 12Us, and the remainder were 18Xs. Although some ALFA tour pilots have been sent directly from undergraduate pilot training (UPT) (referred to as UPT directs), most ALFAs and 11U/12Us have years of prior experience in another rated career. As a result, many are more senior than the 18X population and consequently have filled the more senior-level RPA positions (e.g., instructor, squadron commander, and staff positions) while the 18X career field is maturing.

Although the contribution of ALFA tour pilots and 11U/12Us has been critical to building an RPA force quickly, Air Force leadership has acknowledged that a continued influx of such personnel will not be productive in the long term if the Air Force intends to develop 18X as a standalone career field. As a result, current plans propose shifting the mix of pilots to rely far less on ALFA tours over the next decade. The current aim is that 90 percent of MQ-1/9 pilots will be 18X by 2026.

To achieve that goal, the Air Force will need to establish a plan for how many 18Xs, 11Us, and 12Us need to be produced or crossflowed in the years leading up to 2026. We therefore designed our model to specify not only the number of pilots required in the enterprise but also the optimal mix of ALFA tour, 18X, 11U, and 12U pilots over the next few years and into the future, to achieve the desired end state. Air Force leadership has, however, also questioned whether 90 percent by 2026 is the right goal. To address this issue, we solicited views on the value added from continuing to utilize each type of pilot in the force of the future during our discussions with Air Force leadership. We also use our model to explore this issue in Appendix E.

The Importance of Long-Term Career Field Management

Although the Air Force has been increasing the numbers of 18X personnel in earnest and continuing to bring in new ALFA tour and 11U/12U pilots to fill the gaps, recent reports show that members of the RPA community (regardless of their career field) are still feeling stretched thin. In addition, they are dissatisfied with many other aspects of the way the career field is being managed. This in turn could lower retention, leading to even greater staffing shortages.

² Though its origin dates back to the Vietnam era, the term *ALFA tour* is still used to describe assignments that are “bills” to be paid by the operational flying community (i.e., experienced aviators) (Air Force Instruction 11-412). ALFA is an acronym for ALO, LIFT, FAC, and AETC (air liaison officer, lead-in fighter training, forward air controller, Air Education and Training Command).

How long these issues will persist will ultimately depend on how the Air Force manages RPA personnel in future years. First and foremost, the Air Force must carefully plan out how many people to access into the RPA community annually. However, decisions about annual accessions should consider not only any immediate staffing-shortage problems, but also many long-term career field planning factors, including the likely flow of people through training, flying, and instructing positions; current and future anticipated combat line demands; ways to address combat operational tempo (OPTEMPO) concerns for the RPA; long-term individual career development needs in the RPA community; and the Air Force's need for commanders and leaders with RPA experience. All of these issues should factor into how the career field is managed going forward. We therefore sought to explicitly address these issues as part of our career field management model.

Our Approach

Our approach to building an MQ-1/9 RPA career field management model was informed by past RAND work developing rated force management models, but it is also distinctly different from those models in several meaningful ways.

How Our Approach Differs from Recent Models

Rated force management models typically use a red-line/blue-line (RL/BL) framework for exploring the health of the force. In an RL/BL framework, the number of personnel in the current inventory over time (denoted as a blue line) is compared with the number of personnel required to run the enterprise (i.e., requirements, denoted as a red line). When the blue line is higher than the red line, the enterprise is considered fully staffed but overmanned; when it is below the red line, it is considered understaffed.³

The RL/BL models currently used by the Air Force can be extremely useful tools for assessing the long-term impact of policy decisions on the force or for short-term projects when making execution-year changes. Therefore, they continue to be used for a variety of purposes, including predicting rated inventory in future years, determining annual production numbers to fix rated staffing shortages, and realigning personnel to fill certain positions to improve manning. They were even used quite successfully for establishing the Air Force's most recent get-well plan for ramping up the RPA training pipeline and filling the formal training unit (FTU) at 100 percent (see Martin, Richmond, and Swisher, forthcoming, for the RPA get-well

³ For more explanation on the difficulty of balancing rated personnel requirements and inventories and examples of RL/BL rated force model graphs, see Bigelow and Robbert (2011). For a high-level description of a total force rated RL/BL model and modeling details, see Terry et al. (2017). For a description of a similar modeling approach regarding force-of-the-future policies, see Robbert et al. (2017).

model and Dr. Jerry Diaz⁴ for the Air Force Rated Aircrew Management Systems [AFRAMS] model).

Although these models can be useful tools and will continue to be so (including for the RPA community), they have not typically included the level of granularity and content needed to address many career field management issues. For example, the models do not factor in whether the personnel in the inventory are appropriately matched to jobs on the basis of their experience and qualifications. A force composed entirely of junior-level personnel could look adequate to man the enterprise; however, many positions require more senior-level personnel. A mismatch between the experience requirements and the experience in the inventory would therefore not be diagnosed by a typical RL/BL framework. This limitation could lead to an overly rosy picture of the career field's health. It is worth noting that other models have explored some of the issues tackled in our model. For example, Robbert et al. (2015) explored ways to address fighter pilot shortages while factoring in the need to grow experienced pilots through a process called absorption. However, none have incorporated the bulk of the career field planning issues that leadership points to as defining a healthy career field. The goal of this research effort was to provide such a model.

While RL/BL models can be helpful to assess the steady-state behavior of a policy decision, if other career field health issues are not explicitly factored into planning for the long-term future of the enterprise, there is a chance that the enterprise will never achieve health in those areas. Because Air Force leadership is interested in finding ways to ensure that these other career field management factors are addressed in the long term while they continue to ramp up the force, we sought to build a model that considered them while making recommendations regarding annual production. To do that, we incorporated more into our end-state requirements than is typically considered in an RL/BL model. (Note that use of the term *requirements* in this report is different from that in traditional RL/BL models. This is discussed further in the following section.)

Building Our Model

This study sought to develop a multigoal linear programming model to project the short-term (e.g., over the next five years) and long-term (e.g., 15 or 20 years down the road) consequences of career field planning decisions for the health of the active component MQ-1/9 RPA force. The model tries to exactly match the pilot inventory to the desired end-state requirements by duty by determining the annual production and crossflow needed. The model factors in retention patterns derived from previous RAND research (e.g., Hardison,

⁴ Dr. Jerry Diaz is Chief of the Force Management and Enterprise Readiness Analysis Division (AF/A1PF) within the Directorate of Force Management Policy (A1P).

Mattock, and Lytell, 2012) and assignments patterns and developmental opportunities similar to those for traditional manned-aircraft pilots.

We defined the majority of the model constraints, inputs, and desired end-state requirements by

- *Interviewing Air Force senior leaders and stakeholders to define what a healthy and sustainable MQ-1/9 RPA pilot career field might look like in the long term.* This information was used to help justify various model design decisions, including what to vary in the model, how to prioritize our multiple goals, what to display as output, and, most importantly, the desired end-state requirements for the career field.
- *Analyzing existing data, including manpower authorizations and personnel data files.* For example, these data were used to identify the starting inventory of MQ1/9 pilots and to benchmark historic distributions of duty assignments across commissioned years of service (CYOS).
- *Meeting with RPA subject-matter experts (SMEs).* For example, SMEs in the MQ-1/9 enterprise helped to define mission-essential desired end-state requirements of the future to address how the enterprise will likely be reorganized to accommodate initiatives to improve the health of the force.

Note, however, that by constructing end-state requirements based on SMEs' and leadership's vision of an ideal healthy and sustainable career field of the future, we use the term *requirements* in an unconventional way. Requirements are typically defined in the Air Force as those currently listed in existing manpower documents, either funded or unfunded. In this study, requirements are an ideal, a desired end state to aim for that is not burdened by current budgetary processes and end-strength limitations. In addition, the desired end-state requirements we specify in our model represent not only the personnel needed to accomplish the mission but also those needed to incorporate healthy career field aspects (such as accommodating combat-to-dwell and increased crew-to-line ratios), along with developmental opportunities similar to those in the traditional manned-aircraft pilot communities—all of which are important elements in the leadership's vision for the future of the career field. This more-inclusive definition of future requirements (one that aims to fill positions related to career field health as well as mission requirements) is key to eventually building a healthy career field years down the road; however, we acknowledge that it is a departure from the way career field planning models (and many Air Force personnel) typically define them.

After building preliminary versions of the linear programming model, we refined it by exploring a number of excursions to understand how it was functioning. This involved using a variety of different policy inputs and constraints and then observing the impact of those inputs and constraints on the shape of the career field many years into the future.

Organization of This Report

The purpose of this report is to explain the inputs, constraints, and model formulation and to provide a few examples of the excursions that we explored during model development. Chapter 2 provides an overview of the RPA career field model, including model inputs and parameters and the model objective function and constraints. Chapters 3 and 4 present the results of two model excursions that illustrate the how the model functions. The first excursion examines the two types of production tempos, and the second examines the impact of growth in requirements. These excursion scenarios were chosen for inclusion because they address some of the issues that decisionmakers are grappling with as part of several RPA get-well initiatives currently under way in the Air Force (see Chapter 2 for examples of the get-well initiatives). The report concludes in Chapter 4 with a discussion of how policymakers can use the model to inform decisionmaking.

Several appendices are included that provide additional technical information about various elements of the model and support for those elements. Appendices A and B present detailed information about the stakeholder and senior-leader interviews that provided support for many of the elements included in the model. Appendix A lists the leaders and stakeholders with whom we spoke, the questions we asked during the discussions, and the main topics that they raised. Appendix B provides examples of and summarizes the comments relating to each topic. Appendix C contains details of the model inputs and assumptions. Appendix D describes the model formulation. Finally, Appendices E and F present results of two additional model excursions that analyze the effects of increased crossflow of pilots from other communities and adopting air battle manager (ABM) assignment policies. These appendices further illustrate how the model can be adjusted to address alternative career field management policies and decisions.

2. RPA Career Field Model Overview

RAND’s optimization model forecasts how career field dynamics, such as production, assignment patterns, and retention, might unfold over time. Thus, the modeling decisions that simplify the real context of career field planning are critical to the accuracy and usefulness of the model and its results. However, the modeling decisions are just one important piece; the data analysis from which the model inputs are created is equally important. This chapter provides a conceptual overview of the inputs, assumptions, and decisions that contributed to our model design and describes how we arrived at various elements of the model. A more technical discussion of the model elements is given in Appendices C and D.¹

We start by explaining briefly how input from senior leaders informed the content of the model. We then discuss the current state of the RPA enterprise and provide an overview of the model inputs and baseline assumptions. Finally, we describe the model formulation, which defines how the model behaves, along with the desired model output.

Characteristics Defining a Healthy Career Field

Development of the optimization model was informed by the future vision for the RPA career field held by Air Force leadership—a vision we captured through interviews conducted with senior leaders and key stakeholders (see Appendix A for a list of participants). These discussions were focused broadly on two questions: (1) How do you define a healthy career field and good quality of life? and (2) What is your vision for 18X pilots in a 2026 “Air Force of the future?”

Senior leaders identified a number of initiatives that are essential for ensuring a healthy RPA pilot career field. Among them were new basing options for RPA pilots, meeting minimums established for crew-to-line ratios,² establishing combat-to-dwell ratios,³ limiting

¹ Appendix C contains a more detailed discussion of model assumptions and inputs, and Appendix D provides the model formulation.

² An RPA *line* is the communication link allowing the pilot to fly the RPA remotely. *Crew-to-line ratio* refers to the number of crews (consisting of a pilot and a sensor operator) required to operate a single RPA line 24 hours per day, 365 days per year. The minimum crew-to-line ratio required is still the subject of debate, and until an in-depth manpower analysis addresses the issue to the community’s satisfaction, the debate is likely to continue. Nevertheless, a 10:1 crew-to-line ratio has been the recent target for ensuring a healthy OPTEMPO in the Air Combat Command (ACC) community. In Air Force Special Operations Command (AFSOC), that number may differ.

³ Combat-to-dwell is the ratio of months spent assigned to combat shift work to months spent not assigned to combat shift work. It is essentially an analog to the concept of deploy-to-dwell but applied to RPA pilots deployed in-garrison. The goal of combat-to-dwell is to provide a break from the OPTEMPO of combat shift

(if not fully eliminating) the number of ALFA tour pilots filling positions in the career field, building confidence and pride among homegrown 18X pilots, establishing crossflow similar to that found in other rated career fields, and including opportunities for RPA pilots to fly manned aircraft. The leaders also defined a healthy career field as one that ensures job satisfaction, good retention, and positive quality of life and is attractive to potential rated candidates.

Most of the leadership participants also articulated that, in the long run, the goal should be to create a career field experience for 18X personnel that mirrors that of traditional manned-aircraft pilots.⁴ They especially emphasized the need to ensure that 18X personnel are well developed professionally, with developmental and educational opportunities similar to those in the traditional manned-aircraft pilot communities. This was considered important to help ensure that 18X personnel are prepared to fill RPA leadership roles, as well as fill command positions that oversee more than just the RPA community; are competitive for colonel and general officer ranks; and are well represented in those ranks. The leaders also noted that it will be important for the health of the career field to clearly define developmental and educational opportunities and assignments that junior personnel can ultimately expect in the 18X career field and to ensure that these opportunities and assignments are being filled by 18X personnel as soon as possible.

These and many other details from our discussions with leadership and stakeholders about how the RPA career field should look in the future factored heavily into the way we designed the model and/or model inputs. For additional detailed comments from our interviews, see Appendix B.

Initiatives to Make the RPA Enterprise Healthy

The Air Force has undertaken a number of initiatives to improve the health of the RPA enterprise, recognizing the combat-type missions in which RPA forces are engaged and the need to improve the morale of airmen in the career field. In August 2015, ACC launched its Culture and Process Improvement Program (CPIP) for the RPA community. More than 3,300 surveys were sent to officers and enlisted airmen to solicit their views on the challenges facing the RPA community (Everstein, 2016); nearly 1,200 face-to-face interviews were conducted

work and combat exposure and to allow time for continuation training and other administrative duties typically associated with being at home station. A combat-to-dwell policy does not currently exist, but it is slated to be introduced in ACC for mission control element (MCE) pilots in the not-too-distant future to address health-of-the-force concerns voiced by the RPA community. Ensuring appropriate dwell for launch and recovery (LR) pilots is already addressed under the existing deploy-to-dwell policy.

⁴ A few participants stated instead that while a traditional manned-aircraft pilot pattern would be fine, it was not the only pattern that could be acceptable. However, the majority of the participants were adamant that the traditional manned-aircraft pilot pattern was best. We therefore proceeded with our baseline model using that pattern. An alternative pattern is explored in Appendix F.

(Carlisle, 2016). The initial results of the surveys led the Air Force to announce, in December 2015, 140 actions that will be taken to improve RPA operations. These actions include expanding the size of the force, developing a stable deployment schedule and combat-to-dwell ratio, a reduction in work schedules, and allowing enlisted airmen to fly the RQ-4 Global Hawk.

Other notable initiatives that are under way include the following:

- In April 2015, Secretary of Defense Ashton Carter approved new guidance reducing the number of combat lines assigned to the Air Force from 65 to 60. Additional support for this mission is being provided by the Army and by government-owned aircraft that are operated by contractors (Everstein, 2016; Carlisle, 2016).
- In January 2016, Air Force Secretary Deborah Lee James approved a plan to increase RPA pilot aviation pay from \$650 per month to \$1,500 per month (Everstein, 2016). In addition, the Air Force received authorization for an annual \$25,000 aviator retention pay for RPA pilots, which is in line with retention pay for manned-aircraft pilots (Carlisle, 2016).
- In spring 2016, the Air Force approved two initiatives for the RPA career field. The first was to redesign eight RPA reconnaissance squadrons as attack squadrons. Reconnaissance squadrons provide intelligence, surveillance, and reconnaissance; close air support; and battle damage assessment. The redesignation acknowledges that the mission of these squadrons can include strikes against targets (Secretary of the Air Force Public Affairs, 2016)
- Also in spring 2016, RPA aircrews were authorized to log combat time when flying aircraft within designated hostile airspace (Secretary of the Air Force Public Affairs, 2016). This too acknowledges the combat role played by these pilots in the conduct of their missions (Secretary of the Air Force Public Affairs, 2016).
- The Air Education and Training Command (AETC) has increased production in the training pipeline and will graduate 384 pilots in FY 2017, 200 more than have graduated annually in past years. Resources freed up from the reduction in combat lines were used to increase training capacity. The Air Force is increasing its FTU capacity to increase RPA pilot production (Carlisle, 2016).
- The Air Force has taken steps to decrease OPTEMPO, establishing a combat-to-dwell ratio of 1:0.5. This step will “provide airmen predictable schedules, improve work-life balance, enable further professional development, offer increased training opportunities, and ultimately improve readiness” (Secretary of the Air Force Public Affairs, 2016).

The Air Force also has many other relevant initiatives under way to improve morale and quality of life and to increase professionalism of the RPA force.

Some of the initiatives listed above have clear implications for our model (e.g., the increases to the training pipeline, the reduction in the combat lines, and the effects of the aviation pay on retention). We therefore incorporated those that are already under way, as well as some that are still being planned for implementation in the near- and even long-term future. We turned to SMEs within Headquarters Air Force, ACC, and AFSOC to confirm the details of these initiatives for our model inputs and to identify additional initiatives that are planned for the future. The details of the initiatives are discussed below.

Model Inputs and Assumptions

The model is initialized with the current inventory of each type of active component MQ-1/9 RPA pilot (18X, 11U, 12U, and ALFA tour)⁵ at the end of FY 2015 and a set of MQ-1/9 desired end-state requirements. The main goal of the model is to increase the initial inventory to ultimately match the desired end-state requirements, while limited by some real-world constraints. Important considerations are the composition of the inventory over time, the ability to provide the 18X career field with developmental opportunities similar to those of traditional manned-aircraft pilots, the time it takes to attain an inventory that matches the desired end-state requirements, and whether or not attaining this inventory is sustainable.⁶

The current MQ-1/9 RPA pilot inventory comprises 18X RPA pilots, 11U and 12U pilots, and ALFA tour pilots. The desired end state that we incorporated into the model is a reflection of the RPA community's vision for what the career field should look like in terms of (1) the number of requirements by duty category and (2) pilot distribution across CYOS by duty category⁷ once the career field has had time to mature. This vision of the future RPA career field addresses several current sources of systemic dissatisfaction⁸ in the RPA community and the actions required to improve satisfaction,⁹ while considering the future demands that will be placed upon the community.

The model provides a solution that best matches the inventory to the desired end-state requirements by determining the production and crossflow needed, while factoring in retention patterns of each type of RPA pilot and assignment patterns that provide traditional pilot-like assignments, career paths, timing, and opportunities. As a result, many complexities are

⁵ The model treats 11Us and 12Us as distinct populations when defining the inventory.

⁶ Sustainability is determined by whether or not the inventory stabilizes over time, i.e., the annual production is equal to the annual losses. The inventory can be sustainable and not meet the desired end-state requirements.

⁷ We use CYOS as a proxy for grade. We do not include grade distributions in the model.

⁸ See Hardison et al. (2017) for information about sources of dissatisfaction; examples of the initiatives to address some of them are listed above.

⁹ For instance, implementing combat-to-dwell by increasing desired end-state requirements and thereby increasing the inventory in the career field.

involved in both the model inputs and the model formulation. We provide a general overview of the main elements of the model inputs and formulation in the remainder of this chapter; more technical details are provided in Appendices C and D.¹⁰

The main elements that are captured in the model are listed in Table 2.1, along with the information source that forms the basis of the input for each element.

MQ-1/9 Desired End-State Requirements

We translated the information gathered on the leadership’s preferred direction for the RPA career field as well as potential plans to improve job satisfaction (e.g., through CPIP

Table 2.1. Elements Captured in the RPA Model

Model Element	Our Approach and Source of the Information
Desired end-state requirements by duty category	
<ul style="list-style-type: none"> Wing level and below within operational community 	Expanded to match strategic direction with respect to capacity and number of units <ul style="list-style-type: none"> Source: Unit structure in FY 2016 authorization data
<ul style="list-style-type: none"> Above wing level or outside operational community 	Benchmarked to have the same proportion relative to the size of the unit-level pilot population as in other rated career fields using personnel data files <ul style="list-style-type: none"> Source: Personnel data files
Maximum production capacity	Maxed out at total number of FTU seats currently available <ul style="list-style-type: none"> Source: AF/A3XC
Retention by CYOS	
<ul style="list-style-type: none"> 11U/12U 	Benchmarked on historical retention patterns since 2004–2005 <ul style="list-style-type: none"> Source: Personnel data files
<ul style="list-style-type: none"> ALFA tour 	Assumed to automatically return to original community after fixed four-year tour (official intended use of ALFAs) <ul style="list-style-type: none"> Source: AF/A3XC
<ul style="list-style-type: none"> 18X 	Forecast from prior research <ul style="list-style-type: none"> Source: Hardison, Mattock, and Lytell (2012)
Assignment patterns by CYOS and duty category	Benchmarked on other rated communities in previous 10 years <ul style="list-style-type: none"> Source: Personnel data files
Crossflow levels by CYOS	Benchmarked on historical patterns of reclassification of rated or nonrated into to traditional pilot career fields <ul style="list-style-type: none"> Source: Personnel data files
Years of service distribution of entry-level 18X pilots	Benchmarked on CYOS of recent 18X RPA pilots at the point of undergraduate RPA training (URT) completion <ul style="list-style-type: none"> Source: Personnel data files

¹⁰ Appendix C provides a very detailed description of the vision for the future RPA career field that was used to define the desired end-state requirements in our model.

initiatives) into a set of desired end-state requirements by duty that approximates the types of jobs that RPA pilots should fill *if this were a mature and healthy career field*.¹¹

We started constructing these requirements by specifying the various types of duties RPA personnel perform, which we refer to as *duty categories*. The specificity of the duty categories, as well as the number of duties considered in the model, necessitated balancing competing goals—the categories should be specific enough to meaningfully describe all the functions performed by RPA pilots, yet should maintain a reasonable level of complexity and allow for meaningful analysis of how each of these facets affects the projected inventory levels.

Table 2.2 presents the 17 duty categories that we modeled. While more specific duty titles exist, these 17 are sufficient to describe the kinds of duties a pilot is expected to perform, for modeling purposes. In the table, the duty categories are grouped according to the goals that were specified by the leadership and that we aimed to achieve in the model. In the model, each goal is translated into a set of numerical desired end-state requirements, i.e., the number of RPA pilots needed for each duty.¹²

Line-Flying Duties

To develop the desired end-state requirements at the wing level and below, we began by establishing a baseline of authorized MQ-1/9 active duty positions based on FY 2016 data from the Manpower Programming and Execution System (MPES) and RPA manning-related products from AF/A3TC. We then updated or added elements to reflect our current best understanding of the desired future end state for the MQ-9 force. These changes were based on inputs from SMEs at ACC/A3MU, 432 Wing (WG), and AFSOC/A3V and our interviews with senior Air Force leadership (as noted below). For units unaffected by these changes (e.g., the 9 and 29 attack squadrons [ATKS] at Holloman Air Force Base), we used the baseline authorizations in the FY 2016 MPES data.

¹¹ As discussed in Chapter 1, by constructing end-state requirements based on SMEs' and leadership's vision of an ideal, healthy, and sustainable career field of the future, we use the term *requirements* in an unconventional way. Unlike the requirements typically defined in the Air Force, ours are not those currently listed in existing manpower documents, either funded or unfunded. Rather, they are an ideal, a desired end state to aim for and not burdened by current budgetary processes and end-strength limitations. In addition, the desired end-state requirements in our model are not only the personnel needed to accomplish the mission, but also those needed incorporate healthy career field aspects (such as accommodating combat-to-dwell and increased crew-to-line ratios), along with developmental opportunities similar to those in the traditional manned-aircraft pilot communities—all of which are important elements in leadership's vision for the future of the career field. This more-inclusive definition of future requirements is key to building a healthy career field years down the road; however, we acknowledge that it is a departure from the way other career field planning models (and many Air Force personnel) typically define requirements.

¹² We assume a one-to-one relationship in the assignment process: one and only one person is assigned to one and only one job. We know this is not the case in the Air Force, but it would be the result in a perfect world.

Table 2.2. RPA Model Duty Categories

Duty Category	Goal
Line Flying	
<ul style="list-style-type: none"> • Line pilot • Line instructor • Line examiner 	Sufficient base of RPA pilots to meet demand with appropriate crew-to-line ratio and combat-to-dwell and deploy-to-dwell time
Training Instructor	
<ul style="list-style-type: none"> • Undergraduate RPA training instructor • FTU instructor • LR element instructor 	Adequate training capacity to sustain the enterprise
Leadership	
<ul style="list-style-type: none"> • Operations squadron director of operations (DO) • Operations support squadron/training DO • Operations squadron commander • Operations support squadron/training commander • Group commander/deputy commander • Wing commander/vice wing commander 	Experienced officers to lead all levels of the expanded organizational structure
Development and Support (RPA Operations)	
<ul style="list-style-type: none"> • Wing and below staff/support • Wing or group executive assistant 	Necessary manning in staff and support roles to sustain the enterprise and provide career broadening and professional development
Development and Support (Other)	
<ul style="list-style-type: none"> • Above-wing staff (Air Force, joint, executive assistant) • Special duty assignments • In-residence professional military education (PME) 	Necessary manning in staff and support roles to sustain the enterprise and provide career broadening and professional development

The desired end-state requirements are driven in large part by a multifaceted plan in response to ACC’s CPIP to improve the quality of life for 18X personnel, as well as to provide them the time and space to sharpen their skills through continuation training. Key elements of ACC’s plan include the following:

- Establishing a new ACC MQ-9 wing at a new base composed of two operations groups (OGs) with three MCE squadrons per OG.¹³
- Implementing a 1:0.5 combat-to-dwell ratio for MCE crews by either rotating squadrons within an OG or rotating line MCE crews internally within squadrons. The crew-to-line ratio remains 10:1.¹⁴ The concept of combat-to-dwell was supported by multiple interviewees as a positive move for the career field.

¹³ One of the new wing’s two groups could be located at yet another base. This would further diversify the number of alternative locations for ACC operations squadrons.

¹⁴ We assume that the 10:1 crew-to-line ratio provides a sufficient number of crews to allow for days off, temporary duty, PME, mission-qualification training, and continuation training, while also covering for personnel who are unqualified or are DNIF (duty not involving flying). The ratio does not cover requirements for squadron leadership (commander and DO) or other squadron overhead, such as liaison officer (LNO) or squadron

- Creating two ACC squadrons dedicated to performing LR missions. Together, the two squadrons would be capable of operating launch and recovery elements (LREs) at seven different locations on a steady-state basis at a 1:2 deploy-to-dwell ratio.
- Expanding MQ-9 initial qualification training (IQT) capacity by creating two new active associate FTU squadrons at Air National Guard (ANG) FTU locations at March Air Reserve Base and Hancock Field Air National Guard Base.

The desired end state assumes that AFSOC would follow ACC's lead by expanding the manning in its RPA squadrons to implement a 1:0.5 combat-to-dwell and a 1:2 deploy-to-dwell for its MCE and LRE crews, respectively. Overall, the Regular Air Force RPA force envisioned in this desired end state would be responsible for operating 44 out of 60 combat lines on a steady-state basis, although it would be capable of flying 45 combat lines.

In total, the desired end-state requirements specify a total of 924 positions for line flyers¹⁵ in operations squadrons. For each operations squadron, we assume that 15 percent of the line-flyer positions are for line instructors and 10 percent are for line examiners, which results in a total of 147 line-instructor and 97 line-examiner positions across the MCE and LRE operations squadrons in ACC and AFSOC. The remaining 680 positions are for line pilots. While the vast majority of line-flyer positions are needed to fill MCE and LRE "cockpits" at a 1:0.5 combat-to-dwell and a 1:2 deploy-to-dwell (827), respectively, it should be noted that a significant number of line flyers (97) are also needed to fill squadron-level "overhead" positions, including serving as liaison officers (LNOs) (27 of the 97) or in a squadron operations center (SOC) (70 of the 97).¹⁶ For comparison, the total number of authorized line-flyer positions in the MPES database as of FY 2016 is 704, with a combat-to-dwell of 1:0, i.e., combat all the time with no dwell time.

Because these desired end-state requirements are built to achieve the combat-to-dwell and crew-to-line ratios that ACC has targeted in response to CPIP proposals to ensure that the force is not overburdened and has sufficient time to conduct continuation training and to do so while being able to conduct the mandated 45 active duty combat lines, this should provide a sufficient base of RPA pilots to meet the mission demands (assuming the lines are 100 percent manned). This does, however, assume that the crew-to-line and combat-to-dwell ratios ACC has identified as targets are adequate. If manpower analyses or other research in the future suggests that they are not sufficient to meet the force's continuation training needs and reduce the combat burden on the force, these numbers will need to be revised. In addition, if the

operations center (SOC) duty, since operations squadrons are provided separate authorizations for those positions.

¹⁵ Line flyers comprise line pilots, line instructors, and line examiners.

¹⁶ These 97 positions do not include any LNO positions in AFSOC RPA squadrons, even though, in practice, AFSOC sends people to fill those types of positions. They do so "out of hide."

structure of the ACC or AFSOC MQ-1/9 enterprise changes—e.g., if additional wings or LR locations are added—the numbers would also need to be revised.

Training-Instructor Duties

The training-instructor duty categories encompass positions for active duty instructor pilots engaged in URT, IQT for new MQ-1/9 MCE crews, and qualification training for MQ-1/9 LRE crews. A total of 235 active duty instructor positions were specified as the target desired end state, a majority (141) of which are concentrated in three FTU squadrons at Holloman.¹⁷ At the same time, we recognize that long-term production needs should ultimately determine FTU instructor manning (i.e., the number of instructors needed depends on the number of students), so the model does not attempt to fill FTU instructor requirements after FY 2018 beyond what is necessary for annual production based upon a specific student-to-instructor ratio. This adjustment to the training-instructor end-state requirement is intended to capture leadership's view about the importance of ensuring that training capacity is just high enough to sustain the enterprise.

Leadership Duties

In the leadership category, the desired end-state requirement is 27 commander and 26 DO positions at the squadron level. These positions are roughly evenly divided between operations support squadrons (OSS) and OSS/training squadrons. Although wing- and group-level command positions in RPA units are not always explicitly coded to be filled by 18X personnel, we assumed the desired end state would, at a minimum, envision developing 18X personnel to fill the commander and vice commander positions at the wing level for all-RPA wings (six positions in three wings), as well as the commander and deputy commander positions for their subordinate groups (ten positions in five groups), thereby providing officers to lead all levels of the organization.

Development and Support Duties

For certain duties that fall within the general area of development and support, information on current requirements either does not exist or would likely provide a poor forecast of future requirements. Actual staff requirements in FY 2016, for example, are widely viewed as insufficient for the future, in part because of the current lack of career development opportunities. In addition, the Air Force does not award opportunities to attend PME via manpower authorizations, so there are no firm data to draw on for projections of long-term PME opportunities.

¹⁷ The student-to-instructor ratio is provided in Appendix C.

Without a feasible way to design model requirements for these duties, we sought to use the proportion of these positions in other rated communities as a benchmark to determine the number of requirements for RPA pilots based on the desired end state. To calculate the benchmark, we first classified all personnel in the benchmark community into the 17 duty categories presented in Table 2.2. Then, for each the five development and support duties missing a desired end-state requirement, we calculated the ratio of benchmarked personnel to the number of benchmarked line flyers. To obtain the RPA requirement for each of the five duties, we took the ratio for that category and multiplied it by the total line-duty requirement in the RPA end state. For example, the traditional Air Staff to line duty traditional pilot ratio is 0.19, which, when multiplied by the 924 line-duty requirement, results in roughly 176 Air Staff RPA positions.¹⁸

We explored each traditional pilot community and the ABM career field as possible benchmarks.¹⁹ Figure 2.1 shows the numbers of personnel in each type of developmental assignment.²⁰ The traditional pilots and ABM benchmarks have similar above-wing executive officer, staff, and special duty requirements for the future RPA career field, but they differ in joint staff and PME. Ultimately, we focused on the traditional pilot benchmark in the bulk of our model excursions, as that would best represent the vision expressed by most of the senior leaders and stakeholders in our interviews (i.e., that the career field should be modeled after traditional pilot developmental assignment patterns). However, we did explore the ABM benchmark as an alternative. Those results are presented in Appendix F. The remainder of this report presents results using the pool of all traditional manned pilots as the benchmark.

While there are no explicit requirements for these development and support duty categories, by ensuring that the same proportion of the desired end-state requirements exist at the same experience levels (in terms of CYOS) as in the traditional pilot world, the model will seek to fill them with the appropriately experienced personnel. By doing so, the model ensures sufficient opportunity for RPA pilots to be developed with leadership opportunities much like those of traditional manned-aircraft pilots. Building in similarity to traditional manned-aircraft pilots will help ensure that RPA personnel are getting the right developmental assignments at the right points in their career.²¹ Figure 2.2 summarizes the desired end-state requirements described in this subsection by aggregate duty category.

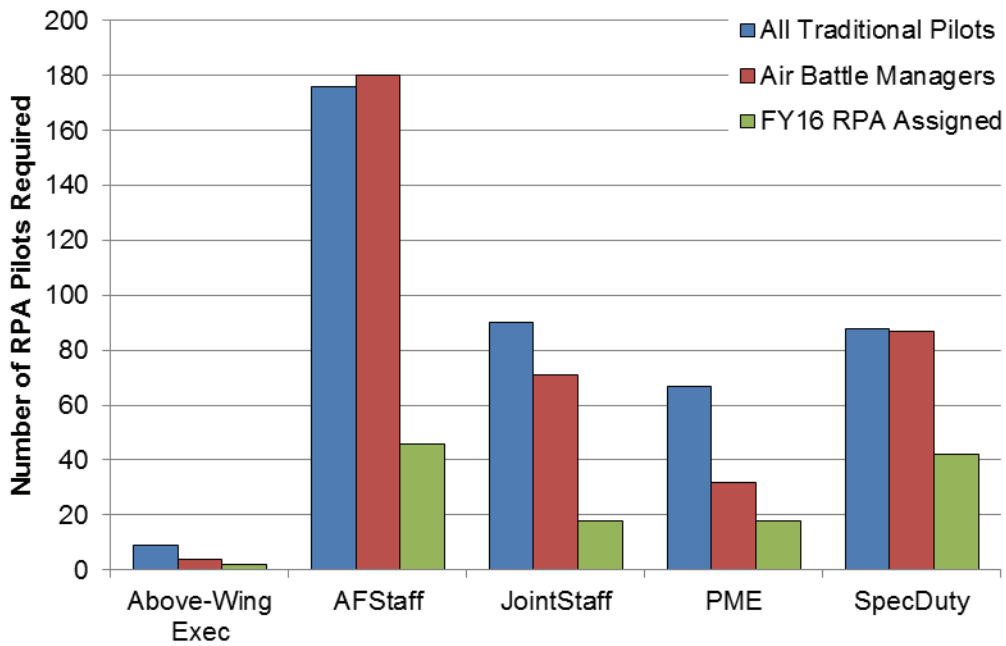
¹⁸ The final benchmark ratios that determine the model requirements are an average of the ratio calculated in each of the previous 10 fiscal years to ensure that they better approximate the long-run tendencies in the benchmark communities.

¹⁹ At our sponsor's request, we investigated the space and missile career field as a possible benchmark, but we decided the result was not sufficient to proceed with incorporating it into the model.

²⁰ Table C.2 in Appendix C presents all the benchmarks calculated.

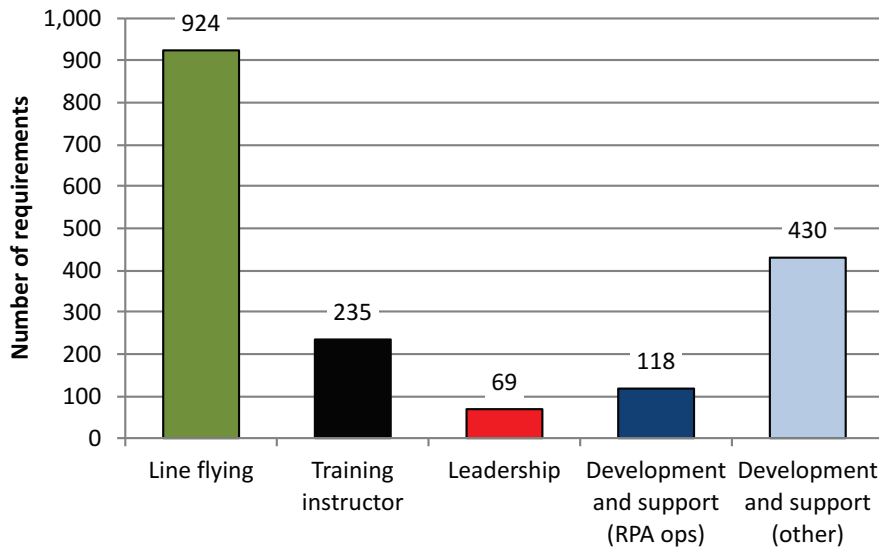
²¹ For example, headquarters staff jobs for junior-level personnel have far less value for development than headquarters staff jobs for more senior personnel. Also, traditional manned-aircraft pilot assignment patterns tend

Figure 2.1. Theoretical RPA Requirement for Different Community Benchmarks



NOTE: Requirements are based on a line-flying population of 924, which applies to the scenario involving 45 active duty lines, a 10:1 crew-to-line ratio, and a 1:0.5 combat-to-dwell ratio.

Figure 2.2. End-State Requirement by Aggregate Duty Category



NOTE: Requirement scenario involves 45 active duty lines, a 10:1 crew-to-line ratio, and a 1:0.5 combat-to-dwell ratio.

to involve staff assignments for more senior personnel. Giving RPA personnel similarly relevant developmental experience will make them more likely to be competitive for colonel and general officer positions.

Maximum Production Capacity

The main mechanism available to increase the RPA inventory is production, which in this model refers to the number of officers who successfully graduate from FTU training annually.²² Without any constraints, the model (and any system in general) would maximize the production to meet the desired end-state requirements (or to mitigate the shortage) as soon as possible. If allowed to do so, the model would suggest significantly large production for the first couple of years and then would significantly decrease it and then increase it again years later, thereby producing an erratic sine wave (or EKG [electrocardiogram]-like) pattern that is neither stable nor predictable.

Similarly, the Air Force needs a stable and predictable training plan to ensure that it has the correct number of instructors for training. (A long lead time is required to produce qualified instructors.) Also, enough seats to train the officers in a timely fashion are needed to minimize breaks in training. And finally, a healthy OPTEMPO through the FTU is needed. Therefore, it is necessary to place upper bounds on production to ensure meaningful and reasonable production levels in any given year. More specifically, we limit production in three ways. First, we impose annual production upper bounds from FY 2016 through FY 2018, based on inputs from RPA career field representatives.²³ These upper bounds capture the fact that some training resources are dedicated to transitioning MQ-1 pilots to the MQ-9 airframe and thus are unavailable for new RPA pilot training. We also limit annual 18X production at 300, the maximum number of RPA pilots that are expected to graduate from URT annually over the same time period.²⁴

Second, we limit the number of new RPA pilots that the FTU can produce according to the number of instructor requirements that are met while meeting a student-to-instructor ratio of 2.55; however, we allow for a temporary surge in the student-to-instructor ratio (i.e., we allow for an increase in production beyond what should be expected given the number of available instructors) in the first four years. In essence, we assume that it would be unrealistic and unsustainable to continue that surge in student-to-instructor ratio for longer than a few years.

²² Our definition of *production* is different from other uses of the term. Production usually refers to the moment officers earn their wings, which, for traditional manned-aircraft pilots, is the completion of UFT.

²³ The FY 2016–FY 2018 upper bounds differ from the FY 2019 and onward upper bounds due to meeting the Deputy Secretary of Defense’s decision that the FTU instructor positions need to be manned at 100 percent and the RPA community’s belief that production needs to increase significantly over those years. FY 2019 and onward have a different upper bound based on the number of officers graduating from undergraduate RPA pilot training and funneling into the FTU.

²⁴ The 300-graduate limit represents all URT graduates to feed all RPA platforms, not just the MQ-1/9. If the model chose to produce 300 MQ-9 FTU graduates, this would mean shifting all URT graduates to the MQ-9 platform and providing zero URT graduates to the other RPA platforms. While this is a valid possibility, it is highly unlikely.

Third, we incorporated a smooth-flow production constraint to ensure that year-to-year deviations in production are within reason, i.e., we added a constraint that ensures that production from one year to the next does not change by more than 10 percent. While not a direct production capacity constraint, it does limit the production options from year to year and avoids having sine-like patterns occur in the production projections.

Retention

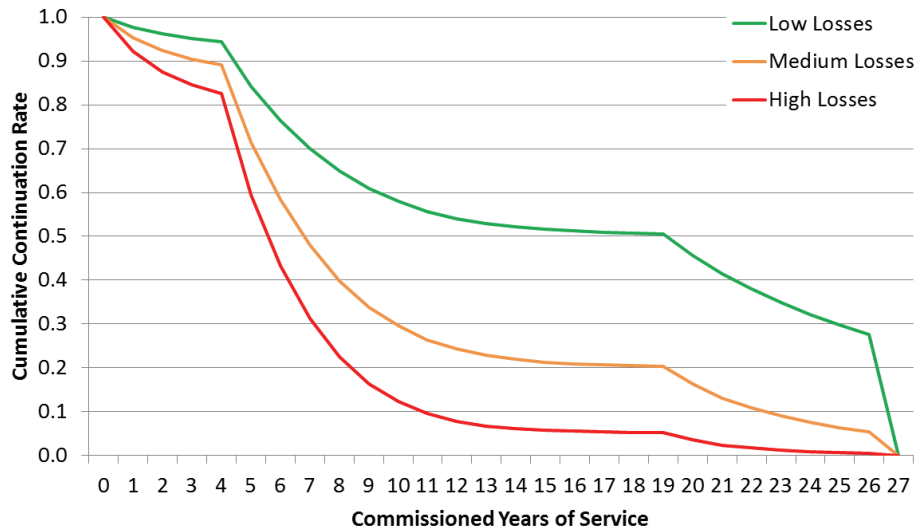
Retention is also a key component of career field planning and health. If retention is high, less production is required to maintain a healthy inventory. If retention is low, more production is required to keep inventory levels steady. Production needs to be adequate to ensure that enough personnel make it to the later years and gain the experience needed to fill leadership positions and take advantage of developmental opportunities. Because the RPA career field is new and the first cohort is coming up on the end of its active duty service commitment (ADSC), it is not clear what retention behavior will emerge. Production levels are tightly tied to retention behavior, so this uncertainty is causing anxiety over how to plan for the career field. Thus, it is necessary to consider and model various retention patterns.

Retention patterns also differ by career field and CYOS. For instance, 18Xs incur a six-year ADSC, while 11Us incur a 10-year ADSC, which implies very different retention rates for 6 and 12 CYOS. As a large bulk of service personnel leave after the expiration of their ADSC, 18Xs will leave earlier and have less certainty of making it to retirement eligibility. Thus, we apply distinct retention patterns for each career field (11U, 12U, 18X, and ALFA) by CYOS.

We assume that all ALFA tour pilots exit the career field at the end of a fixed four-year term, and, for 11Us and 12Us, there are sufficient historical data to calculate retention rates for each CYOS. However, there has not been enough time since the 18X pilot career field's inception to observe retention patterns. Without historical retention data to draw on, we chose to apply 18X retention profiles from econometric forecasts made in prior RAND research (Hardison, Mattock, and Lytell, 2012). However, due to the uncertainty inherent in these forecasted retention rates (especially given that personnel in the 18X pilot career field appear to be stressed and dissatisfied with many aspects of the community), we included a range of possible retention profiles for 18X personnel which we characterize as either low, medium, or

high losses.²⁵ Figure 2.3 presents the cumulative continuation rate curves used as the retention rates in the model.²⁶

Figure 2.3. Cumulative Continuation Rates Used in the Model



By examining the impact of a range of losses, it is possible to determine how sensitive the results are to changes in loss rates and at what point increased losses measurably affect inventory and production outcomes. To help provide context for our low, medium, and high losses, we compared the size of the loss profiles with losses experienced in the 11U career field. While it is difficult to compare the two groups by CYOS (due to differences in service commitments and retention patterns), the low-losses retention profile can be considered as being slightly better than historical 11U retention through 15 cumulative CYOS, while the medium- and high-loss retention profiles would be significantly worse than historical 11U retention.²⁷

²⁵ Our low, medium, and high RPA retention loss profiles are based on predicted retention profiles in Hardison, Mattock, and Lytell (2012). *Low losses* are the expected retention rates if civilian pay is similar to military pay, *medium losses* are the expected retention rates if civilian pay is 125 percent of military pay, and *high losses* are the expected retention rates if civilian pay is 150 percent of military pay. Given that retention and losses are opposites, knowing one rate (say, retention) ensures that one can calculate the other (losses). We chose to implement loss rates in the model.

²⁶ The high losses are not shown or discussed further because the inventory levels under high losses were decimated and never recovered. Additionally, it seemed unrealistic that the Air Force would let such a high level of losses persist over time without taking any action to reduce them.

²⁷ As noted previously, we cannot speculate with confidence on the level of RPA pilot retention to expect today or in the near future, because no data on 18X retention currently exist. The career field is simply too young, with most members having not yet reached their service commitment end date. However, as explained in a previous footnote, our low-loss profile (obtained from Hardison, Mattock, and Lytell, 2012) is based on historical data on

Assignment Patterns

The prime difficulty for career field planners lies in the variation of experience levels across categories of job requirements and the fact that it often takes many years to build the experience required for certain duties, such as more senior-level leadership positions. We capture this dynamic by imposing limits on how RPA pilots can be assigned to desired end-state requirements by duty category, according to norms in other communities. For example, suppose a healthy career field tends to assign junior officers to line duties while reserving more senior officers for staff and leadership duties; we address this by ensuring that our assignment process follows these patterns of behavior. To capture these kinds of assignment patterns, it is necessary to identify a mature career field that contains the desired developmental and leadership opportunities and has been consistent over time.

Specifically, the model assigns officers to desired end-state requirements by duty category in such a way that duty-specific maximum percentages for each CYOS for each duty category are maintained. These values are based on the maximum percentages of traditional manned-aircraft pilots (or ABMs, in the case where we explore an alternate assignment paradigm) assigned to each duty category over the previous 10 years. For each CYOS, the model is permitted only to meet desired end-state requirements in a way that does not exceed the

the level of observed retention among nonrated line officers, when military and civilian pay opportunities are similar.

Given this, if we assume that civilian or private sector RPA pilot job opportunities pay about as well as RPAs are paid in the military (and we assume that RPA pilots will behave similarly to that of typical nonrated line officers), then we could speculate that RPA pilot retention rates would be closer to the low-loss profile in our model. However, if RPA pilot job opportunities in the civilian sector are garnering significantly higher pay now or in the near future, then retention rates could look more like the medium- or high-loss profiles. As noted in Hardison, Mattock, and Lytell (2012), high-paying RPA pilot job opportunities in the civilian and private sector markets do exist, but those jobs are not widespread, and of the few available, some include deployments to foreign locations, reducing their attractiveness. This would therefore suggest that the low-loss profile could be a reasonable expectation for the near future; however, that may change—and change drastically—as soon as the Federal Aviation Administration starts allowing RPA into commercial airspace. It is also worth noting that it has been more than five years since the Hardison, Mattock, and Lytell (2012) study. Civilian and private sector jobs for RPA pilots could be more plentiful or lucrative now.

In addition, the low-loss profile also assumes that the satisfaction level within the RPA community is about equivalent to that of the typical nonrated line officer. If, instead, the RPA community is less satisfied with its job, it could lead people to leave at higher rates than expected, even if civilian pay is equivalent. Given the findings of Hardison, et al. (2017) and the Air Force's CPIP effort, there may be reason to be concerned about satisfaction within the RPA community. If CPIP efforts to address sources of dissatisfaction within the community are unsuccessful (or modest at best), then this would change our thinking on what level of retention to expect going forward.

In short, the level of retention to be expected hinges on both the Air Force's efforts to address satisfaction within the community and the potential pay opportunities for RPA pilots in the civilian and private sector. If the Air Force is committed to taking actions to provide RPA pilots pay that is competitive with the private sector, even when those private sector opportunities increase, and they take steps to mitigate the major sources of dissatisfaction and are successful, we would speculate that the low-loss profile is a safe assumption. If the Air Force does not succeed in accomplishing both of these, retention could be worse. How much worse will depend on the magnitude of the dissatisfaction and/or gaps in pay and the number of civilian job opportunities.

historical percentages of traditional manned-aircraft pilots in that CYOS assigned to that duty category.²⁸ It is important to note that the model does have some flexibility in the CYOS distribution, as the CYOS by duty historical maximums are treated as an upper bound. That is, the model can assign up to the maximum percentage for each CYOS, but it cannot assign more than that. This assignment-pattern distribution helps determine the distribution of RPA personnel across CYOS in the inventory as the model tries to match the inventory to the desired end-state requirements.

It is also important to note that the model limits the assignments that RPA pilots can fill, depending on the RPA pilot's career field. We assume that 18X and 11U pilots are interchangeable and ought to be assigned according to the benchmark career field shape across CYOS, as described above. However, leadership (including our sponsor and those we interviewed) has indicated that ALFA tour pilots and temporary 11Us who came directly from UPT are meant primarily to augment unit-level requirements and are not a permanent part of the community. Therefore, we limit their assignments to line flying, FTU instructor, and LRE instructor duties.

Crossflow Levels

It is common in the Air Force to have low levels of crossflow where an officer in one career field reclassifies into another career field. However, the Air Force has exploited this mechanism to help increase the RPA career field inventory quickly to meet the operational mission demands. Crossflow can occur within rated communities and from nonrated communities.

Because leadership and stakeholders indicated that crossflow should be no more or less than what naturally occurs in other rated career fields, to establish planned crossflows for the RPA community we again turned to the rated community's historical crossflows for benchmarks. We tracked all officers who were reclassified within the rated community over the past 10 years. Examples include reclassifying from mobility pilot (11M) to reconnaissance pilot (11R) and from a nonrated specialty such as intelligence (14N) to a pilot specialty. Using this information, it is possible to calculate benchmarks based on the fraction of pilots in each community who recently transitioned from a different pilot career field or from a nonrated career field.²⁹

²⁸ The traditional manned-aircraft pilot benchmark cannot be used for officers in the first six years of their careers, because traditional manned-aircraft pilot training is so much longer than RPA pilot training. There is also one duty (LRE instructor) that does not exist among traditional manned-aircraft pilots. Thus, for CYOS 0 through 5 and for LRE instructor duty, we use the patterns observed in the RPA community, averaged over the previous four years.

²⁹ See Table C.8 for the historical crossflow data within the pilot community.

As before, we average these benchmarks over the previous 10 years and we apply the benchmarks to the total number of desired end-state requirements (which represent the long-run size of the RPA community). For example, over the previous 10 years, about 1 percent of traditional manned-aircraft pilots were classified as a different pilot specialty in the previous year. Applying this 1-percent benchmark to the total size of the RPA community (about 1,700 pilots) produces a maximum crossflow rate of 17 pilots per year. This benchmarking process is identical for nonrated crossflow into the RPA community, except that it arrives at the benchmark by identifying RPA pilots who held a nonrated specialty in the previous year.

Years of Service at Time of Entry Into the RPA Force

The length of training and when a pilot earns his or her wings are variable and depend on a large number of factors, including source of commission, graduation, and training-seat availability. Therefore, because every pilot graduates at a different point in his or her career, ADSC commitment does not begin until the pilot earns his or her wings. Since every produced officer differs in timing, we incorporate this aspect by calculating the CYOS distribution of each newly produced officer over time and distribute them in the model according to this distribution. Also, any officer who crossflows into the RPA career field has prior experience that must be accounted for as we distribute him or her into an appropriate CYOS.

To calculate these distributions, we collect all RPA pilots who appear in the previous three annual personnel data snapshots and determine each pilot's CYOS at the point where he or she completed training. The model can then use this information to accurately assign new pilots to CYOS bins over time. Early versions of the model classified new RPA pilots into CYOS bins by the simple fractions found in the personnel data (i.e., if 9 percent of the 18X pilots in the data completed training in year 2, the model allocated 9 percent of all new pilots to CYOS 2). However, there is likely some noise in these fractions that is unique to the recent time period, and using the raw fractions preserves this noise and applies it to the career field forever. To achieve smoother CYOS distributions, we fit a univariate probability distribution to the data for each career field.³⁰

³⁰ We explored the Poisson and negative binomial distributions as they are commonly used in statistics for variables that can only be integer values. The final results employ Poisson distributions for each career field. Additionally, for each career field, there is a CYOS floor that is greater than zero (e.g., no RPA pilots finished training in the first year of service). Thus, we had to truncate the distributions at the career-field-specific CYOS minimums to accurately fit the data. For 11U and ALFA tour pilots, we also truncated the distributions from above at year 12, as it seemed unlikely that the career field managers would want to crossflow pilots into RPA any later in their careers, even if they had done so in the past out of necessity.

RPA Model Objective Function and Constraints

Our RPA model is a multiyear linear programming model, implemented in SAS,³¹ that takes user-specified manpower requirements (in this case, the desired end-state requirements) as inputs. By varying flows such as production, losses, and crossflow, the model shapes projected MQ-1/9 inventories that attempt to match the MQ-1/9 desired end-state requirements while also meeting constraints and conditions on either the flows or the inventories. A technical description of the model is provided in Appendix D.

Objective Function

The objective function is the means by which the linear programming solver identifies an optimal solution, and the constraints determine the feasible region containing all possible solutions that satisfy all of the constraints and in which the optimal solution (or solutions) is found. Thus, it is important that the objective function contain a meaningful metric (or metrics) for identifying that one solution is better than another (or all others). In our model, we include four goals in the objective function, which can be thought of as multigoal programming: to match the inventory to the desired end-state requirements exactly (i.e., with zero shortage and surplus) and to produce and crossflow the smallest number of RPA pilots to accomplish the match while adhering to a desired assignment pattern. The shortages are represented by the sum of all unfilled desired end-state requirements. The surplus is calculated as the sum of all unassigned individuals. To reduce training, salary, and future retirement costs (without directly calculating these costs), the model minimizes the total number of produced RPA pilots, while trying to meet requirements.³² As RPA pilots who crossflow into another career field often require additional training, the model also minimizes the total number of RPA pilots who crossflow into the RPA career field (per the leadership and stakeholders' vision to phase out ALFAs and limit crossflow into the community to levels similar to those in other rated communities). Taking these goals into consideration, the objective function minimizes the summation of the following:

1. The number of unmet desired end-state requirements (this represents a personnel shortage for the RPA career field).
2. The number of RPA pilots who are not assigned to a desired end-state requirement (this represents an RPA pilot surplus).

³¹ SAS once stood for statistical analysis system. Here we are referring to the SAS programming language and the SAS PC environment, which are products of SAS Institute, Inc.

³² If the model can bring in 10 RPA pilots and meet requirements, it could bring in 20 RPA pilots and still meet requirements. So without calculating the true lifetime cost for each additional pilot, it stands to reason that if you were to minimize the number of produced officers, you would in fact reduce the cost to the Air Force.. Thus, the model aims to bring in the smallest number of pilots that still meets requirements.

3. The number of produced RPA pilots (to keep training, pay, and retirement costs at a minimum).
4. The number of crossflows into the RPA career field (to keep training costs at a minimum).

However, we found that it is not enough to simply minimize the summation of these four goals, which, as generally stated above, equates all of these goals to each other. Within a goal, all duties are equal to each other; penalties for shortages/surpluses are equal to the penalties for producing and crossflowing RPA pilots. Assuming equality across the goals was found to not match reality—some duties are prioritized higher than others. Thus, we weighted the terms in the objective function to reflect the priorities that we heard from senior leaders and our sponsor.

As one example, FTU duties in the near term and line-flying duties are prioritized above all others. Manning the line (filling line-flying duties at 100 percent) has traditionally been the priority. More recently though, in recognition of the fact that an increase in training production necessarily involves an increase in the number of instructors, senior leaders have directed all instructor positions in the MQ-1/MQ-9 FTU to receive manning priority. To capture this policy, we placed a higher weight on the FTU instructor requirements relative to others in the model.

As a second example, crossflowing in ALFA tours for four-year tours is seen by senior leadership as less desirable than crossflowing in 11Us/12Us, which is seen as less desirable than producing 18Xs (beyond the levels of crossflows that occur naturally in any career field). Thus, we assign a penalty to each ALFA tour pilot who crossflows into the RPA career field, and we phase out ALFA tours starting in FY 2026. With this penalty, it is still possible for ALFA tour pilots to fill desired end-state requirements, but the model will do so only if the desired end-state requirement cannot be filled with 18X pilots. We cap the 11U production at the normal crossflow levels benchmarked against other career fields (see the previous section on crossflow levels and Appendix C for more information). The section titled “Parameters” in Appendix D presents more details on the values of the weights used in the objective function, as well as further discussion of the implications of these weights.

Model Constraints

Constraints are mathematical formulations of real-world limitations that should be taken into consideration or, at the very least, the best approximation to the real-world limitations that we are able to model. Any valid or practical solution in real life should satisfy these limitations, so they are enforced in the model to ensure that any model solution makes sense in real life and to the decisionmaker. As noted above, the model calculates inventory from one

fiscal year (FY) to the next in a typical inventory-control model formulation³³ as applied to this specific situation. The main constraints that define meaningful model solutions given our objective function are the following:

1. The inventory for each pilot type for a particular FY and CYOS is equal to the inventory in the previous FY and CYOS plus total gains in the current FY and CYOS minus total losses in the current FY and CYOS.
2. The number of assigned personnel (which is equal to filled desired end-state requirements) plus the number of unfilled desired end-state requirements³⁴ equals the total number of desired end-state requirements for each duty and FY.
3. The number of assigned personnel plus the number of unassigned personnel is equal to the total inventory for each career field, CYOS, and FY.
4. FTU production (which includes newly produced 18Xs and 11U/12U/ALFA crossflows) is no more than a specified upper bound.
5. 18X production is no more than the maximum number of expected graduates from URT.
6. Production for a career field in a particular FY must not vary significantly from the production in the previous year, which smooth-flows the production from year to year, making production and training capacity planning easier.
7. The number of FTU instructors and the number of students must satisfy the specified student-to-instructor ratio exactly. Without this constraint, the model would often fill more FTU requirements than needed, resulting in as high as a one-to-one student-to-instructor ratio.
8. The objective-function value is not penalized for unfilled FTU instructor desired end-state requirements if those requirements are not necessary to meet the level of production given the specified student-to-instructor ratio.
9. The number of personnel who crossflow into the RPA career field does not exceed the upper bound, which is the average historical crossflow rate for traditional manned-

³³ Inventory theory is a subspecialty within Operations Research. The inventory-control problem is a classical example in which a company must decide how much of each product to order in each time period to meet demand for its products. Here, the order of products represents the production of RPA pilots and the demand is the desired end-state requirement by duty category for a time period of one year.

³⁴ To be clear, when we say unfilled desired end-state requirements, we mean the gap between the inventory in a given FY and the desired end-state requirements if they were filled at 100 percent. Some of these unfilled requirements may include developmental assignments and other positions that, while not critical for executing the mission, are important for ensuring a healthy and sustainable career field (e.g., a sustainable OPTEMPO, time for training, staff assignments). However, given that our definition of requirements includes these other, non-mission-essential roles, it is important to note that the existence of unfilled positions may not mean that ability to execute the mission (at least in the near term) would be compromised. Instead, it means that over time, if those positions continue to go unfilled, career field health could be eroded, which in turn could impact the mission in the long run.

aircraft pilots multiplied by the desired end state. (We used desired end-state requirements as a proxy for inventory under the assumption that each desired end-state requirement will be filled with one and only one officer.)

10. The number of personnel who crossflow into the RPA career field must be greater than the lower bound, which is a user-specified rate for traditional manned-aircraft pilots multiplied by the desired end-state requirement and can be zero. (We used desired end-state requirements as a proxy for inventory under the assumption that each desired end-state requirement will be filled with one and only one officer.)
11. The model returns the current and future (i.e., created by the model) ALFA tour and UPT-direct pilots to their original traditional manned-aircraft pilot career field once they have finished serving the four-year tour.
12. Losses are equal to the inventory multiplied by the loss rate.
13. Assignments to desired end-state requirements by duty category should not exceed the maximum upper-bound percentage of the desired assignment pattern, which dictates the upper-bound percentage of the number of officers from a particular CYOS that can be assigned to each duty category for all those assigned as RPA pilots.

Together, the objective function and constraints enable the computation of the optimal inventory by RPA pilot type, CYOS, and FY for the desired end state, and as a result, optimal production and crossflow rates are provided, as well as a timeline to career field health. Appendix D presents technical details of the model formulation. The next two chapters outline two case studies: one in which the top priority is to fill desired end-state requirements as quickly as possible, and one that takes a more balanced approach to career field planning, where we look at the effect on production and inventory while increasing the desired end-state requirements.

3. Comparison of Two Production Tempos

The current thinking in the RPA community is that production needs to be maximized to build up the RPA career field quickly. The thinking behind a quick build-up is that there will be enough personnel to achieve many of the targets the Air Force is currently aiming for, such as instituting combat-to-dwell, increasing the crew-to-line ratio, potentially flying more combat lines when the 60 combat lines cap is lifted in a few years, having enough personnel to perform the day-to-day mission while providing some personnel the opportunity for education and development, and, as a last example, the chance to fill Air Force staff and joint positions. This last point is seen as an added bonus given the current fighter pilot crisis. The fighter pilot manning situation has gotten so dire that the Air Force is considering not filling the fighter pilots line-flying duties at 100 percent so that there will be a nonzero number of fighter pilots available to fill Air Force staff positions. In the march to achieve what is an impressive list of goals simultaneously, the Air Force sees maximum production as a means for attaining these goals and enabling it to do so quickly.

With that in mind, we considered two scenarios that affect production tempo: One imparts this sense of urgency to fill desired end-state requirements to achieve the goals quickly; the other takes a more mindful approach to filling the desired end-state requirements in a timely manner while making sure there are assignments and opportunities for each RPA pilot and realizing that production decisions made now will have lasting effects into the future. This chapter describes results from these two scenarios, more specifically described as follows:

1. *Meet desired end-state requirements as soon as possible* (or, for brevity, the ASAP scenario). In this scenario, the model places a far higher priority on filling desired end-state requirements in the near term and a higher priority on filling desired end-state requirements than on minimizing unassigned personnel (i.e., pilots in excess of desired end-state requirements given the experience levels required for the duty category). This scheme represents a policy environment where operational needs demand that the career field be able to fill all desired end-state requirements as quickly as possible, even if it means that the experience levels across the force deviate from the ideal and must be managed in the future.
2. *Balanced career field management*. This scenario (the balanced scenario) weighs the number of unfilled desired end-state requirements equally against the number of unassigned personnel. The balanced scenario also weighs the future and the present equally (although it keeps a high priority on requirements through FY 2017, to capture the fact that the Air Force has already planned for high levels of production for these years).

Thus, the fundamental difference between the scenarios is the urgency placed on filling requirements as quickly as possible (short-term career field planning) versus more-holistic, longer-term career field planning. Table 3.1 shows how the model assumptions differ between the two scenarios.

Table 3.1. Assumptions Under Two Career Field Planning Scenarios

Assumptions	Fill Requirements ASAP	Balanced Management
FTU instructors ^a	<ul style="list-style-type: none"> • Anyone with CYOS ≥ 3 in 2016–2017 can fill position 	<ul style="list-style-type: none"> • Same
Production caps ^b (due to MQ-9 TX and URT capacity)	<ul style="list-style-type: none"> • Total FTU throughput: 2016: 334 2017: 259 2018: 270 • 18X: 300 per year 	<ul style="list-style-type: none"> • Same
New pilots per FTU instructor	<ul style="list-style-type: none"> • 2016–2017: 3.0 • 2018–2019: 2.71 • 2020+: 2.55 	<ul style="list-style-type: none"> • Same
Filling duties and crossflow ^c	<ul style="list-style-type: none"> • Higher priority on FTU instructor and line duties • Higher priority on near-term requirements • Penalize ALFA tours • Historical levels of 11U crossflow 	<ul style="list-style-type: none"> • Same through 2017, line only thereafter • Same through 2017, requirements and overages balanced thereafter • Same • Same unless noted otherwise in the text

^aAfter 2017, FTU instructors are limited according to traditional pilot norm.

^bThere is no total FTU production cap after 2018.

^cALFA tour pilots are not allowed, starting in 2026.

ASAP Production Tempo Results

Given the Air Force’s desire to build up the RPA career field to meet a high level of demand and to improve career field satisfaction, there is a sense of urgency to grow the MQ-1/9 portion of the career field quickly. We created the ASAP scenario to see if providing a sense of urgency (by prioritizing unfilled desired end-state requirements in the near term) could result in the Air Force reaching the desired end state sooner (roughly 5 to 10 years) rather than later (roughly 20 years). We tested the ASAP scenario under two different loss profiles: low loss rates and medium loss rates (described in Chapter 2). We present the results for these two loss profiles and provide some insight into our findings, what they mean for the Air Force, and the advantages and disadvantages of this scenario.

RPA Model Results for the ASAP Scenario with Low Losses

The first set of results covers the implications of the ASAP scenario with low losses. We show the optimal decisions under each scenario and loss profile in two parallel charts.

Figure 3.1 shows annual production¹ by type (11U,² 18X, and ALFA tour). The first few years have some restrictions, included at our sponsor's request:

- FY 2016 production includes 80 UPT directs (general pilot accessions that were classified as 11Us upon graduating from UPT) who enter the RPA career field after completing RPA FTU training and will transition to a manned-aircraft pilot career field after serving a four-year tour in the RPA community. As they are considered crossflow, with the same tour length as ALFA tours, we include them in the ALFA tour category.
- Zero crossflow pilots are allowed to enter in FY 2017–FY 2018 as the RPA career field is using FTU training capacity to transition the remaining MQ-1 pilots over to the MQ-9 platform.
- The transition from the MQ-1 platform to MQ-9 limits the number of seats available in the FTU to train new 18X RPA pilots, so FY 2017–FY 2018 also shows a smaller production plan.
- The assignment pattern aperture is opened up to allow any personnel with three CYOS or more to fill FTU instructor duties, to help achieve 100-percent FTU manning by the end of FY 2016.

As new 18X RPA pilots are best suited to fill the line pilot duties (based on historical assignment patterns), the introduction of ALFA tours in the near term allows critical gaps in line instructor, line examiner, and FTU instructor positions to be filled with more experienced pilots.³ The suggested production plan aligns with the current thinking of needing to produce 300 18Xs annually for the next five years before decreasing production to a more sustainable level.

However, the high production tempo comes at a cost, as shown in Figure 3.2, which presents the total number of unfilled desired end-state requirements annually and the total number of unassigned RPA pilots annually. When the solid line reaches zero, all desired end-state requirements are filled and the goal of meeting the desired end state is realized. Over time, by placing a high priority on meeting near-term desired end-state requirements as quickly as possible, the model creates a large population of unassigned RPA pilots even while desired end-state requirements remain unfilled.

¹ Annual production is meant to cover all three types of RPA pilots, because we define production as an FTU graduate, and all crossflows must go through FTU training. Thus, all RPA pilots who enter the model are produced.

² Historically, very few 12Us have been produced. For that reason, our sponsor directed us to exclude 12U pilots from the model.

³ Per our sponsor's request, ALFA tour pilots are restricted such that they can fill only line-flying duties, FTU instructor positions, and LRE instructor positions.

Figure 3.1. Annual Production in the ASAP Scenario (Low Losses)

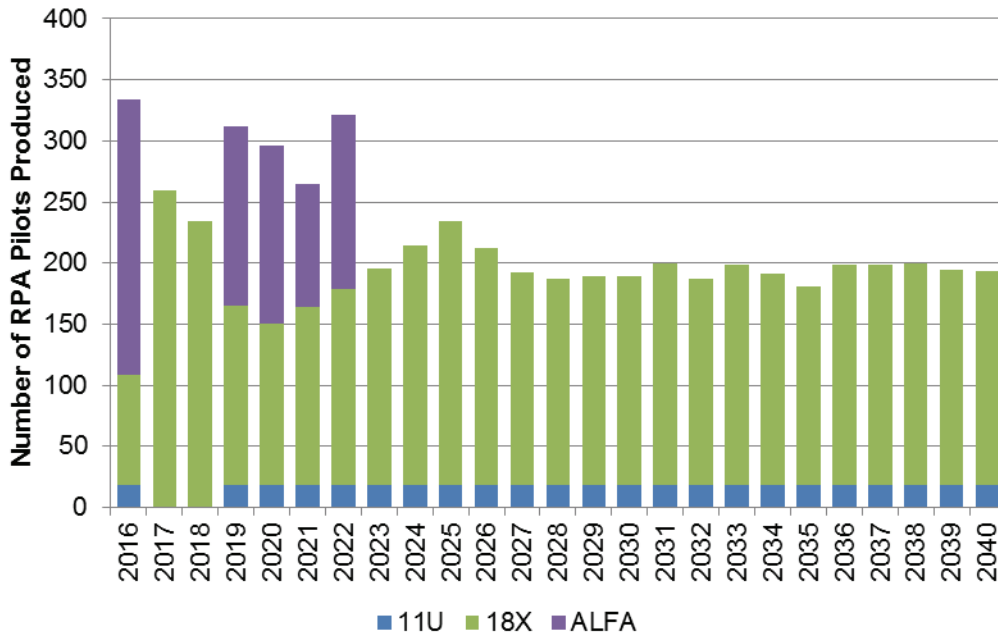
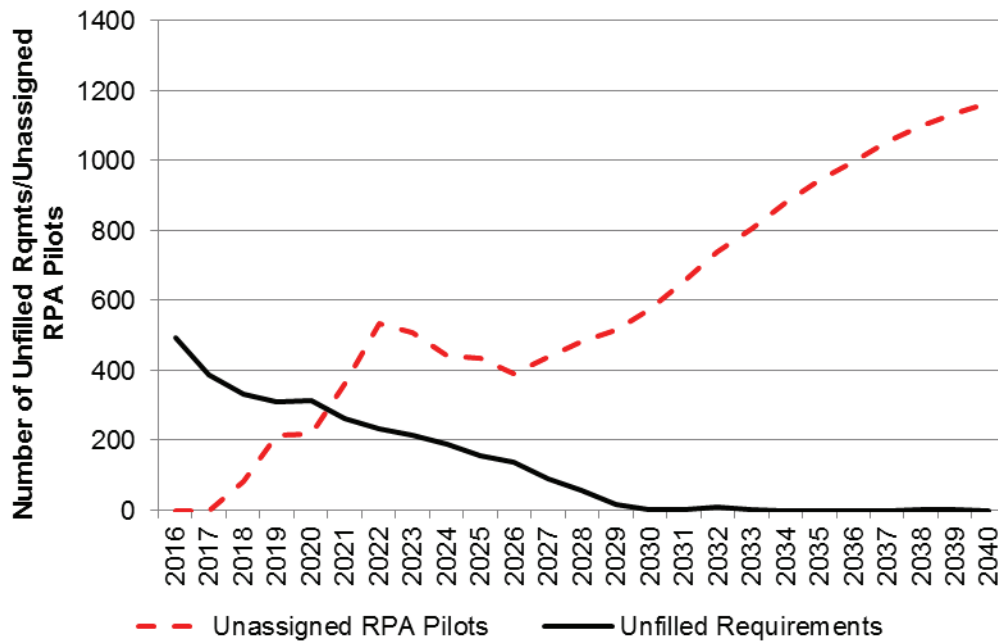


Figure 3.2. Unfilled Desired End-State Requirements Versus Unassigned RPA Pilots in the ASAP Scenario (Low Losses)

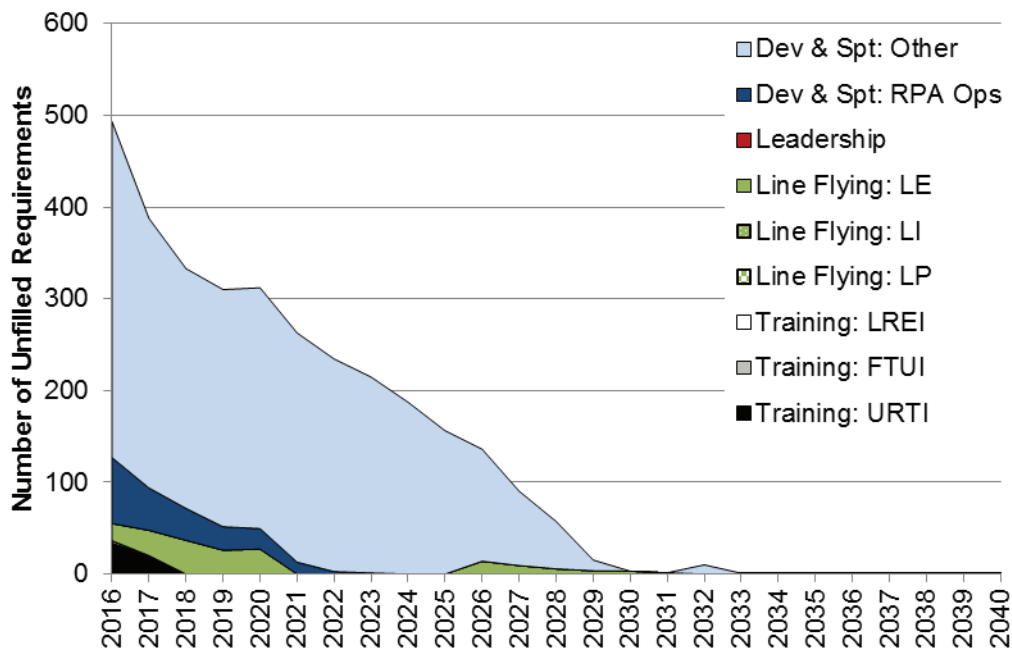


NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

This large population of unassigned RPA pilots occurs because they cannot be matched to any unfilled requirement without violating the assignment patterns of the traditional pilot community. The decrease in unassigned personnel from FY 2022 through FY 2026 results from the ALFA tours completing their four-year tour and returning to the manned-aircraft pilot community. 18X RPA pilots can then fill the positions that had been filled by ALFA tour pilots, but once the ALFA tour pilots phase out, the number of unassigned personnel accelerates again, starting in FY 2026. In the optimal solution for the ASAP scenario under low losses, unfilled desired end-state requirements approach zero in FY 2030—requiring a total of 15 years before all desired end-state requirements are met (although the requirements are technically sustained until FY 2034).

The large number of unassigned RPA pilots and the 15-year delay in filling desired end-state requirements result from the majority of the model’s unfilled desired end-state requirements after FY 2021 being in development and support duties outside of RPA operations, which tend to be positions requiring the most experience. The model fills most types of desired end-state requirements by FY 2021 (including the mission-essential wing and below desired end-state requirements), as shown in Figure 3.3, but the desired development and support desired end-state requirements, such as Air Force staff and joint staff, remain unfilled for another eight years, until FY 2030. These development and support desired end-

Figure 3.3. Unfilled Desired End-State Requirements by Duty in the ASAP Scenario (Low Losses)

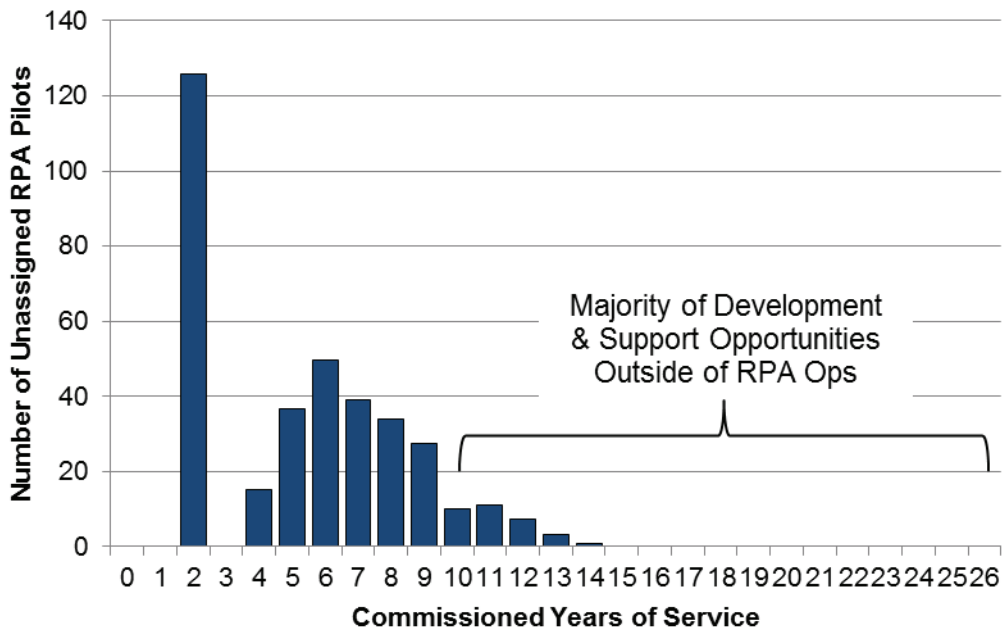


NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

state requirements take more time to fill because more-experienced pilots typically fill these positions under traditional manned-aircraft pilot assignment rules. Thus, before these positions can be filled, it is necessary to wait for the cohorts of 18X pilots that graduate from RPA pilot training in the earlier modeled years to reach the point in their career where they are eligible for these more senior duties. To be clear, these unfilled development and support duties constitute the gap between the current/projected inventory in a given fiscal year and the desired end state if filled at 100 percent. This gap highlights the fact that certain duties require experience and maturity in the RPA force, which the Air Force cannot hurry along and will eventually fill once the more junior cohorts gain the experience and maturity over time. This gap in and of itself is not a negative result and should not be seen as such.

We now explain why the number of unassigned personnel increases over time. Traditional assignment rules assign most new pilots to line-flying duties, in accordance with the traditional pilot patterns in the personnel data. Once the line-flying duties are filled, however, additional production creates a surplus of RPA pilots who are too junior to fill the remaining desired end-state requirements. In FY 2021, for example, most unassigned personnel are in their second CYOS, while the majority of remaining development and support opportunities require at least 10 CYOS (as depicted in Figure 3.4). This occurs because the ASAP scenario is designed to be less economical about unassigned personnel and more concerned with unmet desired end-state requirements, so the best solution to fill those requirements as soon as possible continues to produce new pilots beyond those needed for line-flying duties. The issue

Figure 3.4. Experience Levels of Unassigned RPA Pilots in FY 2021 in the ASAP Scenario



with having too many new pilots (beyond those needed for line-flying) is that they are inexperienced. Not having enough line-flying positions for these officers to fill would cause absorption issues, such that pilots would not gain the experience they need. If the unassigned personnel were more senior officers, this would essentially be a non-issue, because the Air Force could easily incentivize them to leave. In other words, producing high levels of pilots in the short term without factoring in potential overages could quickly create a glut of inexperienced personnel, leading to absorption issues and an imbalance in the experience-to-inexperience mix of officers.

RPA Model Results for the ASAP Scenario with Medium Losses

It is tempting to view the unassigned personnel in the low losses case as a buffer against higher losses, as if poor retention might reduce the inventory imbalance (between unmet desired end-state requirements and unassigned personnel). To test this possibility, we ran the optimization solver on the ASAP scenario with a medium-loss profile, while all other inputs remained the same. We find both a delay in filling desired end-state requirements, which under the higher losses takes until FY 2040, and a similarly high inventory imbalance. The delay is straightforward, as more time is required to build up the inventory when higher numbers of RPA pilots are lost each year. The lack of improvement in the number of unassigned personnel stems from the fact that the production plan compensates for higher losses with additional production, leading to a similar equilibrium level of unassigned personnel.⁴

The ASAP scenario illustrates several career field management dynamics. Placing a high priority on filling near-term desired end-state requirements leads to higher levels of production and creates a pool of unassigned personnel. Newly produced RPA pilots must gain experience before they are eligible to fill more-senior desired end-state requirements (according to traditional manned-aircraft pilot assignment patterns), so unfilled desired end-state requirements remain for many years, even while a significant portion of the career field is underemployed. This phenomenon occurs, under this scenario, no matter how many RPA pilots are produced. Planning for higher-than-expected losses does not result in a better alignment of personnel to desired end-state requirements, as additional unassigned personnel are needed to overcome the increased losses, all else being equal.

Balanced Career Field Management Approach

After seeing the ASAP scenario results and the number of unassigned junior personnel, we wanted to see how career field planning would change if giving each RPA pilot a job to

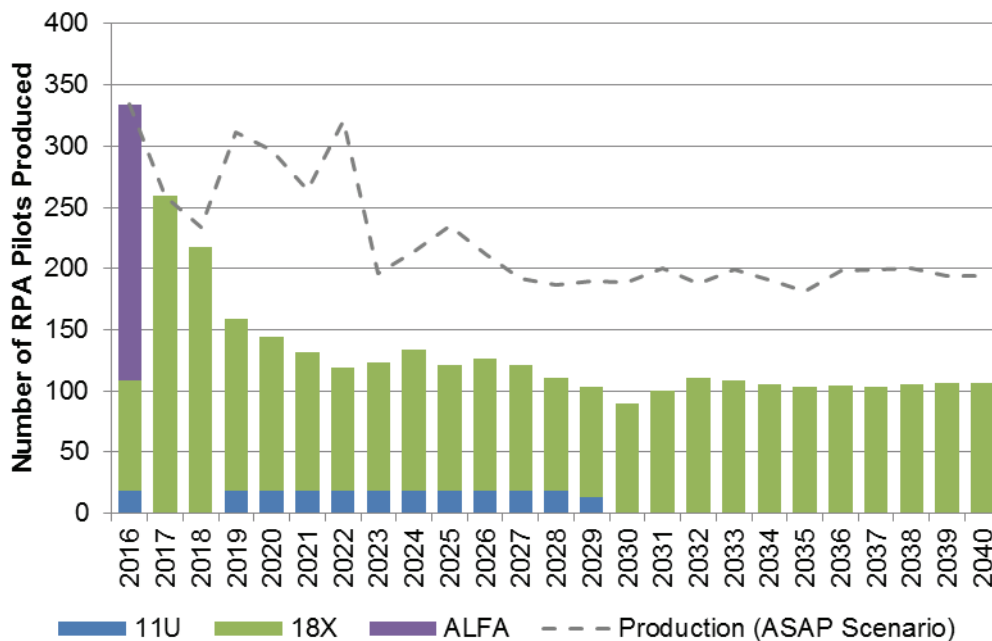
⁴ Beginning in FY 2034, the number of unassigned personnel in the low-loss case jumps above the number in the medium-loss case and remains higher in steady state.

perform was as important as meeting the desired end-state requirement.⁵ We also made the priority of the near term equal to that of the long term so that solutions considered by the model could allow for tradeoffs between not growing as quickly and being healthier and more stable in the long run. We tested the resulting balanced scenario under the same two low- and medium-loss profiles we used for the ASAP scenario to see how retention affects production and inventory. We also compared the two production plans for implications of the effect on mix, production tempo, timeline, and sustainability, and we included insights, advantages, and disadvantages.

RPA Model Results for the Balanced Scenario with Low Losses

The results for the balanced scenario displayed in Figure 3.5 show the optimal mix of personnel under low losses (bars), with a reference line indicating the results for the ASAP scenario under low losses. We imposed the same restrictions on the first few years in the balanced scenario under low losses as we did in the corresponding ASAP scenario (restrictions on FTU throughput in FY 2017–FY 2018, no crossflows in FY 2017–FY 2018, and the 80 UPT directs in FY 2016). The best solution in the balanced scenario includes much lower levels of production than in the ASAP scenario, thereby significantly decreasing the production tempo through the FTU. Another notable difference is that the balanced scenario

Figure 3.5. Annual Production in the Balanced Scenario (Low Losses)



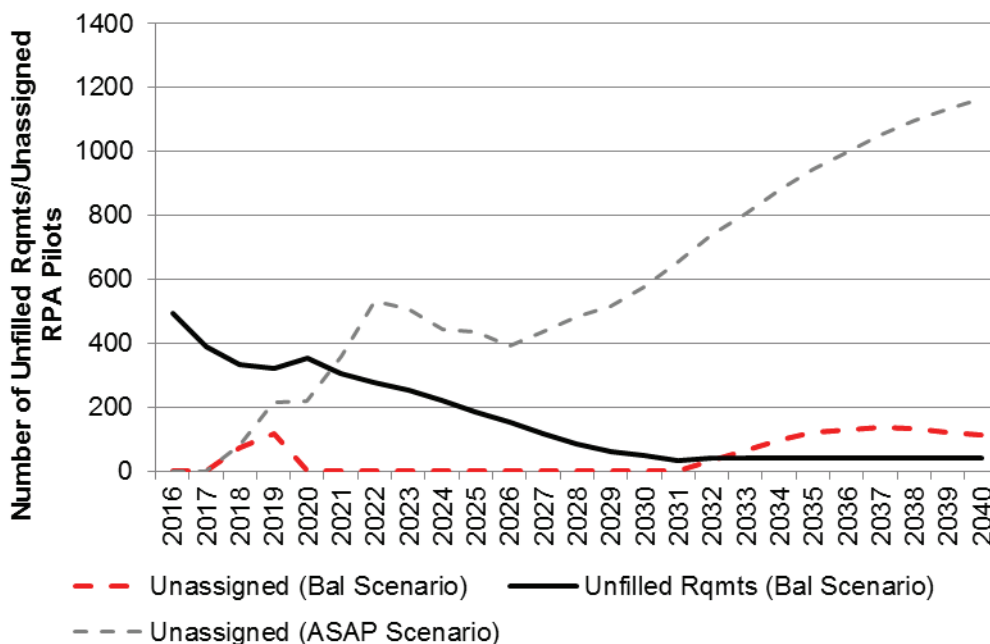
⁵ Conversely, one unfilled requirement incurs the same penalty in the model as one unassigned RPA pilot.

does not crossflow ALFA tour pilots past FY 2016. A production plan that crossflowed ALFA tours only in FY 2016 would address senior leaders’ desire to reduce the usage and reliance upon ALFA tours and to allow ALFA tour pilots to return to the manned-aircraft pilot community.

Also, the smaller annual production eliminates the runaway numbers of unassigned RPA pilots, as shown in Figure 3.6. Yet, despite the significantly lower production in the balanced scenario (2,232 fewer RPA pilots are produced through FY 2040), fewer than 10 development and support desired end-state requirements are unfilled after FY 2030, which is within a year of the point where the ASAP scenario met all desired end-state requirements. This result reinforces the point that the time required for the early RPA cohorts to gain experience, not the number of pilots produced in those cohorts, drives the ability to fill the development and support requirements in the future.

The balanced-scenario solution presented in Figure 3.6 includes a small number of desired end-state requirements that remain unfilled in perpetuity—desired end-state requirements that cannot be filled under the traditional manned-aircraft pilot assignment patterns without adding additional unassigned personnel. Similar to the ASAP scenario, the balanced scenario fills most categories of desired end-state requirements quickly, but additional time is required to

Figure 3.6. Unfilled Desired End-State Requirements Versus Unassigned RPA Pilots in the Balanced Scenario (Low Losses)

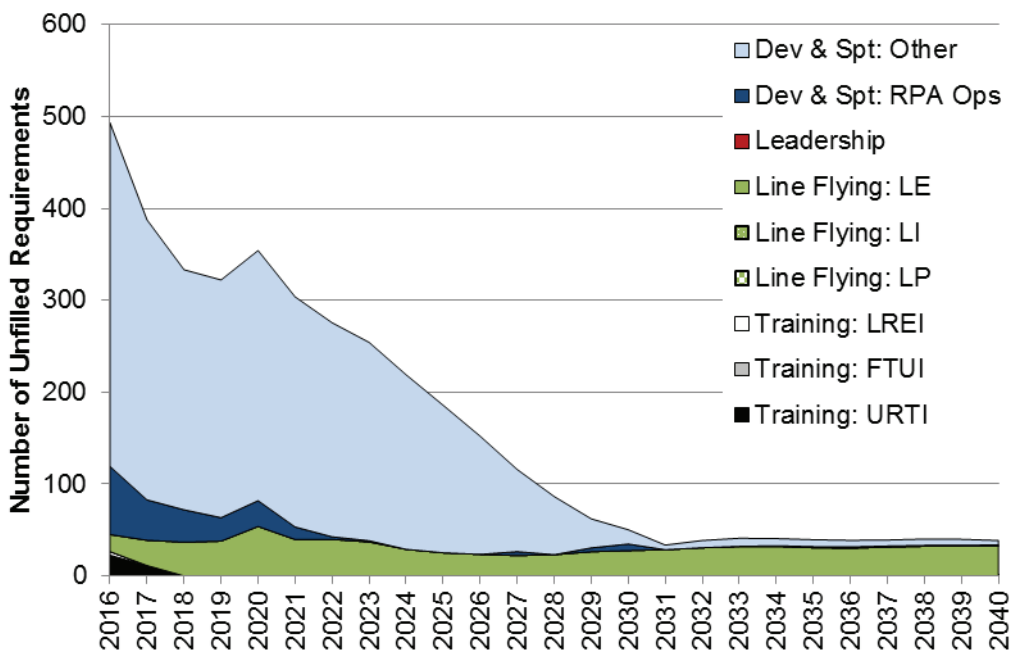


NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given fiscal year and the desired end state filled at 100 percent.

fill development and support duties outside of RPA operations. In the balanced scenario, however, two types of duties remain unfilled after most other desired end-state requirements are finally met in FY 2031.

While perpetually unmet desired end-state requirements might sound like a crippling problem for the career field, the duty breakout shows that these may not be as problematic in practice, as shown in Figure 3.7. First, the majority of the unmet desired end-state requirements are in the line examiner duty (an average of 31 per year). These requirements likely would not present a problem, as they would be amenable to a few unit-level actions.⁶ Further, the remaining number of unmet desired end-state development and support requirements is negligible (fewer than 10 requirements within the category). Therefore, we

Figure 3.7. Unfilled Desired End-State Requirements by Duty in the Balanced Scenario (Low Losses)



NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

⁶ For example, in FY 2031, there will be 426 RPA pilots assigned to line-pilot duties in CYOS 4 or higher. Even though it would be atypical to certify additional RPA pilots as examiners by traditional pilot standards, these RPA pilots have more operational experience than their traditional pilot counterparts, who spend a much longer time completing training. Thus, unit leadership could assign any one of these 426 RPA pilots to the 31 line examiner positions. The model cannot do this because it would break the assignment pattern constraint, which mimics manned-aircraft pilot assignments.

interpret this result as implying that the balanced scenario meets most desired end-state requirements within a year of the same goal reached by the ASAP scenario.

Finally, Figure 3.6 shows a buildup of unassigned RPA pilots starting in FY 2032 that increases to more than 100 in FY 2035. This buildup of unassigned officers is the result of good retention past 20 CYOS, where an excess of officers are not needed in the duties to which they can be assigned based on experience (development and support duties) and their experience does not align with traditional manned-aircraft pilot assignments for the unfilled line examiner positions (i.e., they are too senior to fill those positions). As a result, in this case there are both unmet positions and unassigned senior-level personnel.

This issue of too many senior personnel could be addressed by the Air Force through force management actions such as force shaping. However, it is also worth noting that our retention estimates may be overestimating retention at higher grades (i.e., after the point at which personnel are eligible for retirement). When we compare the retention estimates we used in this model (which were based on historical retention among nonrated line officers) with actual retention in traditional manned-aircraft pilot communities, we see lower retention in the later CYOS groups in the traditional manned-aircraft pilot communities. This could suggest that retention was overestimated in our model for these post-retirement eligibility CYOS years. If, in fact, such retention turns out to be lower than we have estimated, an excess of senior officers would not exist. Unfortunately, because there are no historical data on RPA retention at the higher CYOS years, there is no way to know how similar their retention would be to that of traditional pilots.

RPA Model Results for the Balanced Scenario with Medium Losses

Planning for medium losses in the balanced scenario increases the number of RPA pilots that need to be produced each year. However, the balanced scenario solution keeps production below 200 per year after FY 2018, while also leaving more desired end-state requirements unfilled (Figures 3.8 and 3.9, respectively). The ASAP scenario solution compensated for higher losses with increased production (and more unassigned RPA pilots), but the balanced scenario solution leaves desired end-state requirements unfilled to avoid overages. This result suggests that in order to build a healthy RPA career field that is comparable to that of traditional manned-aircraft pilots while avoiding large numbers of unassigned pilots, personnel policies may be needed that minimize losses as well as boost production. Simply put, if policies cannot keep actual retention at a level similar to the rates assumed under our low-loss case, the RPA community will likely not be able to reach the desired end state. In that case, other interventions such as increased bonus pay or other incentive pay would be needed to help address the unmet desired end-state requirements. Examples of other possible alternatives that improve the medium-loss outlook are given in Appendices E and F.

Figure 3.8. Annual Production in the Balanced Scenario (Medium Losses)

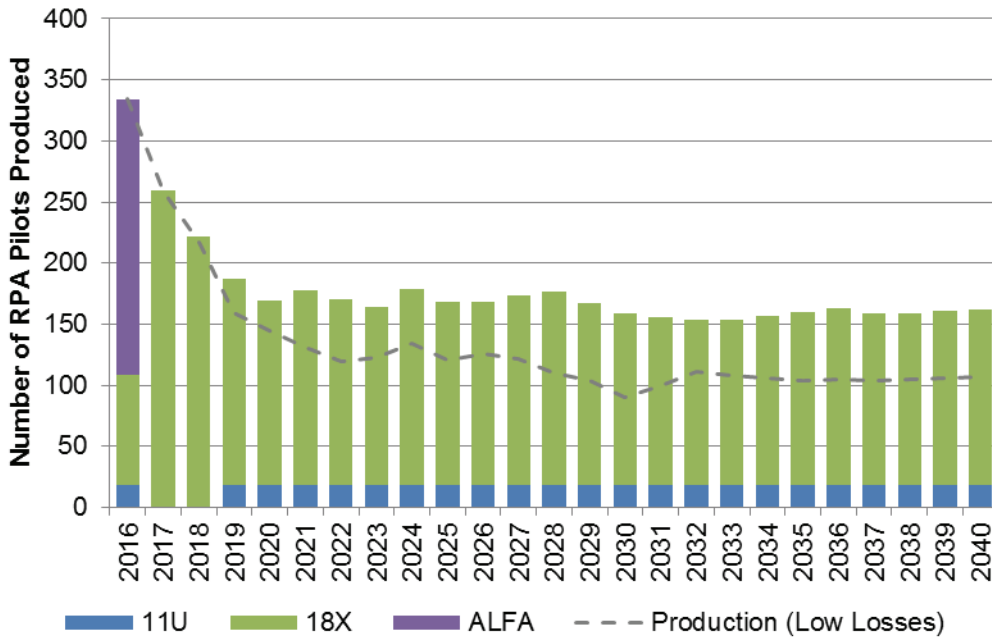
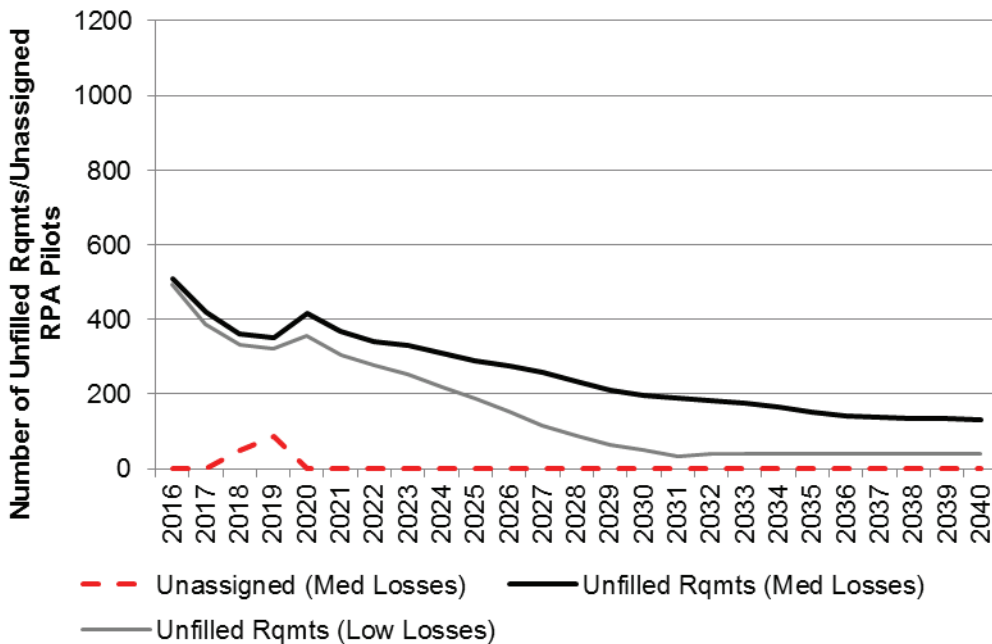


Figure 3.9. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots in the Balanced Scenario (Medium Losses)



NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given fiscal year and the desired end state filled at 100 percent.

In the medium-loss case, the unfilled desired end-state requirements fall mainly in the line examiner and development and support duty categories. Unfilled desired end-state requirements in the first category could potentially be dismissed (using the same argument as presented in the low-loss case), but the presence of unfilled development and support desired end-state requirements indicates that the number of senior RPA personnel with appropriate career broadening experience would be lower than is generally typical for traditional pilots.

Summary

Overall, the solution to the balanced scenario shows some promising findings for the RPA community. The findings indicate that it is possible to build a healthy career field with fewer than 150 FTU graduates per year, provided retention policies can control RPA pilot losses. Additionally, this solution reaches the end state within a year of the time required in the ASAP scenario in FY 2031, where matching the personnel numbers exactly with desired end-state requirements was of less concern. Producing more RPA pilots in the ASAP scenario does little to reduce the overall timeline to fill desired end-state requirements because it takes time for newly minted pilots to gain the experience appropriate to fill development and support duties, and the Air Force cannot rush these new pilots' gaining experience. However, these results also show that if retention is poor, the Air Force is unlikely to be able to fill all desired end-state requirements in the long run and will have fewer pilots available for more senior developmental duties.

The next chapter examines how changes in desired end-state requirements affect pilot production, inventory levels, mix of RPA pilots, and the timeline to meeting the desired end state. Scenarios are presented that explore changes involving combat-to-dwell, crew-to-line ratios, and the number of active duty combat lines being conducted.

4. The Impact of Growth in Desired End-State Requirements on Production and Inventory Levels

Results thus far have shown that transforming the RPA career field into a community with healthy levels of personnel requires significant growth, both in the overall size of the community and in the opportunities available to RPA pilots. This growth is necessary even while operational requirements remain somewhat constant so that all increased manning can go toward improving career field health, job satisfaction within the RPA community, and a better quality of life for that community. However, many SMEs interviewed for this study indicated that they believe operational requirements are likely to increase in the future; it is not a question of if, but when and how soon. Furthermore, earlier results assume that maintaining certain manning ratios (i.e., 1:0.5 combat-to-dwell ratio and 10:1 crew-to-line ratio) will relieve the documented stress on RPA operators, but there is no evidence that these ratios will address the concerns thoroughly (although since the current ratios are worse, there is a consensus that these ratios will improve the situation). With these limitations in mind, we used the RPA model to examine the implications of further increases in operational requirements for achieving and maintaining a healthy, sustainable career field.

Overview

We examined three different kinds of growth in operational desired end-state requirements: increases in the number of active duty lines, increases in crew-to-line ratios, and increases in combat-to-dwell ratios. We refer to these as growth in operational desired end-state requirements because they primarily affect the number of line pilots, instructors, and examiners. Yet increases in desired end-state line requirements also generate increases in other areas—e.g., development and support requirements are designed to remain proportional to the size of the line population based on the historical levels among traditional pilots. Table 4.1 shows total desired end-state requirements (summed across all duties) for each type of growth.

In the analyses that follow, we compare the increased desired end- end-state requirements with our baseline scenario, which assumes 45 active duty combat lines (i.e., the current mission), a 10:1 crew-to-line ratio (ACC's current minimum), and a 1:0.5 combat-to-dwell ratio (ACC's current planned target for combat-to-dwell ratio), which is the backbone of the results presented in Chapter 3. Then we change one assumption at a time. First, we consider hypothetical mission growth from 45 active duty combat lines to 55 and 65 active duty combat lines (while maintaining a 10:1 crew-to-line ratio and a 1:0.5 combat-to-dwell ratio). Second, we consider a scenario that increases the crew-to-line ratio from the default of 10:1 to 13:1 (while maintaining 45 active duty combat lines and 1:0.5 combat-to-dwell ratio). Third, we

Table 4.1. Total Desired End-State Requirements for Planning Scenarios

Scenario	Total Requirements
Baseline	1,776
Higher OPTEMPO	
55 combat lines	2,035
65 combat lines	2,334
Higher manning cushion	
13:1 crew-to-line	2,079
1:1 combat-to-dwell	2,133
13:1 combat-to-line and 1:1 combat-to-dwell	2,536

NOTE: The baseline assumes 45 active duty combat lines, a 10:1 crew-to-line ratio, and a 1:0.5 combat-to-dwell ratio.

consider a scenario that plans for a 1:1 combat-to-dwell ratio rather than 1:0.5 (while maintaining 45 active duty combat lines and a 10:1 crew-to-line ratio).

We run all of the models under the balanced scenario, assuming that balancing the number of unassigned personnel against the number of unfilled non-mission-essential duties is a worthwhile goal. As in Chapter 3, given that retention assumptions regarding 18X RPA pilots play a key role in determining the timeline and production plan to meet desired end-state requirements, we present results for both low- and medium-loss profiles.

In the remainder of this chapter, we explore the results of the analyses according to their impact on the time it takes to meet the desired end-state requirements, production numbers, numbers of unassigned personnel, and inventory composition. All of the growth scenarios follow essentially the same trends with respect to the consequences.

How Long It Takes to Meet Desired End-State Requirements

Despite the fact that the three scenarios examined here significantly increase the target number of desired end-state requirements over the number in the baseline scenario, these increases do not translate into longer timelines to meet those requirements. When losses are low, solutions for all scenarios reach a steady state that is close to filling all desired end-state requirements by FY 2031 (see Table 4.2). A small number of desired end-state requirements remain unfilled due to rigidity in the assignment structure that could potentially be overcome in real-world practice.¹ With medium losses, the same tendency to fall short of filling all

¹ Although our model does not pull people from other duty assignments to fill positions when they fall outside of the possible range of assignment patterns or go against the priorities we have specified, the Air Force necessarily would find an alternative way to fill them if the position were considered important enough and if doing so would not lead to significant shortages elsewhere. Under those circumstances, career field managers would decide how

Table 4.2. Annual Unfilled Desired End-State Requirements with Low and Medium Losses When Increasing the Number of Lines, Crew-to-Line Ratio, and Combat-to-Dwell Ratio

Scenario	Number of Unfilled Desired End-State Requirements by Year						Percent Unmet in 2040
	2016	2021	2026	2031	2036	2040	
Low losses							
Baseline	493	304	152	34	39	39	2.2
55 combat lines	752	419	220	46	49	50	2.5
65 combat lines	1051	530	256	51	56	57	2.4
13:1 crew-to-line	796	442	234	45	48	49	2.3
1:1 combat-to-dwell	850	458	240	52	54	54	2.5
13:1 crew-to-line and 1:1 combat-to-dwell	1253	658	337	105	90	61	2.4
Medium losses							
Baseline	508	368	276	188	143	131	7.4
55 combat lines	767	504	353	238	181	164	8.0
65 combat lines	1066	700	429	289	211	188	8.0
13:1 crew-to-line	811	497	361	244	186	169	8.1
1:1 combat-to-dwell	865	504	372	252	193	176	8.3
13:1 crew-to-line and 1:1 combat-to-dwell	1268	898	503	361	263	239	9.4

NOTE: The percentages of unfilled desired end-state requirements in 2040 are all within the development and support categories.

desired end-state requirements is present, and the tendency worsens with increased requirements.

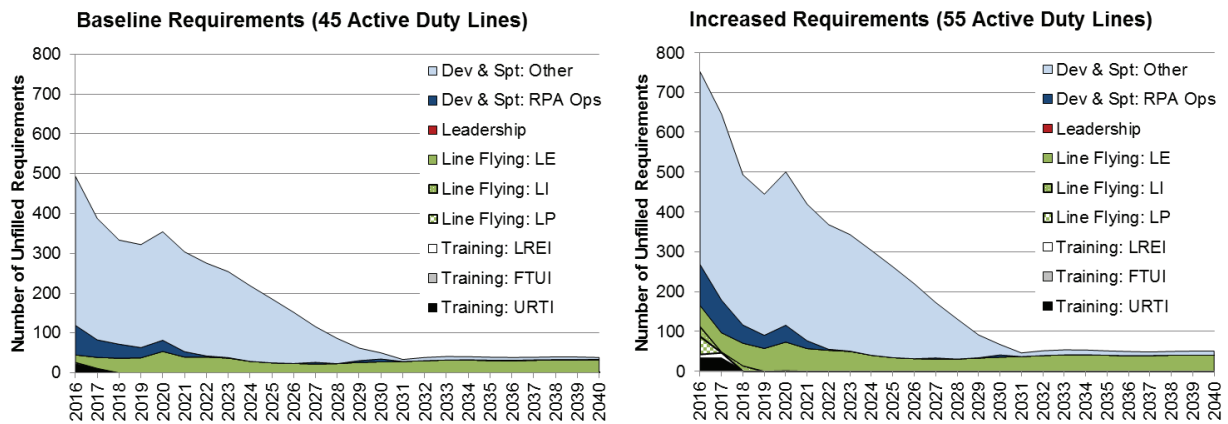
The baseline medium-loss scenario, for example, fills all but 131 desired end-state requirements by FY 2040 (7.4 percent of the total, shown in the last column of Table 4.2), whereas the scenario with the largest requirement (13:1 crew-to-line ratio and 1:1 combat-to-dwell ratio) leaves 239 positions unfilled (9.4 percent of the total).

Figure 4.1 compares annual unfilled desired end-state requirements by duty category for the baseline scenario (which supports 45 active duty lines) and the scenario that builds toward 55 active duty lines.² The duty groupings in Figure 4.1 are the same as before, with the development and support duties combined by whether they are within operational RPA wings (e.g., in an OSS) or outside of the RPA organization (e.g., Air Force staff, PME, and joint staff assignments).

best to pull from other duties to fill those positions. Our model is not designed to capture such fine-grained tuning in response to these small shortages; therefore, in such cases, we simply assume that workable solutions are possible.

² We ran other scenarios through the model, but we have chosen these as examples.

Figure 4.1. Unfilled Desired End-State Requirements by Duty Category, Baseline Scenario Versus 55 Active Duty Lines with Low Losses



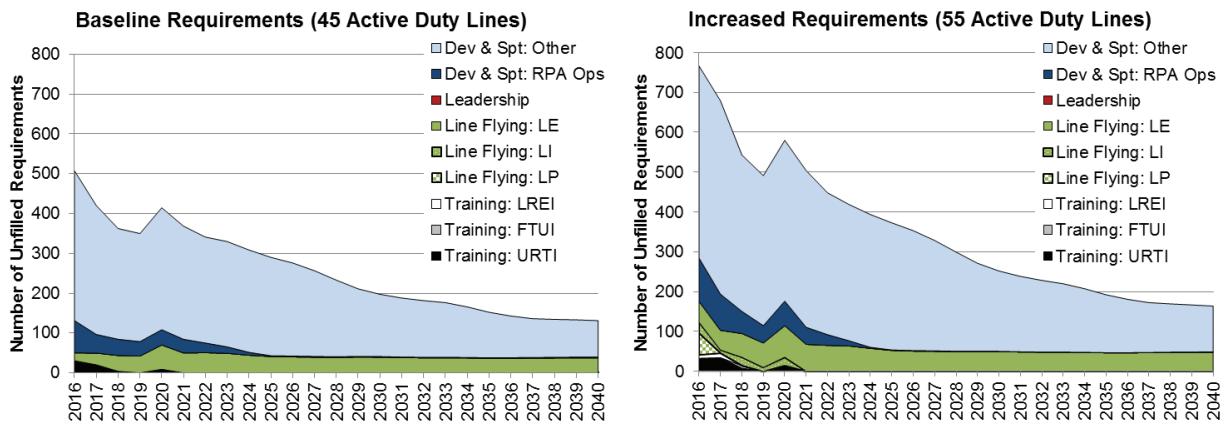
NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

As expected, the two scenarios differ greatly in the number and type of unfilled requirements in the near term. Yet by FY 2022, development and support duties outside of the RPA wings make up the majority of unfilled desired end-state requirements, and both solutions are able to grow to a steady state that fills most desired end-state requirements by FY 2031. In either case, desired end-state requirements for line examiner positions are the most difficult to fill, which reflects a disconnect in the model between desired end-state requirement levels in RPA unit authorizations (which were used to create the line examiner requirement) and levels that are normal among traditional manned pilots (which constrain how many personnel in each CYOS the model can assign to the requirement).³

Examining unfilled desired end-state requirements over time in the medium-loss scenarios (Figure 4.2) shows that most of the long-term unfilled desired end-state requirements are in the development and support duties outside of RPA operations. This pattern mirrors the finding in Chapter 3 that higher losses prevent the model from retaining enough experienced pilots to fill more senior duties. The inability to fill these desired end-state requirements is not rooted in production constraints. Rather, the model reaches the point where additional production would create new pilots that are not needed for junior duties. Therefore, these pilots would remain unassigned for many years while they mature to the point where they can fill the remaining duties—a state the model is programmed to avoid. In other words, Figure 4.2 represents an equilibrium where the RPA career field is underrepresented among

³ Again, while this pattern emerges as a limitation for the model, it is unlikely to be a real-world problem, as unit-level training and certification policies would be able to adapt to fill the true examiner requirement.

Figure 4.2. Unfilled Desired End-State Requirements by Duty Category, Baseline Scenario Versus 55 Active Duty Lines with Medium Losses



NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

career development assignments because of a lack of supply rooted in retention, rather than a lack of opportunities. Again, this gap in unmet desired end-state requirements is not a negative result, but rather is an artifact of a newly emerging career field that requires time to mature.

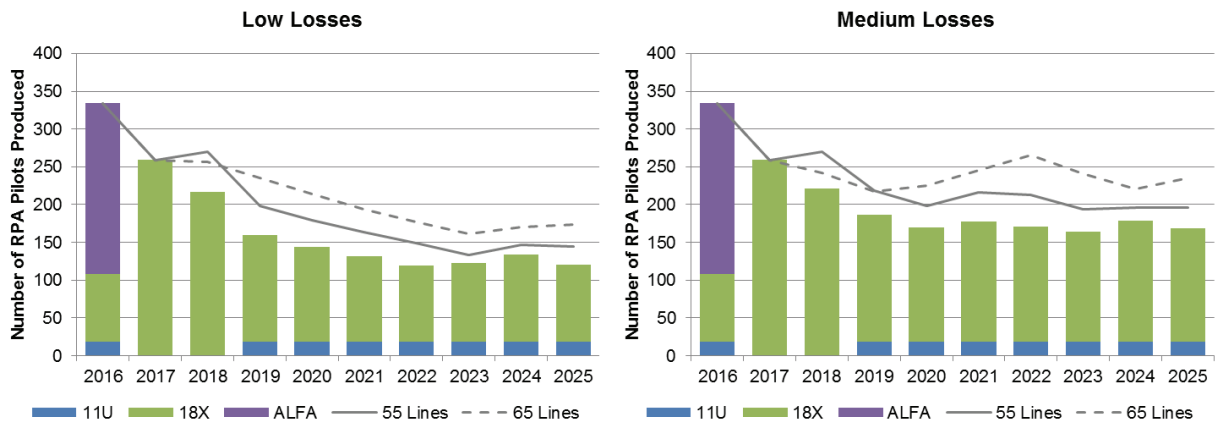
The findings for the other scenarios (65 lines and combat-to-dwell and crew-to-line increases) are very similar to those shown in Figures 4.1 and 4.2. Overall, the tendency for development and support desired end-state requirements to remain unfilled for longer is consistent across requirement growth scenarios, as is the inability to fill all developmental assignments in the medium-loss scenarios.

Our exploration of these growth scenarios showed that the RPA career field has the capacity to grow far beyond the baseline desired end-state requirements fairly quickly and still achieve a large career field that mirrors the patterns among traditional manned-aircraft pilots. Although the career field is strained today, the model shows that the production pipeline could accommodate plans to significantly increase the number of active duty lines or support higher manning levels for a given OPTEMPO, provided retention is closely monitored and annual production numbers plan in advance for anticipated growth. The following section discusses the impact of these scenarios on the necessary levels of annual production.

Annual Production Numbers Required to Meet Desired End-State Requirements

For all of the growth scenarios, the short-run production patterns in each optimal solution involve a period of high production that produces rapid growth before settling into a steady-state level of production that is consistent from year to year. To illustrate this, Figure 4.3 shows the total annual production levels under the baseline scenario from FY 2016 through

Figure 4.3. Optimal Level of Production for Low and Medium Losses, Baseline Scenario Compared with 55- and 65-Combat Line Scenarios



FY 2025 for low losses (left panel) and medium losses (right panel), by pilot type (represented by the vertical bars). Production levels for the scenarios increasing to 55 and 65 lines are shown as solid and dashed lines, respectively.⁴ All scenarios produce at the maximum levels in FY 2016 and FY 2017; this is intentionally programmed into the model to reflect actual Air Force production decisions for those years. In the baseline scenarios (represented by the vertical bars), production is scaled back in FY 2018 before settling into a steady-state rhythm. In scenarios with higher desired end-state requirements, production elevates accordingly and decreases more slowly over time. The optimal solution did not utilize the full accessions capacity of 300 18X pilots in any year for any of the scenarios examined.

As shown in Figure 4.3, the optimal level of production increases as desired end-state requirements increase (or as losses increase), but no scenario that we examined causes the model to be continually constrained by the maximum production capacity (which we limit, based on the number of instructors assigned to the FTU and annual accessions caps). Table 4.3 shows the steady-state production level, as measured by the average annual production in the 10-year period from FY 2026 to FY 2035. It also shows the average annual number of 11U pilots, which varies over scenarios. For those steady-state years, the model did not crossflow any ALFA tour pilots.

The values in Table 4.3 suggest a wide range of possibilities for the size and scope of the future RPA pilot career field. After the initial period of growth, the baseline scenario with low losses requires 108 new pilots per year in steady state. The scenario with higher crew-to-line and combat-to-dwell ratios, which would produce a much larger community, requires an average of 171 new pilots each year.

⁴ Results that increase the crew-to-line and combat-to-dwell ratios are qualitatively similar.

Table 4.3. Steady-State Production Level for Varying Desired End-State Requirement Scenarios with Low and Medium Losses

	Average Annual Production (2026–2035)	
	All RPA Pilots	11U RPA Pilots
Low losses		
Baseline	108	7
55 combat lines	130	8
65 combat lines	150	10
13:1 crew-to-line	134	8
1:1 combat-to-dwell	138	9
13:1 crew-to-line and 1:1 combat-to-dwell	171	8
Medium losses		
Baseline	162	18
55 combat lines	188	21
65 combat lines	220	24
13:1 crew-to-line	191	21
1:1 combat-to-dwell	196	22
13:1 crew-to-line and 1:1 combat-to-dwell	235	26

Higher losses significantly affect the pipeline throughput that is necessary in the long run. Sustaining the baseline scenario with medium losses, which has a greater shortfall compared with the career field health benchmarks than the low-loss scenario, requires nearly as many new pilots annually as the largest low-loss scenario of 13:1 crew-to-line and 1:1 combat-to-dwell (162 versus 171). Additionally, the medium-loss solutions tend to include the maximum number of cross-trainees available, as a hedge against higher 18X losses (since 11U pilot losses are fixed at historical levels and 11U retention is greater due to their pilot ADSC). Therefore, continual heavy 18X losses coupled with growing desired end-state mission requirements will cause the long-run equilibrium to look more like the present-day RPA career field accession patterns—the long-run equilibrium requires higher accessions levels and higher influxes of pilots from other communities and is underrepresented among career development and broadening assignments.

Given that leadership wants to eliminate the use of ALFA tours and large numbers of 11Us and that a lack of developmental assignments is a major source of dissatisfaction within the RPA community, continuing to maintain the status quo for the career field would not be wise. It may be advisable for the Air Force to do what it can to prevent a medium-loss scenario, while at the same time preparing for it as a possible eventuality by fulfilling the high production numbers suggested by the model, especially if growth in lines is expected in the future.

Impact on Numbers of Unassigned RPA Pilots

Although the RPA career field model seeks to minimize the number of RPA pilots that cannot be matched to a desired end-state requirement, there are occasional situations in which the inventory and desired end-state requirements in the optimal solution do not align perfectly, as shown in Chapter 3. For both loss levels, rapid growth during the initial years (while transitioning toward a steady state) produces brief periods where some junior pilots cannot be matched to desired end-state requirements, while the low-loss case results in a surplus of RPA pilots beyond 2030 (generally more senior personnel who remain as a result of relatively good retention).⁵

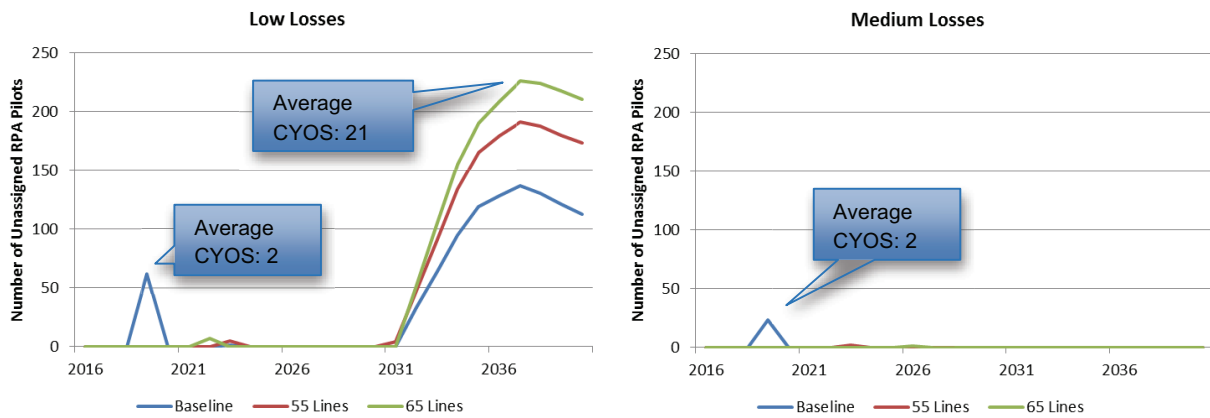
To illustrate how growth in desired end-state requirements affects these patterns, Figure 4.4 shows the number of unassigned pilots each year, again comparing the baseline to the 55-line and 65-combat line scenarios. The left panel shows results under low losses, and the right panel shows the same information for medium losses. In the medium-loss scenario, the model cannot grow the force fast enough to have a surplus of personnel even in the baseline case; as a result, nearly every officer has a job that is matched to his or her experience level. In the low-loss scenario, however, the surplus accumulates after 2031, around the time when the majority of the requirements are filled.

For both the low- and medium-loss cases, the surplus of junior officers that peaks in FY 2019 (where the average CYOS of unassigned personnel in FY 2019 is 2) improves with higher desired end-state line requirements, as the rising number of those requirements creates more space to absorb the new pilots from the production boom of FY 2017 to FY 2018, and it disappears in scenarios involving 55 or 65 active duty lines. By contrast, the surplus of senior pilots that occurs only in the later years of the low-loss case (where, for example, the average CYOS of unassigned personnel in FY 2037 is 21) results from a mismatch between the number of senior positions and the size of the inventory remaining later in their careers. This tendency worsens with increasing desired end-state line requirements.

In practice, some of this surplus manpower could augment the remaining unfilled desired end-state requirements (see Table 4.2 and Figure 4.1). The RPA career field model keeps these pilots unassigned because it has reached the point where putting them toward the remaining desired end-state requirements would violate the assignment patterns that are normal for traditional pilots of comparable seniority.

⁵ As noted in Chapter 3, it is possible that our retention estimates for personnel at the senior CYOS levels may be overly optimistic. If retention is not as high as our estimates, this excess of senior officers would not exist.

Figure 4.4. Annual Number of Unassigned Career RPA Pilots for Different Numbers of Active Duty Combat Lines Under Low and Medium Losses



NOTE: Career RPA pilots include 18X, 11U, and 12U pilots. There were some unassigned ALFA tour pilots in 2018–2019 in both scenarios that are not included in the figure because it is assumed that these pilots would be returned to their home communities if they were not needed.

Impact on Inventory Composition

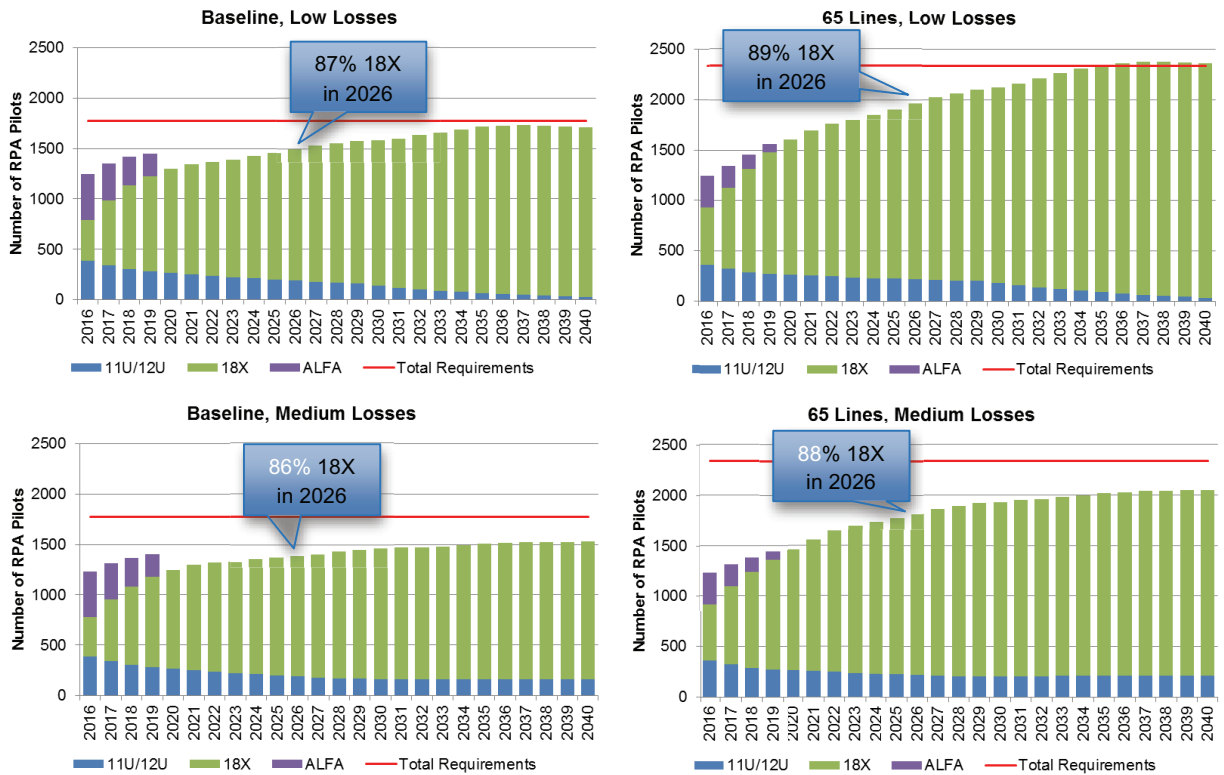
The final question regarding increased desired end-state requirements concerns the composition of the career field over time in view of the proposed 90-percent 18X threshold. In all cases, the fact that 11U crossflow is capped based on normal levels for traditional manned-aircraft pilots, combined with significant growth in the 18X inventory, tends to produce an RPA career field in which 11Us and 12Us are a small minority. The precise point at which the RPA career field crosses the 90-percent threshold depends on how quickly the 18X population grows relative to the 11U population, which is determined by both the production tempo and the loss rates.

Figure 4.5 shows the overall inventory of RPA pilots by pilot type for the baseline scenario compared with the scenario increasing to 65 active duty lines for low and medium losses. In the low-loss scenarios, the RPA career field reaches 90-percent 18X before FY 2030. The medium-loss scenarios, however—which require higher levels of 11U crossflow (see Table 4.3)—never clearly surpass the 90-percent threshold, leveling out at 89 percent through FY 2040.

Conclusion

Growth in desired end-state operational requirements and greater-than-expected manning needs would lead to substantial increases in the long-run size of the RPA pilot community. Still, the basic dynamics of growing the RPA career field, as outlined in Chapter 3, are consistent through other potential futures that involve substantial growth in requirements. If

Figure 4.5. Inventory Over Time by Pilot Type, Baseline vs. 65 Active Duty Combat Lines, Low and Medium Losses



NOTE: The baseline scenario includes 45 active duty lines.

18X retention levels turn out to be slightly better than those of 11U pilots (as in the low-loss case), the community could reach a much larger end state—one that would support a 13:1 crew-to-line ratio and a 1:1 combat-to-dwell ratio—with a steady-state production of fewer than 200 RPA pilots per year. However, 18X retention that is substantially worse than historical 11U retention will require higher production and would not retain enough experienced officers to fill developmental assignments proportionally to the retention of traditional manned-aircraft pilots. Therefore, the results echo the previous finding that Air Force planning should maintain the right level of production, given the desired capacity of the RPA career field, while also ensuring that sufficient numbers of experienced pilots are retained. Without both factors, the RPA career field is unlikely to reach traditional manned-aircraft pilot benchmarks of normal career field health.

5. How the Model Can Be Used to Support RPA Policy Analysis

The model was designed first and foremost to address the following question: *What is the best way to ramp up production of active component MQ-1/9 RPA pilots to bring the career field to a healthy, sustainable state where OPTEMPO, retention, recruitment, job satisfaction, career development, and training become comparable to those of other established, healthy career fields?*

The model results presented in this report begin to address the question by exploring issues impacting growth in the career field over time—production tempo, crossflow policies, possible impacts of retention incentive policies, and assignment patterns and desired end-state requirements. The results presented evaluate not only whether annual inventory numbers look healthy overall (as in traditional RL/BL models) but also whether the personnel in the inventory are a match for the experience profiles of the available jobs. The results also allow policymakers to determine the year in which various types of desired end-state requirements (displayed for each duty category) will be met and what annual production numbers would be required to meet the desired end-state requirement in that year.

The overarching purpose of the model and of the results that are produced from various model runs is to allow policymakers to visualize the impact of these issues on the shape of the future MQ-1/9 career field and, accordingly, make decisions about policies for managing it that are informed by projections of the impact of those policies on the career field's health 10 or 20 years down the road.

We illustrated the use of the model to help inform decisions about how best to manage the career field by exploring the impact of two production tempos (ASAP vs. balanced), two potential retention scenarios, and increases in operational desired end-state requirements caused by changes to combat-to-dwell ratios, crew-to-line ratios, and number of active duty lines. The results showed that all desired end-state requirements (including filling more senior senior-level developmental duty assignments) can be met around FY 2030, regardless of which scenario is used, as long as the Air Force anticipates the circumstances simulated in the scenario and adjusts its production numbers accordingly, but only when assuming a low level of losses. In medium-loss circumstances, some fraction of the developmental assignments will go unfilled. This will necessarily reduce the numbers of experienced RPA pilots who are competitive for senior leadership positions (relative to the proportions that would be expected given the size of the RPA pilot population). This would likely only add to dissatisfaction and

unrest within the community. The Air Force will therefore have to be vigilant in monitoring retention as well as ensuring adequate production.¹

The model showed that production numbers must be much higher now if the Air Force anticipates that the number of active duty lines will increase in the future. Failure to anticipate such an increase well in advance will only perpetuate the issue currently facing the RPA community—namely, that they are in a constant state of surge and feel stretched thin as they try to keep up with demand. The model can help policymakers make informed decisions about the importance of retention incentives, how to ramp-up MQ-1/9 RPA pilot production now and whether to maintain that ramp-up in the future, and how to prevent a mismatch between available personnel and experience levels of the desired end-state requirements.

The model can also address a number of other policy questions about alternatives for managing the force. In the appendices to this report, we explore increasing the crossflow from two traditional manned-aircraft pilot communities (11Us and ALFAs) and adopting assignment patterns from the ABM community rather than those used for traditional manned-aircraft pilots. The crossflow excursions show that increasing the use of 11Us could speed up the timeline to meet desired end-state requirements, and 11Us are more versatile than ALFA tour pilots. With high 18X production, line duties are easy to fill, making ALFA tour pilots unnecessary. Higher 11U crossflow can also fill above-wing desired end-state requirements sooner. Moreover, by increasing the use of 11Us, desired end-state requirements could be met even if 18X retention is difficult to manage. In our interviews, participants wondered whether the goal of achieving a 90-percent 18X career field is obtainable by 2026. That question is addressed by the results presented in Appendix E, which show that, under the baseline scenario, the goal is not obtainable by 2026 but is obtainable by 2029. In the increased-crossflow scenario (where up to 50 11Us are allowed to enter annually), the overall desired end-state requirements are filled faster, but the time to achieve a 90-percent 18X career field is longer (it is not achieved until 2035).

The model reflects the best data and information about the RPA 18X community and the best approximations of the Air Force's priorities for it; however, policymakers may wish to change the information in the model in the future. For example, although many elements in the model were decided based on leadership's current views, those views may change in the future. In addition, as the career field matures, the Air Force will have new, different, and in some cases more accurate information on which to base model inputs. For example, because the oldest members of the RPA 18X population are only now reaching their six-year ADSC, we were unable to observe actual retention behavior for that population. In the absence of that information, we used econometric forecasts (Hardison, Mattock, and Lytell, 2012) to estimate

¹ Failing to control retention is not mitigated by increased production because filling above-wing duties requires more senior officers or a change in the CYOS assignment patterns.

that behavior. However, in a few years, it will be possible to observe the retention behavior of this population, and new information can be substituted for the information currently in the model.

Other changes may be appropriate to better reflect how the enterprise will be managed in the future. For example, ACC has specified how it thinks it will structure the enterprise to accommodate new initiatives (including new basing locations and the addition of combat-to-dwell); however, that information may need to be adjusted once plans are solidified. In addition, each year a certain number of personnel will be produced, and that will lead to changes to the starting inventory. Those numbers will need to be fixed in the model and no longer allowed to vary. Anticipating the need for various types of changes to the model (including those described here), we have ensured that the model can be adjusted and edited so that it will be useful to policymakers not only today, but for years to come.

In closing, the results presented in this report illustrate how useful the RPA career field model can be to policymakers as the career field matures. The ability to vary assumptions in the model to depict alternative policy scenarios can provide valuable information to Air Force leadership as new initiatives are being considered prior to implementation. As changes in desired end-state requirements are anticipated, the model can help estimate levels of production that will be needed in future years to inform planning for future training needs. Understanding the implications of different retention patterns provides insight into the importance of monitoring retention and devising appropriate incentives to develop enough seasoned officers and enlisted personnel to fill leadership positions within and outside of the RPA community. These and other analyses can be conducted using the model to inform Air Force decisionmakers as they strive to develop a healthy RPA career field.

Appendix A. Interview Participants, Themes, and Questions

At early stages of the project, we met with Gen Carlisle, Commander ACC, to explain the goals of the work and to get his insights into the future of the RPA pilot career field. During the discussions, we asked several questions that were on our preliminary protocol. Those questions formed the basis of our subsequent and more-detailed interview protocol (reproduced at the end of this appendix), which we shared with the rest of our interviewees. In the remaining discussions, the participants provided many useful insights on factors that contribute to a healthy career field leading up to 2026 and beyond. Table A.1 lists the senior leaders and stakeholders who participated and their affiliations. Some participants asked experts from within their offices to join in the interviews and contribute their views and insights. In addition, Lt Col Gregory W. Nita, Lynda Conner, and Maj Clint Carlisle from AFPC met with us to offer their insights into the questions of interest.

The interviews were largely unstructured, with questions tailored to the interests and roles of each participant and the amount of time available. However, we did ask many of the same questions across participants, and a sample of those questions is given at the end of this appendix.

Because not all questions were asked of all participants, and each participant brings a different area of expertise to the discussion (and because some interviews included contributions from multiple participants), it would not be appropriate to provide counts of participants who offered one comment versus another. Instead, we sought to provide an accounting of the full range of perspectives held by leadership. We do, however, call attention to topics that were raised by many interviewees and note instances where there was widespread support for an idea. In those cases, we do not provide exact counts of interviewees mentioning a topic, as not all may have been asked a question that would prompt that response. Instead, we characterize the amount of agreement more broadly, using terms such as

Table A.1. Interview Participants

Stakeholders	Affiliation
Deborah Lee James	Secretary of the Air Force
Gen Herbert Carlisle (and staff)	ACC/CC
Lt Gen Marshall B. "Brad" Webb	AFSOC/CC
Lt Gen Darryl L. Roberson	AETC/CC
Lt Gen Maryanne Miller (and staff)	AFRC/CC
Lt Gen John W. Raymond	HAF/A3
Maj Gen Linda R. Urrutia-Varhall (and staff)	Dep A2
Col David Kumashiro and Katrina Jones	A1 DPG
Col Chris Larson (and staff)	ACC 69 RG/CC

a majority of, most, many, some, and few to indicate how often a topic was raised. This allows us to provide a sense of topics that came up often.

We identified about 30 unique types of comments from interview participants that were integral to the discussion about the health of the future 18X career field. We then nested these comments under the three top-level categories shown in Table A.2. Appendix B contains examples of the comments relating to each of these categories. However, the information from the interviews that we directly incorporated into our model design (and that most leaders and stakeholders agreed with) are as follows:

1. The end-state goal for the MQ1/9 RPA pilot community should be a career field structure that is similar to that of the other rated jobs in the following ways:
 - a. No ALFA tours (none exist in other rated communities)
 - b. Levels of crossflow similar to those found in other rated jobs (i.e., numbers of 11U/12Us should be around the same as the numbers of traditional pilots that typically flow into other rated career fields)
 - c. 18X personnel should be well developed professionally
 - i. Similar amounts of developmental opportunities (intermediate and senior developmental education, command opportunities, joint assignments, staff jobs, etc.)
 - ii. In the desired end state, 18X personnel will fill the RPA leadership roles
 - iii. 18Xs should fill command positions that oversee more than just the RPA community
 - iv. We should be developing 18Xs to be competitive for colonel and general-officer positions
 - v. A sizable number of colonel and general-officer-level personnel should come from the MQ1/9 RPA pilot community.
2. The following could help improve the health of the MQ1/9 RPA pilot career field in the future:
 - d. Instituting combat-to-dwell
 - e. Raising the crew-to-line ratio
 - f. Clearly defining developmental opportunities and assignments that can be expected across the lifespan of an 18X and ensuring they are being filled with 18X personnel as soon as possible
 - g. Aiming for a career field end state in which the distribution of assignments across CYOS is similar to that of other rated careers
 - h. Aiming to improve job satisfaction, retention, and quality of life, to the extent possible
 - i. Production should be planned to accommodate an increased number of lines, as demand will likely increase beyond 60 or 65 in the future. The Air Force should continue to produce new 18Xs at a rate that would accommodate more lines and continued surges in demand, once the career field is healthy.

Table A.2. 18X Health and Sustainability Schema

Top-Level Category	Full List of Interview Comment Themes
Quality-of-life factors	Acknowledging the importance of quality of life Addressing retention concerns by addressing sources of dissatisfaction Ensuring predictability of an 18X career in the Air Force Enhancing the prestige and attractiveness of the 18X career field Improving the lifestyle characteristics of 18X pilots Limiting aversion toward the 18X assignment Reducing unhappiness once inside an 18X job Continuation of the RPA get-well plan Managing the crew-to-line ratio and the number of combat air patrols (CAPs); instituting a combat-to-dwell concept Proper determination of ADSC length
Logic and desirability of 90/10% mix	Advantages of using 11U/12U pilots Disadvantages of using 11U/12U pilots Advantages of using ALFA tour pilots Disadvantages of using ALFA tour pilots Preference for no ALFA tour pilots Crossflow Officers coming in from elsewhere Developing homegrown 18X pilots from within
Pilot and 18X career field maturation	Modeling 18X after other traditional pilot career fields Comparing 18X to the ABM career field Identifying the future health needs of the 18X career field Ensuring developmental opportunities for 18X pilots Making 18X pilots competitive for colonel and general-officer positions Grooming 18X pilots for leadership roles Managing accession Distributing duty assignments across the 18X career field
Enlisted personnel as 18X pilots	Use enlisted personnel as 18X pilots

Interview Questions

DEFINING KEY CONCEPTS

1. How would you define:

- a. A healthy career field?
- b. Good quality of life?

THOUGHTS ON A PLAN FOR THE MQ1/9 PILOT COMMUNITY

2. If you could build an MQ1/9 pilot force from scratch today, what would it look like and why?

Consider the following:

- a. What kind of people would make up that force?
- b. How would personnel be distributed across duty assignments and across years of service?

- c. Should there be dwell time to allow for continuation training and a break from the stressors of combat operations?
- d. What would you like 18Xs to be able to do that they cannot do now?
- e. What would you like them to have that they do not have now?

3. What is your vision for 18X pilots in the "Air Force of the future?" Consider the following:

- a. What role do you see for RPA aircraft platforms 10 and 20 years in the future? Growth of the field (beyond 45 active duty combat air patrols (CAP), new airframes, etc.)
- b. Should leadership within the MQ1/9 RPA community be 18Xers? Why?
- c. Should there be 18X leadership in the Air Force?
 - i. Should there be a pool of 18X colonels in Headquarters Air Force and Joint assignments? Why?
 - ii. How about general officers? Why?
- d. What else should we plan for in the vision of the future?

4. Should improving satisfaction in the MQ1/9 RPA pilot community be a top priority?

Consider the following:

- a. Should the Air Force do things to make the job of RPA pilot more attractive to officer candidates and others within the Air Force community?
- b. Should retention of 18X officers be a priority?

ADVANTAGES AND DRAWBACKS OF INCLUDING ALFAs AND 11U/12U PILOTS

5. What do you see as advantages and drawbacks to using each type of pilot (11U/12U, ALFA, and 18X) in the MQ1/9 RPA pilot community? Consider the following:

- a. Are there any unique skills ALFAs could bring to or from their career fields?
- b. Are there disadvantages to not having an entire career field of people who have permanently specialized in RPA (i.e., the 18Xs)?
- c. Are there unique skills that would be lost without an 18X community?
- d. What is the impact (positive or negative) of 11U/12Us and ALFAs on the functioning of the other rated career fields? On the attitudes of the 18Xs?
- e. Are there other Air Force career fields that also mix personnel in a similar way? If so, what are the advantages and drawbacks in those career fields?

Appendix B. Senior Leader and Subject-Matter Expert Perspectives

Appendix A identified the themes obtained from our discussions with senior leaders and SMEs that provide insight into the health and sustainability of the 18X career field. This appendix provides a sample of verbatim quotes and paraphrased comments from these discussions for the categories listed in Table A.2. Consistent with the schema presented there, the insights are grouped into three broad categories: quality of life, logic and desirability of a 90/10-percent mix, and pilot and 18X career field maturation.

Quality-of-Life Variables

Interviewees identified a range of independent variables they thought determined quality of life for RPA pilots: acknowledging the importance of quality of life; the prestige and attractiveness of the 18X career field; the lifestyle characteristics of the career field; limiting aversion toward the RPA assignment; reducing unhappiness once inside the 18X job; maintaining the RPA get-well plan; reducing and managing the crew-to-line ratio; and managing the combat-to-dwell ratio and proper determination of ADSC length.

Acknowledging the Importance of Quality of Life

- Ruminating about breadth and depth of quality of life, a senior leader remarked, “A good quality of life involves many, many different things from [managing] deploy-to-dwell to the time steps between training opportunities. It also includes the ability to cope with much more demanding operational needs.”
- Another spoke positively about the CPIP: “Much of this has to do with the CPIP work Gen Carlisle is leading out at ACC, which really gets at do we have the right number of child development centers at the right place? And even, how do we present RPA forces in the future and include new wings, new groups and new squadrons so life doesn’t only consist of (1) going to Creech [Air Force Base], (2) spending your whole life at Creech and (3) retiring while there?”

Addressing Retention Concerns by Addressing Sources of Dissatisfaction

- Interview respondents discussed pilot attrition while speculating about a range of catalysts and how the Air Force might mitigate losses in the future. We learned, for example, that staving off attrition and building a healthy career field might require (1) a reconsideration of basing options for RPA pilots, (2) a revision of crew-to-line and combat-to-dwell ratios, and (3) limiting, if not fully eliminating, the number of ALFA tour pilots crossflowing into the career field in order to build confidence and pride among homegrown 18X pilots. This last insight is particularly poignant, as a majority

of interviewees described an ideal 2026 end state as consisting of a 100 percent, rather than 90 percent, 18X pilots.

Ensuring Predictability of an 18X Career in the Air Force

- “Quality of life comes down to predictability and opportunity. By predictability we mean more than having a defined battle rhythm, it’s also about having a variety of PCS [permanent change of station] locations and a career path that looks like the rest of the Air Force.”
- Discussed in earnest and related to the issue of equities was the need to ensure developmental opportunities for 18X pilots and a transparent path to leadership. The majority of respondents felt that this was integral to the proper maturation of the career field and to maintaining a high quality of life.

Enhancing the Prestige and Attractiveness of the 18X Career Field

- The majority of participants agreed that something akin to a “makeover” was needed to enhance the prestige and attractiveness of the budding 18X career field. This was described as directly related to retention.
- It was suggested that AETC can enhance the attractiveness of the career field by ensuring that instructors have an RPA background. “Many of our instructors are civilians with prior flying experience but not with specific RPA experience. But as the RPA community matures, we should be able to bring in more instructors who have been there and done that. Students being taught by pilots with experience should help increase satisfaction.”
- Another interviewee opined that RPA pilots need to see growth opportunities outside of just flying the line.

Improving the Lifestyle Characteristics of 18X Pilots

- Some participants mentioned that when entering the RPA community, pilots were both welcomed and warned that they would not be leaving. Pilots were unable to pursue leadership opportunities, take command, or pursue other assignments. “That’s a big downgrade for the community—you feel like you’re stuck there [at Creech].”

Limiting Aversion Toward the RPA Assignment

- “There will always be a ‘black mark’ on the RPA career field and a negative perception associated with it if there aren’t career opportunities equivalent to every other platform in the Air Force—through staff, school, and the general ranks.”
- “The majority of folks who get tagged to do the [RPA] mission aren’t happy about it.”

Reducing Unhappiness Once Inside the 18X Job

- “I saw similar instances of a self-loathing mob mentality in the ICBM and space communities. Airmen would say ‘life isn’t good, life isn’t good’ and we would watch that sentiment take on a life of its own. Right now there is a fair degree of skepticism

within the 18X crew force that the Air Force understands their concerns enough to implement change.”

- “If you fill the RPA requirements gaps with [certain manned-aircraft pilots] and give them all the benefits, you’ll have a minority of 18X folks who won’t care and want to separate at the nearest opportunity because they’re left running 24/7 ops 365 days a year.”
- Another senior leader said RPA pilots understand how they connect to the mission and the role they play. He then opined, “What offsets this a perceived inequity of how we think we’re being used in comparison to the manned community. That gets us out of whack.”

Continuation of the RPA Get-Well Plan

- The get-well plan was described as having the potential to do much more than originally planned. “The plan gets us to 10:1 crew-to-line and 100-percent schoolhouse manned. That might be sustainable and better than where we are today, but it doesn’t set us up to meet future CAP demand in this mission area.”
- One interviewee similarly said, “Our RPA get-well plan has provided a little more job satisfaction and stress relief because they’re not working the same schedules they used to and we can send more people to school. If you look at the numbers, the squadron commanders who are being picked nowadays have previous RPA experience. The metrics on those type of things have increased over the past couple of years as the career field has grown and matured.”

Managing the Crew-to-Line Ratio and the Number of CAPs

- A majority of SMEs and senior leaders speculated that the number of CAPs will likely increase in the future, with one stating, “The appetite for this will be insatiable. The Air Force will have to balance its mission set. We can’t be the ISR [intelligence, surveillance, and reconnaissance] force—but we very well could be.”
- Another remarked, “The manning ratios are such right now that we’re not able to professionalize RPA pilots because of how much they’re flying the line. There are no normalized opportunities to do staff, PME, and the officer professional development that is found across other weapons systems.”
- Some participants acknowledged that CAP requirements, which are ultimately determined by combatant commanders, are manageable today only because of the RPA get-well plan. Further, as fanfare around the plan stabilizes and the career field begins to normalize, we may see both a spike in CAPs and a reduction in the ratio.
- Added to that are CAPs and capabilities. “You’re first instructed of the CAP requirement and then told you’ll get the manning further out. It seems the manning must always catch up with the CAP, instead of the other way around.”

Instituting a Combat-to-Dwell Concept

- “The RPA community has a high level of expectation but does not truly train to meet those expectations due to the constant requirement of combat support.”

- Some participants mentioned the necessity of instituting a combat-to-dwell policy, with continuation training being a core element.
- Regarding combat-to-dwell, a participant mentioned that pilots could be “deployed for a chunk of time, training up for a chunk of time and doing professional development for a chunk of time, and then you can cycle.” They stipulated that if the RPA community had the manning to employ such a model, it would pave the way to career field health.
- “You need a good balance between deployments and home station basing, and a good shift cycle balance. In other words, giving not only the member a break at home of one to three months but also giving the unit a break.”
- There needs to be [down]time for CT [continuation training] in order to get a break from stressors. “Sharpening of the sword,” which is what we call it at the unit level. CT also includes more. The unit that would stand down would also conduct home station ops by getting involved with CT and the LR squadron. They would also participate in exercises such as Red Flag, etc.

Proper Determination of ADSC Length

- Some thought an elongated 18X ADSC would be counterproductive. “The longer you make it [ADSC], the more negative it is. The Air Force is going from an 8- to a 10-year ADSC for pilots, which is negative in the long run. The URT 18X pipeline is significantly cheaper than the UPT pipeline. Making the URT commitment equivalent to the UPT commitment means asking for a much bigger payment of the initial investment, which would negatively impact recruiting.”
- One participant echoed a similar view, claiming that few pilots would be enthusiastic about spending years in UPT, a year training on the RPA, and then incurring a longer than usual ADSC (i.e., more than six years). “They won’t want to endure a longer training path for a longer or equivalent ADSC.”

Logic and Desirability of 90/10-Percent Mix

Senior leaders and SMEs discussed the pros and cons of mixing 11Us/12Us, ALFA tours, and 18X pilots in the RPA career field. The following themes were visited: advantages of 11U/12U pilots; disadvantages of 11U/12U pilots; advantages of ALFA tour pilots; disadvantages of ALFA tour pilots; preference for no ALFA tours; crossflow; officers coming in from elsewhere; and developing homegrown 18X pilots from within.

Advantages of 11U/12U Pilots

- “Having a mix of experience is good for the career field, especially in the initial growth stages. As [the RPA] career field matures, this may be less so. The ALFA tours [comparatively] are less valuable because they come into the community for a short period of time and then jump back out. The 11U/12U pilots come, join and ‘re-cat.’ They buy into the mission and help the community grow into a more mature system.”

- “11Us and 12Us have a lot to offer. We should keep it open if people want to cross over into the career field. The community benefits from these types of people if it is on a voluntary basis. The negative connotation occurs when people are forced to do it.”
- “You always want that ‘one-off,’ that new view to come into the picture,” according to a senior leader.
- Another interviewee said, “There’s probably going to be a mix for a period of time.”

Disadvantages of 11U/12U Pilots

- Some thought it was a bad idea to place 11U/12U pilots in RPA leadership positions, citing the possibility of a demoralizing effect on junior 18X pilots. “I think we have enough of an 18X base now where the leadership needs to come from that 18X community.”
- “Having these pilots interferes with the vision laid out by the chief of having a separate 18X career field. An RPA 18X came up to me and said, ‘Sir, I look around at all my commanders and they’re all manned-aircraft pilots, so what is in it for me?’”
- Some questioned who could best represent the career field in the future. “Most guys coming in from manned will want to go back to their assets. They do bring some valuable aviation experience with them, especially with how new the 18X is right now, but you can’t count on them to be your advocates and planners due to their temporary status. They can’t take the RPA enterprise into the future and won’t spearhead that charge.”

Advantages of ALFA Tour Pilots

- An active duty senior leader said bringing ALFA tours into any RPA platform would be advantageous, even if only for a short period of time, because of the diversity of experience they create.
- It was also explained that many times “ALFA tour injects” come to the RPA community and want to stay, in which case they become 11U/12Us. “Some come over and want to stay because they think it’s a better mission. Whatever the reason, it is usually good for the community, because you have someone who is invested and wants to be here.”
- One participant asked us to mentally revisit how the RPA career field began in the first place and remember that it didn’t start as a normal weapon system going through the acquisition cycle. The process was immediate and expedited. “Because we didn’t get it right at the onset, we need to learn how to make the best with what we have—even if that means mixing 11Us, 12Us, and ALFA tours.”
- Another remarked, “It would be helpful to have a smattering of capabilities. I don’t know what that amount is, but because operations are continually evolving and getting more complex, we should have pilots who have been there and done that in a fixed-wing or manned aircraft. That has proven to be helpful. As the thing matures, there’s probably going to be less of a need. Our current goal is 90/10. That might get reduced as we add missions and mature.”

Disadvantages of ALFA Tour Pilots

- However, the majority of interviewees thought the RPA career field was better served with fewer ALFA tour pilots. A primary reason was the conviction that mixing ALFA tours and 18X pilots would disproportionately benefit the former based on their repertoire of experience.
- “If you have an 18Xer and an ALFA sitting next to each other and look at their records, usually the ALFA will have experience in there that looks better. The squadron leadership at the unit level will undoubtedly push that pilot to do more and progress, limiting opportunities for the 18Xer.”

Preference for No ALFA Tours

- Interviewees said that time and career field health notwithstanding, they would prefer to not have ALFA tour pilots in the 18X career field. “Much of this is a product of RPA being a young, new career field. Eventually the ALFAs will go away. There will be a need for some cross-pollination because of the benefits that accrue, but eventually the ALFAs will go back to their primary AFSC.”
- Most participants stressed the current transitory nature of the 18X career field when speculating about the future utility of ALFAs. “All we’re trying to do right now is answer the demand signal, which ALFAs have allowed us to do. But eventually, the need will be stronger for those folks to return to manned cockpits. So the ALFA is going to go away over time.”
- “Our goal is not to have ALFA tours because they get very fuzzy after a while. This happens when people stay in the community too long. They become irrelevant to their home community. It gets harder and harder to get them spun back up after a few RPA tours.”
- “If you want to have a healthy and sustainable community, I don’t think you should keep having ‘injects’ come into it.”

Crossflow

- Most interviewees supported crossflow but were concerned about the availability of “protected positions” in the career field for junior 18X pilots.
- Many also thought that crossflow was advantageous as long as it was voluntary and not compulsory.
- When asked about crossflow rates and practices compared with other career fields, a number of interviewees remarked that the 11U/12U crossflow should be normalized to resemble what exists in traditional manned-aircraft platforms.
- “We get hung up on the wrong things. Years ago, we would mistakenly focus on you being either a bomber or mobility pilot. Fighters would never come to mobility, and mobility would never come to fighters. Now, thankfully, we care less about these things. What matters is that we have crossflow. The numbers don’t have to be high, but I think you need to have it. It’s a seasoning tool for a pilot to come in and be with the 18Xers.”

- Few disagreed with the above sentiment; however, many identified a double standard characterized by low support for 18Xers crossflowing out of the RPA community, with some citing a total absence of opportunities.
- This was often labeled a professional-development challenge for 18Xers. “18X pilots have to stay in the RPA forever unless, by chance, there is another community where we would need them, which isn’t the case.” Another respondent remarked, “I think they should crossflow. I think it’s important and expands their focus—makes them less narrow. The challenge is making sure they can use their operational skills in other areas.”

Officers Coming In from Elsewhere

- “We have to grow general officers from the internal pool of 18X pilots. Today what we have are a couple who were fighter pilots but then got certified to operate RPAs when they got to the very senior levels, but it’s not homegrown development from within.”
- Another perspective recognizes the relative youth of the 18X career field and sees value in outside officers coming in: “Right now the oldest pure 18X pilot is a major, and no one comes close to filling those senior roles in the career field. Bringing officers in is the right way to do it. Some have come over as 11Us and stayed in the RPA field for a long time. Maybe they became O-6s and perhaps even general officers and remain in that role. If the end state becomes total 18X, then we’ll transition to becoming more homogenous.”

Developing Homegrown 18X Pilots from Within

- “I don’t know that the RPA needs to differ from other careers, but the only way to create stability is to develop young 18X pilots from scratch, grow them, and provide that experience.”

Features of a Healthy 18X Career Field Long-Term End State

A range of factors were described as contributing to career field maturation, all of which were discussed under the broader rubric of health and sustainability: modeling 18X after other traditional pilot career fields; comparing 18X to the ABM career field; identifying the future health needs of the career field; ensuring developmental opportunities; making 18Xers competitive for colonel and general-officer positions; grooming 18X pilots for leadership roles; managing accession; distributing duty assignments across the career field; understanding how and why RQ-4 utilizes enlisted personnel and thinking about enlisted personnel as 18X pilots.

Modeling 18X After Other Traditional Pilot Career Fields

- Most leaders and stakeholders argued that a healthy 18X force is contingent upon equitable opportunities for 18X pilots to do the same things as traditional pilots. Some argued that this was critical because traditional pilots are selected for leadership positions because they are groomed for it, and 18X personnel should be groomed in the same way. Others suggested that traditional pilot development was fundamentally

flawed, but because it is essentially treated as the gold standard for development in the Air Force, 18X should follow the same path. And still a few others said that modeling after the traditional pilots would be fine but should not be the only field to model against. Space, ABM, or any other mature career field could be a useful model. The key, instead, was that a healthy developmental path needed to be laid out, communicated to the force, and followed over time, which the participants agreed was lacking in the RPA community.

- It is not uncommon for the AFSOC and ACC communities to make comparisons to one another. It was explained that ACC is the lead command for RPAs, yet AFSOC and ACC try to stay in alignment with manning and quality-of-life issues. For example, a best-case scenario would see combat-to-dwell ratios applied in both ACC and AFSOC.
- Several participants commented that RPA personnel should have the same career opportunities as those in other weapon systems, such as squadron command, group command, and wing command. One participant commented that in AFSOC they “have blended everything—blended groups and blended wings.” RPA pilots should be qualified to lead in that blended environment.
- A more generalized view about modeling was, “The RPA community should normalize itself to resemble other pilot career fields.”
- Many suggested looking at the traditional manned-aircraft pilot community: “When building a model for the RPA community, you have to understand the value in leveraging the manned pilot model. Every model has certain characteristics and criteria in addition to timeline. You have to make sure the model is compatible.”

Comparing 18X with the Air Battle Manager Career Field

- When inquiring whether the ABM community was an appropriate model on which to base the RPA community in terms of health, requirements, and professional development, participants suggested looking at the traditional manned-aircraft pilot community instead, due to the proportion of staff assignments those pilots have compared with line flyers. ABM, in contrast to the RPA community, has fewer problems with attrition and therefore more flexibility assigning staff and distributing people across their CYOS.

Identifying the Future Health Needs of the 18X Career Field

- “We’re doing better with career field health, but it’s the future I worry about. What is healthy today won’t be healthy in the future. We need to make significant changes across this mission area so we can surge in the future to meet demand. We’re far from being able to scale things up.”
- Related to the issue of retention, one participant spoke about the need to incentivize the career field in the future in order to promote health. “The raw materials for career field development are there. But if these guys become more professionalized in the future and still feel like they’re a ‘one off’ or anomaly, or like they only exist in far-flung bases on a wasteland frontier, health will erode and guys will walk.”

- On participant commented that AETC plans to move the FTU training that ACC currently runs at places like Holloman Air Force Base to Randolph Air Force Base, which might help with health and stability. “The training environment is different than the operational one, and this will add stability.”
- Some mentioned the necessity of an AETC instructor assignment.

Ensuring Developmental Opportunities for 18X Pilots

- “A viable career path is necessary. When you start feeling like you can’t grow up to be senior leaders, that’s when we run into problems. RPA pilots need to be able to visualize their development path ahead.”
- “When you talk about the health of the career field, you have to be able to take someone who is a second lieutenant and have the ability to grow them to be a four-star. And you can take an airman and grow them up to be a chief.”
- “The opportunities for in-residence PME are getting better every year, and part of that has to do with natural maturing of RPA pilots who were there from the beginning and are just now majors.”
- AETC wants to “get to a new level of providing educational and development opportunities for airmen at the individual level. They want 18X pilots to view AETC assignments as doubly beneficial—both enhancing their career development and improving quality of life by freeing up their time—meaning that they would be provided opportunities that extend beyond what they would experience with their operational squadron.
- Air University plans to institute “chunked learning” or “just-in-time learning.” Through distance learning or interactions with experts, they can isolate a piece of learning that is tailored to what they need at the time.

Making 18X Pilots Competitive for Colonel and General-Officer Positions

- A senior leader expounded on the best way forward for RPA pilots who are reared as 18Xers from the ground up. “We need to build a core, season that core and make them good, conduct force development and then circle back to the leadership piece. We then need to move to create the 0-6s, 0-7s, and 0-8s—that path to the top that will allow them to lead the 2025 Air Force. The pilot model shows the way forward with this, but many other developmental pyramids demonstrate the same path.”
- A different perspective looks at the critical mass of 18Xers that may exist in the future, suggesting that despite inherent biases in the Air Force that may favor platforms such as the F-35, an overwhelming mass of junior RPA pilots may equate to larger numbers at the colonel and general-officer level. “If you only have 10 F-35 folks and you have 50 18Xers, chances are, despite biases that may allow these F-35 pilots to advance, just by sheer number you won’t be able to cover all the bases with that group of F-35s. So there will be a lot of opportunities for the pure 18Xers.”
- Another interviewee stated, “Clearly defining the career path and establishing health will have to include command opportunities.” Some noted that those command opportunities should exist not only within the 18X enterprise, but also just like fighter pilots, 18X pilots should be considered competitive and qualified for command positions elsewhere in the Air Force.

- “The problem is creating a pipeline that starts at the schoolhouse at the very beginning and letting those [RPA] pilots grow to be general officers. The secretary and chief have made that a priority. The problem is, at the general-officer level, we’re looking for people that have the experience but also have a broad understanding of our Air Force and have the strategic credibility to move to that next level.”
- Also espousing the merits of linearization, a senior leader stated, “The priority is school and then command and then a staff job. As we build our general officers, we must ask how they are able to grow up, focus on their missions with CGOs [company grade officers], and then learn how to be the RPA advocate at the general-officer level. We have to wait and see because our 18Xers are very young now.”

Grooming 18X Pilots for Leadership Roles

- “At the leadership level, the goal is to lead airmen or air commandos. This is not to downplay the role of wing-wearing airmen, but we’re evolving into a different Air Force, and discussions about command autonomy are really discussions about leadership, and that matters more than the type of wings you wear on your chest.”
- “If we’re trying to get to the 90-percent 18X solution, then it’s important that those pilots be able to form their own identity and take ownership of the community. In the past, ALFAs would come in, and people would naturally defer to them and allow them to lead the community. The 18Xers must lead themselves in the future.”
- A senior leader who observed young 18X lieutenants remarked, “At the end of the day, it’s about the type of leaders we bring into the service. You have to be a good operator but also a good high-level leader. We can’t have someone who crashes a bunch of planes, can’t study their technical orders, and still expects to make general officer. But based on the leadership potential I’ve seen at the lieutenant level, we absolutely have some general officers in the ranks. We may even have some that are in the running for chief of staff in the future.”
- Speaking about leadership and professional growth, another interviewee said, “The only way to get [RPA] stabilized—where we are dealing with a full adult—is by developing and growing the folks that have RPA experience. Like other career fields, we need people from lieutenants to colonels for appropriate growth and leadership. But we’re not only looking for RPA operators as we develop folks but also looking to build leaders that can manage that community while providing important inputs to senior leadership on that community.”

Managing Accessions

- “Right now, with accessions, we’re doing a good job filling what we need in order to go forward. Earlier with RPAs, we started at 8 CAPs, now we’re at 50 CAPs and we will go beyond 65 CAPs.”
- Another example that spoke to the good-news story about accession was, “In FY15 we had 198 airmen from accessions and for FY18 and FY19 we will be pushing 400 students through the pipe, so that is a big difference compared to what we used to do.”
- It was explained that active duty accession issues unequivocally affect the reserve component. The relationship was described as very close. “[The reserve component]

gets limited training slots because they rely on a ‘full-up round of RPAs’ coming off of active duty as their primary accession. Sixty-two percent of RC accessions come from ‘Regular Air Force,’ so the active duty health of the career field automatically impacts the health of the reserves. When active duty is broken in terms of manning, the RC has to respond to meet their needs by going beyond the structure they typically use. This means growing RPAs from the beginning—higher costs, higher training pipeline.”

Distributing Duty Assignments Across 18X Career Field

- Participants noted that having a model or a framework for ensuring that 18X personnel are appropriately distributed across experience levels and appropriately matched to the experience requirements in various duties and in developmental assignments would be a positive step toward improving career field planning in the community.

Enlisted Personnel as 18X Pilots

- One interviewee remarked, “The enlisted pilot initiative is going on in the RQ-4, and there is discussion about its transferability to the MQ-9. This will probably lead to the biggest impact on force health and retention inside our forces.”
- We asked about the viability of “loaning” MQ-9 officers—reminiscent of an ALFA tour assignment—to the RQ-4 community rather than building an RQ-4 officer force. This appeared to have mixed support. Despite the limited number of officers in the RQ-4 force and the need for more, borrowing from MQ-9 as a “quick fix” solution might be counterproductive to the latter community, which is focused on getting well and reducing stressors.
- When ruminating about the RQ-4 community, one participant stated, “My goal is to get the vast majority of people doing RPA work to be 18Xs. But I’ll also throw into the mix the issue about enlisted pilots, which RQ-4 and Global Hawk are using. I think in the future the Air Force will have to make a decision on whether or not to go broader. If I were a betting man, I would say there is a strong possibility that enlisted pilots will be expanded into the MQ-1/9 business as well.”
- Another perspective questioned how a mixed enlisted/officer force might have difficulty advocating for the growth and sustainability of the career field: “If we talk about mirroring communities after one another, we should ask why we are considering this for RPAs and not for the manned community. If a large portion of your RPA force ends up being enlisted pilots, what does that mean for senior leadership and staff opportunities? Who will be on the joint staff advocating for the RPA community, which, generally speaking, is beyond the purview of enlisted airmen?”

Appendix C. Complete Details on the Model Inputs and Assumptions

Desired End-State Requirements—Wing and Below

To develop the desired end-state requirements at the wing level and below, we began by establishing a baseline of authorized MQ-1/9 active duty positions based on FY 2016 data from the MPES and RPA manning-related products from HAF/A3TC. We then updated or added selected elements to reflect our current best understanding of the desired future end state for the Regular Air Force MQ-9 force. These changes were based on inputs from SMEs at ACC/A3MU, 432 WG, and AFSOC/A3V. For units unaffected by these changes (e.g., the 9 and 29 ATKs at Holloman), we used the baseline authorizations pulled from the FY 2016 MPES data.

The desired end-state requirements are driven in large part by a multifaceted ACC plan to improve the quality of life for 18X personnel and provide them the time and space to sharpen their skills through continuation training. Key elements of ACC's plan include the following:

- Establishing a new ACC MQ-9 wing at a new base; the wing is to be composed of two OGs with three MCE squadrons per OG. One of the new RPA wing's groups would be located at another new base.
- Implementing a 1:0.5 combat-to-dwell ratio for MCE crews by either rotating squadrons within an OG or rotating line MCE crews internally within squadrons.
- Creating two ACC squadrons dedicated to performing the LR mission. Together, the two squadrons would be capable of operating LREs at seven different locations on a steady-state basis at a 1:2 deploy-to-dwell ratio.
- Expanding MQ-9 IQT capacity by creating two new active associate FTU squadrons at ANG FTU locations at March Air Reserve Base and Hancock Field Air National Guard Base.

Underlying Assumptions

Based on our discussions with SMEs, we applied the following assumptions in developing the desired end-state requirements for the active duty MQ-9 force:

- Active duty ACC and AFSOC MCE squadrons would be responsible for operating 44 of a total of 60 combat lines, although collectively, the force would be capable of flying 45 combat lines on a steady-state basis.
- A new MQ-9 wing will be established by ACC at a new base. The new wing will be composed of two OGs. Each group will include three MCE squadrons. One of the OGs will be located at a second new base.
- ACC implements a 1:0.5 combat-to-dwell ratio for its MCE squadrons. The new wing and its OGs will accomplish this by rotating whole squadrons within each OG. Another

OG will implement the 1:0.5 combat-to-dwell ratio by rotating personnel internally within each squadron.

- ACC creates two dedicated LR squadrons, mirroring the establishment of the 12th Special Operations Squadron (12 SOS) in AFSOC in FY 2015. The two ACC LR squadrons will be sized to enable sustained operation of seven LRE locations at a 1:2 deploy-to-dwell ratio.
- The crew-to-line ratio for MCE operations remains 10:1,¹ and the ratio for LRE operations is 4:1.
- AFSOC follows ACC's lead and implements a 1:0.5 combat-to-dwell ratio by rotating personnel internally within the 3 and 33 SOS. It also expands the 12 SOS to allow for a 1:2 deploy-to-dwell ratio for its LRE crews.
- 15 percent of line-flyer positions in operations squadrons are instructor positions, and 10 percent are examiner positions.
- Only one wing operations center (WOC) is required and moves to the new wing.
- Active associate FTU squadrons are established at ANG FTUs at March Air Reserve Base and Hancock Field Air National Guard Base.
- 11 Reconnaissance Squadron (RS) (LRE FTU) manning decreases to 20 line instructors as a result of efficiencies gained through the creation of dedicated LR squadrons.
- All other MQ-1/9 authorizations remain at FY 2016 levels as captured by MPES.
- The transition to an all-MQ-9 force is complete.

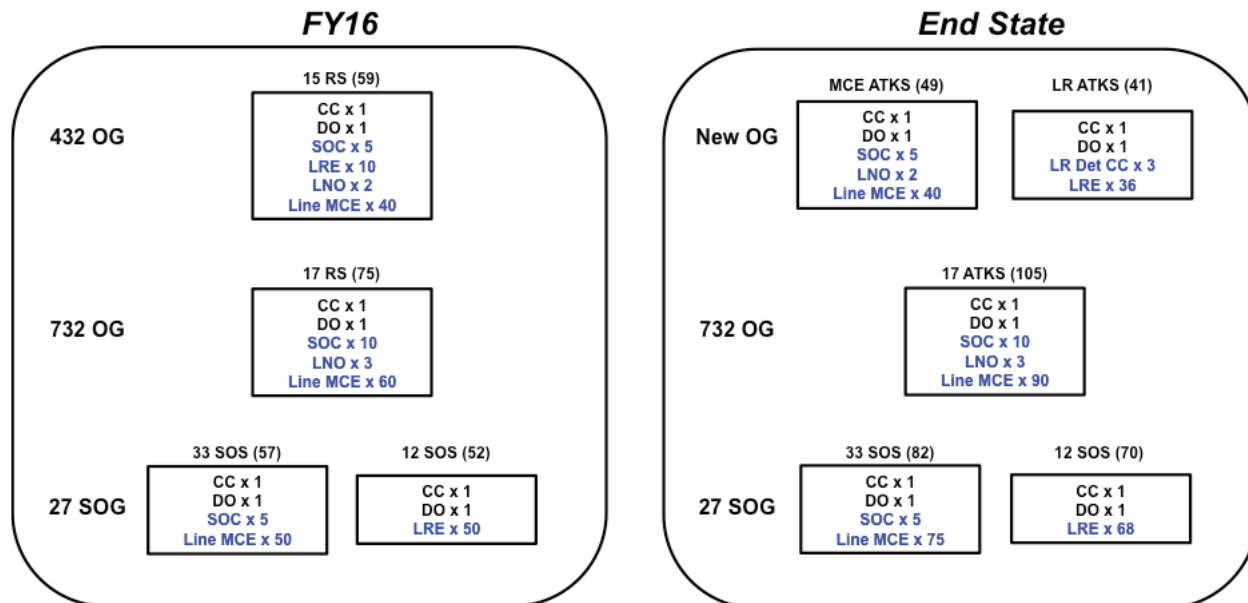
The Desired End-State Structure of RPA Operations Squadrons

The desired end-state goals of implementing a 1:0.5 combat-to-dwell for MCE crews and creating dedicated LR squadrons in ACC require significant changes to the structure of RPA operations squadrons. Moreover, the concept of implementing combat-to-dwell by rotating entire squadrons will help tame the diversity in RPA squadron structures, since those units should be identical. In this section, we focus on how the changes envisioned by the desired end state affect the structure of RPA operations squadrons in both ACC and AFSOC, since these units form the building blocks of a significant portion of the overall desired end-state requirements for 18X personnel.

Figure C.1 compares exemplary MQ-1/9 operations squadron structures from the start of FY 2016 with squadron structures in the end state. At the start of FY 2016, there were two basic types of squadrons in ACC. The 15 RS is representative of one type of squadron that can be found in the 432 OG (432 WG), as well as the 28 OG (28 Bomb Wing). This type conducts MCE and LRE operations, and has authorized positions for both. With 40 authorized line

¹ We assume the 10:1 crew-to-line ratio provides a sufficient number of crews to allow for days off, temporary duty, PME, mission qualification training (MQT), and continuation training, while also covering for personnel who are unqualified or are DNIF (duty not involving flying). It does not cover requirements for squadron leadership (Commander [CC] and DO) or other squadron overhead such as LNO or SOC duty, since operations squadrons are provided separate authorizations for those positions.

Figure C.1. Exemplary MQ-1/9 Operations Squadrons



NOTE: All positions in blue are Air Position Indicator-1 (API-1) (line flyers).

MCE positions, the 15 RS is sized to fly four combat lines on a steady-state basis at a 10:1 crew-to-line ratio.² The 17 RS is representative of another type of squadron that can be found in the 732 OG (432 WG). This type conducts only MCE operations and, in the case of this particular unit, is sized to fly six combat lines on a steady-state basis. The squadrons in the 732 OG also receive a larger number of authorized positions for unit overhead roles such as LNO or SOC duty.

AFSOC established the 12 SOS as a dedicated LR squadron in FY 2015 and thus already had separate types of squadrons for MCE and LRE operations at the start of FY 2016. The 33 SOS is sized to fly five combat lines on a steady-state basis at a 10:1 crew-to-line ratio but does not have any authorized positions for LNOs.³ The 12 SOS is designed to support five LRE locations but at a deploy-to-dwell ratio of 1:1.5 (or less, depending on scheduling and transit times).

The desired end state envisions moving the operations squadrons of the 432 OG (and 28 OG) to one of the new OGs under the new wing. Based on inputs from ACC/A3MU, we assume that these squadrons will focus on MCE operations, and therefore we shed the authorized positions for LRE manning. The squadrons will be sized to fly four combat lines each. Thus, at any given time, with a 1:0.5 combat-to-dwell ratio, each OG of the new wing

² The number of combat lines that squadrons in the 432 OG are sized to fly can range from 3.5 to 5.

³ 3 SOS is structured identically.

will be able to fly eight combat lines on a steady-state basis. The two new ACC LR squadrons will be sized to support four and three LRE sites with a crew ratio of 4:1 at a 1:2 deploy-to-dwell ratio, respectively (the smaller of the two LR squadrons is shown in Figure C.1). They will also include a few additional positions for more senior officers to serve as commanders of deployed LR detachments, if required.

The RPA squadrons in the 732 OG will implement the 1:0.5 combat-to-dwell ratio by rotating personnel within each squadron. To accomplish this, the units will need to be expanded to populate both combat lines and “dwell lines.” Thus, to be capable of flying six lines on a steady-state basis, the 17 ATKs⁴ will need enough line MCE pilots to fill six combat lines and three dwell lines. At a 10:1 crew-to-line ratio, that results in a requirement for 90 line MCE pilots.

The same logic applies to AFSOC MCE squadrons like the 33 SOS, which will need 75 line MCE pilots to fill 5 combat lines and 2.5 dwell lines. Manning for the 12 SOS would need to be expanded as well to allow for a 1:2 deploy-to-dwell ratio for its LRE crews (this is in addition to an increase for expeditionary LRE requirements approved during FY 2016).

New/Updated Requirements in the Desired End State

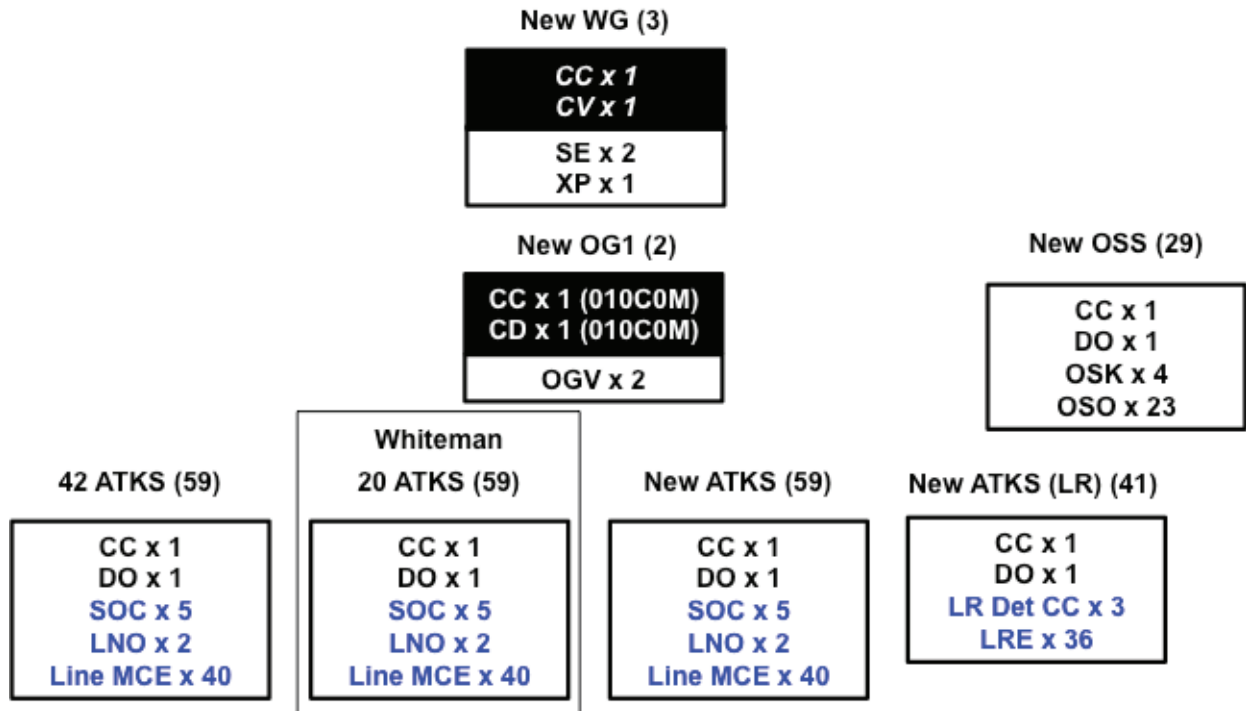
This section describes the requirements for portions of the active duty MQ-9 force structure that were created or modified in view of the desired end-state goals. The requirements encompass the new ACC wing and its subordinate OGs, the 432 WG, AFSOC’s RPA squadrons from the 27 Special Operations Wing (SOW), and the new active associate FTU squadrons.

The New Wing

The structure of the new wing and its subordinate OGs in Figures C.2 and C.3 represent our best understanding of the desired end-state requirements based on inputs from SMEs at ACC/A3MU. As described previously, each MCE squadron in the new wing is sized to fly four combat lines on a steady-state basis. The 1:0.5 combat-to-dwell ratio will be accomplished by rotating squadrons. At any given time, two will be in combat while one will be in dwell. Thus, the new OGs will be capable of flying eight combat lines each on a steady-state basis. This translates into 16 combat lines for the new wing overall. One of the new LR squadrons will also be attached to the new OG at Base X. This unit is capable of operating three LREs simultaneously on a sustained basis at a 1:2 deploy-to-dwell ratio. Overall, the new wing requires 321 line flyers to fill its ranks, which translates into a need for 54 line instructors and 34 line examiners.

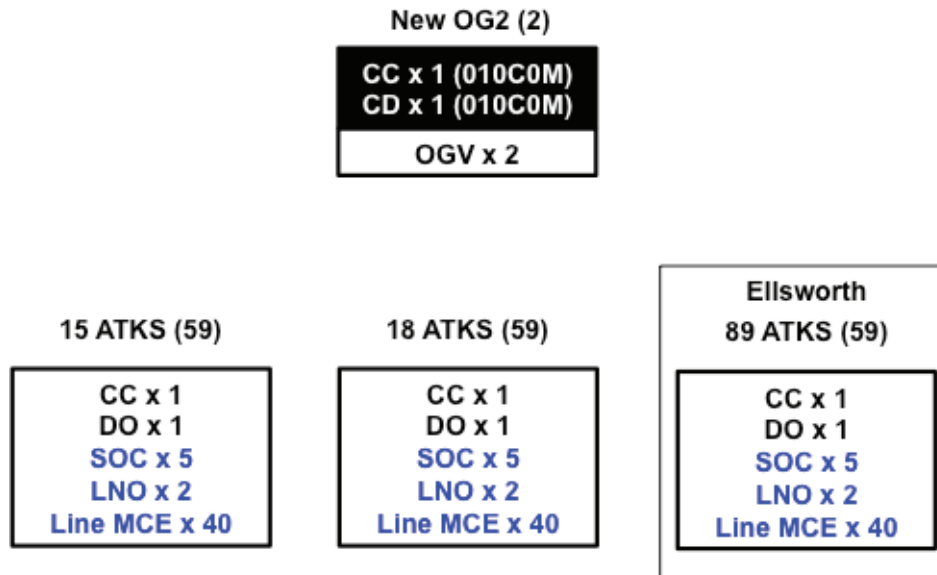
⁴ As RPA squadrons transition from MQ-1s to MQ-9s, they are redesignated ATKs instead of RS.

Figure C.2. Desired End-State MQ-9 Positions at New Wing and OG at Base X



NOTE: All positions in blue are API-1 (line flyers). Black fill highlights non-18X positions.

Figure C.3. Desired End-State MQ-9 Positions at New OG at Base Y



NOTE: All positions in blue are API-1 (line flyers). Black fill highlights non-18X positions.

The WOC and its 13 mission directors are assumed to join the new wing, which results in the sizable OSS contingent. The OSS positions are modeled on the FY 2016 authorized positions for the 432 OSS coded specifically for MQ-1/9 pilots (18AxA and 18AxB). The wing- and group-level staff positions are similarly modeled on the 432 WG. The wing-level staff positions include two positions for safety (SE) and one position for plans (XP). Group-level staff positions include two positions for standardization/evaluation. We also assumed one executive assistant position per OG and one at the wing level. Table C.1 provides a complete breakdown of the desired end-state requirements for 18X personnel by duty in the new wing.

Future 432 Wing

Figures C.4 and C.5 depict the desired end-state requirements in the future for the 432 WG and its subordinate operations groups, the 432 OG and 732 OG. The future 432 OG does not include MCE squadrons. Rather, it is composed of two RQ-170 squadrons, the 30 RS and 44 RS, the LRE FTU (11 ATKS), and the larger of the two ACC LR squadrons, the 489 ATKS. The number of instructors in the 11 ATKS was decreased based on inputs from ACC/A3MU to reflect the efficiencies gained through the creation of dedicated LR squadrons. The 489 ATKS is capable of supporting four separate LRE sites on a sustained basis at a 1:2 deploy-to-dwell ratio.

Table C.1. Desired End-State Requirements for New Wing by Duty

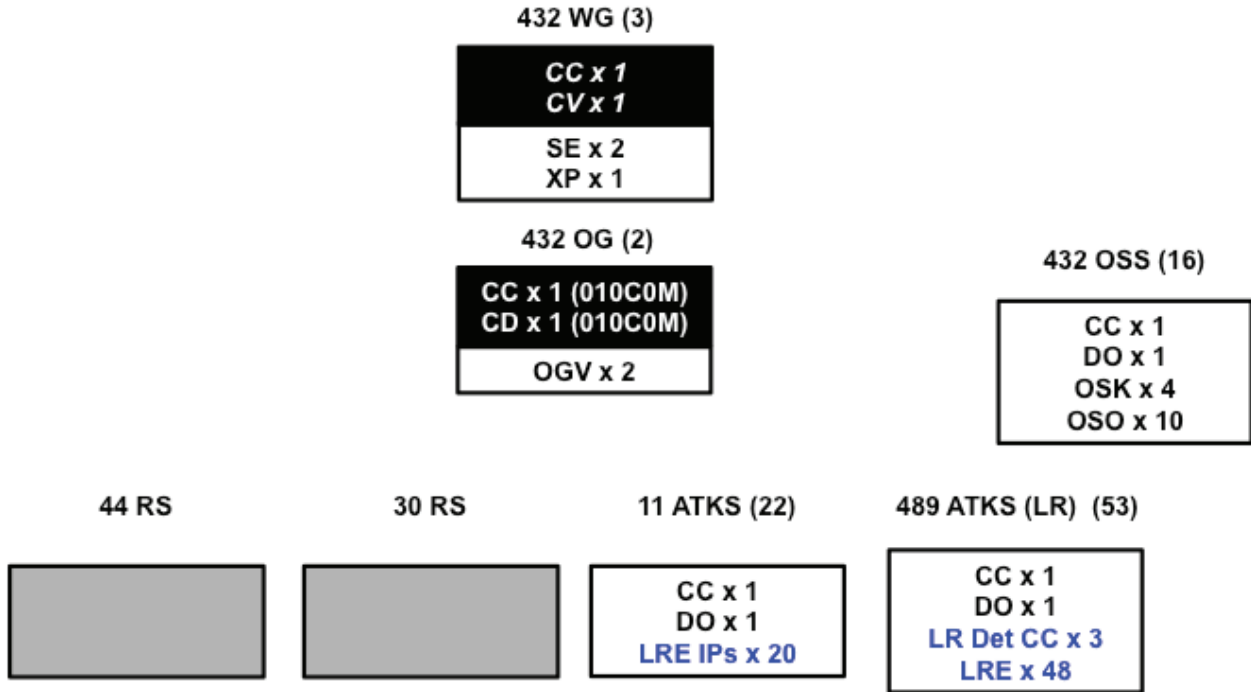
Unit	Training			Line Flying			Leadership					Development and Support		
	URTI	FTUI	LREI	LP	LI	LE	Ops Sqn DO	OSS/Trng DO	Ops Sqn CC	OSS/Trng CC	GP CC/CD	WG CC/CV	WG/ Below Staff/ Spt	WG/ GP Exec
New WG (Base X)												2	3	1
New OG1 (Base X)											2		2	1
New OSS								1		1			23	
42 ATKS				34	8	5	1		1					
20 ATKS ^a				34	8	5	1		1					
New ATKS				34	8	5	1		1					
New ATKS (LR)				29	6	4	1		1					
New OG2 (Base Y)											2		2	1
15 ATKS				34	8	5	1		1					
18 ATKS				34	8	5	1		1					
89 ATKS ^b				34	8	5	1		1					
Total	0	0	0	233	54	34	7	1	7	1	4	2	30	3

NOTE: URTI = URT instructor; FTUI= FTU instructor; GP = group; LREI = LRE instructor; LP = line pilot; LI = line instructor; LE = line examiner.

^a 20 ATKS will remain at Whiteman.

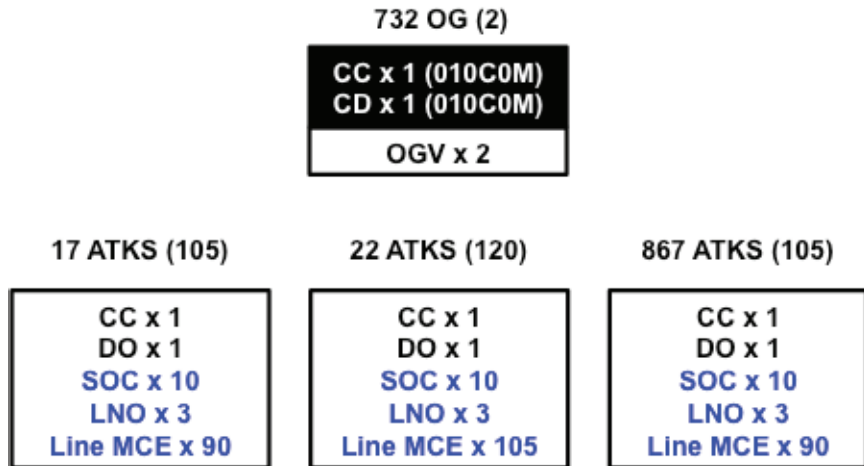
^b 89 ATKS will remain at Ellsworth.

Figure C.4. Desired End-State MQ-9 Positions at Future 432 WG and 432 OG



NOTE: All positions in blue are API-1 (line flyers). Black fill highlights non-18X positions.

Figure C.5. Desired End-State MQ-9 Positions at Future 732 OG



NOTE: All positions in blue are API-1 (line flyers). Black fill highlights non-18X positions.

Wing- and group-level staff positions are represented with the same model as used for the new wing. The desired end-state requirements for the 432 OSS are lower than FY 2016 levels, since the WOC is assumed to move to the new wing.

As discussed previously, the squadrons of the 732 OG will implement the 1:0.5 combat-to-dwell ratio through internal rotations. Two squadrons will be sized for 9 lines—6 combat lines and 3 dwell lines. One will be sized for 10.5 lines—7 combat lines and 3.5 dwell lines. Overall, the 732 OG will be capable of flying 19 combat lines on a sustained basis. This requires a total of 324 line flyers. The future needs of the 432 WG overall account for 375 MQ-9 line-flyer positions in the desired end-state requirements. This translates into a need for 58 line instructors and 40 line examiners. A breakdown of desired end-state requirements by duty for the reconfigured 432 WG is provided in Table C.2.

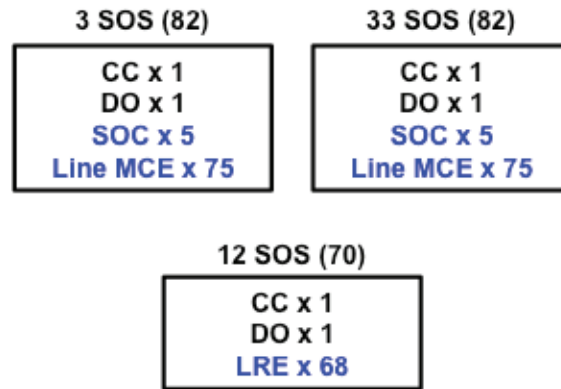
Future AFSOC MQ-9 Squadrons

AFSOC’s active duty RPA force is concentrated in three squadrons in the 27 SOW based at Cannon Air Force Base. Figure C.6 shows the desired end-state requirements for 18X pilots in AFSOC’s operations squadrons, assuming AFSOC leadership follows ACC’s lead in implementing a combat-to-dwell policy for its MCE squadrons through internal rotation of personnel within squadrons and expands the ranks of the 12 SOS to allow for a 1:2 deploy-to-dwell ratio for its LRE crews. The desired end-state requirements for line flyers in the 3 and 33 SOS would need to increase to 160 to support flying a total of 10 combat lines on a steady-state basis. Each MCE SOS would be sized for 7.5 lines—5 combat lines and 2.5 dwell lines. The desired end-state requirement for line flyers in the 12 SOS would need to increase to 68 to enable it to be capable of sustained operations of 4 LREs at a 1:2 deploy-to-dwell ratio, as well

Table C.2. Desired End-State Requirements for Future 432 WG by Duty

Unit	Training			Line Flying			Leadership				Development and Support			
	URTI	FTUI	LREI	LP	LI	LE	Ops Sqn DO	OSS/ Trng DO	Ops Sqn CC	OSS/ Trng CC	GP CC/ CD	WG CC/ CV	WG/ Below Staff/ Spt	WG/ GP Exec
432 WG												2	3	1
432 OG													2	1
432 OSS								1		1			14	
11 ATKS			20					1		1				
489 ATKS (LR)				37	8	6	1		1					
732 OG												2	2	1
17 ATKS				76	16	11	1		1					
22 ATKS				88	18	12	1		1					
867 ATKS				76	16	11	1		1					
Total	0	0	20	277	58	40	4	2	4	2	4	2	21	3

Figure C.6. Desired End-State MQ-9 Operations Squadron Positions at Future 27 SOW



NOTE: All positions in blue are API-1 (line flyers).

as supporting an expeditionary LRE capability. In addition, the number of instructors in Air Force Special Operations Air Warfare Center’s (AFSOAWC’s) 551 SOS would need to increase to 15 to support the SOS with increased mission-qualification training needs. A complete breakdown of desired end-state requirements for 27 SOW’s RPA operations squadrons by duty is provided in Table C.3.

Active Associate FTU Squadrons

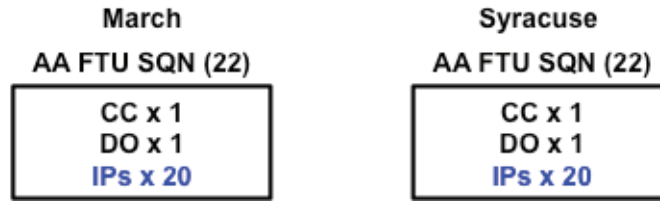
The desired end state also calls for increasing MQ-9 IQT capacity by creating two new active associate FTU squadrons at ANG FTU locations at March Air Reserve Base and Hancock Field Air National Guard Base (labeled Syracuse in Figure C.7 and Table C.4). Figure C.7 depicts the structure of these units. Each unit includes 20 positions for instructor pilots. Together, the two squadrons are supposed to be capable of producing 80 basic course

Table C.3. Desired End-State Requirements for Future 27 SOW MQ-9 Operations Squadrons by Duty

Unit	Training			Line Flying			Leadership				Development and Support			
	URTI	FTUI	LREI	LP	LI	LE	Ops Sqn DO	OSS/ Trng DO	Ops Sqn CC	OSS/ Trng CC	GP CC/ CD	WG CC/ CV	WG/ Below Staff/ Spt	WG/ GP Exec
3 SOS				60	12	8	1		1					
33 SOS				60	12	8	1		1					
12 SOS				50	11	7	1		1					
551 SOS ^a													15	
Total	0	0	0	170	35	23	3	0	3	0	0	0	15	0

^a 551 SOS is part of AFSOAWC but supports 27 SOW.

Figure C.7. Desired End-State MQ-9 Positions at Active Associate FTU Squadrons



NOTE: All positions in blue are API-1 (line flyers).

Table C.4. Desired End-State Requirements for Active Associate FTU Squadrons by Duty

Unit	Training			Line Flying			Leadership				Development and Support			
	URTI	FTUI	LREI	LP	LI	LE	Ops Sqn DO	OSS/ Trng DO	Ops Sqn CC	OSS/ Trng CC	GP CC/ CD	WG CC/ CV	WG/ Below Staff/ Spt	WG/ GP Exec
AA FTU SQN (March)		20						1		1				
AA FTU SQN (Syracuse)		20						1		1				
Total	0	40	0	0	0	0	0	2	0	2	0	0	0	0

equivalents per year on a sustained basis.⁵ Table C.4 presents a breakdown of desired end-state requirements by duty for the active associate FTU squadrons.

Desired End-State Requirements Based on FY 2016 Baseline Authorizations

For portions of the active duty MQ-1/9 force at wing level and below that were assumed to be unaffected by desired end-state goals (e.g., the 9 and 29 ATKs at Holloman), the desired end-state requirements were based on the FY 2016 MPES data that served as our baseline for authorized MQ-1/9 positions. Table C.5 provides a breakdown of the desired end-state requirements for these units by duty.

These units collectively accounted for 240 positions in the desired end-state requirements. More than half of these positions (147) are concentrated in the three FTU squadrons at Holloman—the 6 RS, 9 ATKs, and 29 ATKs of the 49 WG. The 49 WG as a whole accounts for 184 of these positions.

⁵ For comparison, each FTU squadron at Holloman is capable of producing 120 basic course equivalents per year on a sustained basis.

Table C.5. Desired End-State Requirements from FY 2016 Baseline by Duty

Unit	Training			Line Flying			Leadership				Development and Support			
	URTI	FTUI	LREI	LP	LI	LE	Ops Sqn DO	OSS/ Trng DO	Ops Sqn CC	OSS/ Trng CC	GP CC/ CD	WG CC/ CV	WG/ Below Staff/ Spt	WG/GP Exec
558 FTS	34							1	1					
49 WG												2	4	1
49 OG											2		3	1
49 OSS								1	1				6	
ACC TRSS Det 2													2	
6 RS		47						1	1					
9 ATKS		47						1	1					
29 ATKS		47						1	1					
16 TRS								1	1				11	
57 WG													1	
57 WSS								1						
414 CTS													1	
561 JTS													1	
AFSOAWC													1	
371 SOCTS Det 1										1				
705 CTTS													1	
Total	34	141	0	0	0	0	0	7	0	8	2	2	31	2

SOURCE: MPES, 2015.

Model Personnel Data Input and Assumptions

In order for the RPA career field model to produce accurate information for decisionmaking, two factors must be present: (1) the model formulation must meaningfully capture the mechanisms governing the evolution of the career field over time, and (2) the model parameter values must ground the model in the reality and context of the future (or the best approximation of the most likely future state). Regarding the latter, the process of designing and programming the model requires many assumptions and decisions concerning the parameter values that will produce the best results. This section summarizes the process of generating the key inputs from Air Force personnel and manpower data to ensure transparency of the results, as well as to lay the groundwork for future efforts and refinements.

The model draws on manpower and personnel data inputs in the following areas:

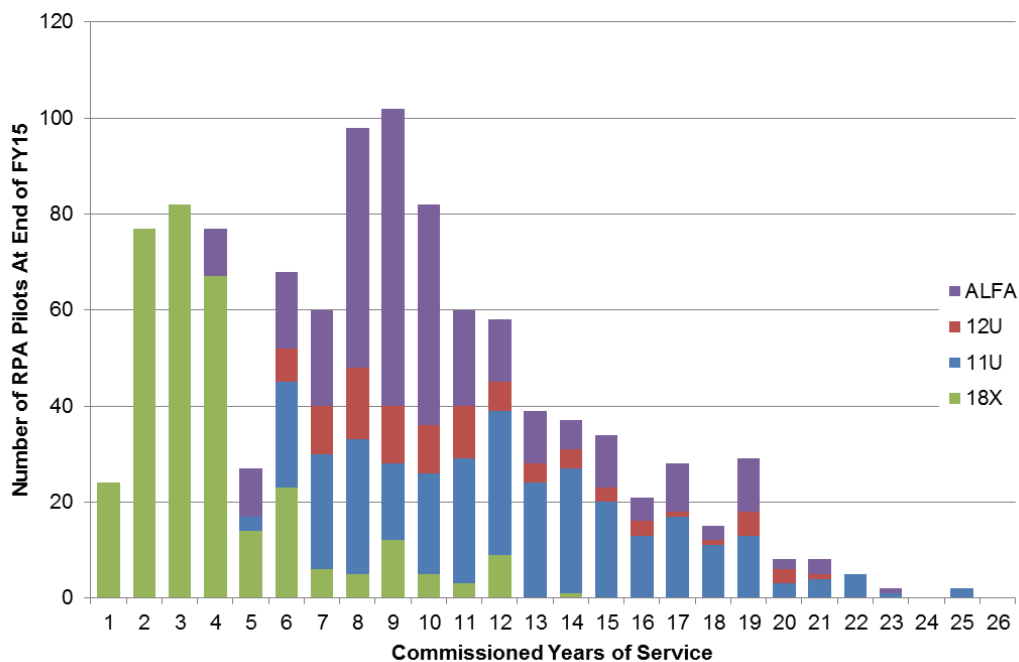
- Calculating the initial inventory of RPA pilots
- Creating benchmark requirements based on other rated career fields
- Determining the “normal” level of crossflow into the RPA career field

- Calculating the CYOS distribution for new RPA pilots
- Determining appropriate assignment patterns for RPA pilots.

Initial Inventory of RPA Pilots

The RPA career field model tracks the number of RPA pilots in each CYOS and career field (i.e., 11U, 12U, 18X, and ALFA tour) over time as the inventory is transformed by new waves of production and annual retention patterns. The starting point for the model is the count of RPA pilots at the beginning of FY 2016, by CYOS and career field (see Figure C.8). To calculate these values, we used the September 2015 active officer end-of-month personnel extract (known as the September BAE⁶ file), merged with information on authorizations from the companion manpower file (known as the September MPW file). Calculating the inventory from this file involves four main steps: (1) keep only MQ-1/9 pilots, (2) categorize MQ-1/9

Figure C.8. Initial Inventory of MQ-1/9 Pilots by CYOS and Career Field



NOTE: These numbers differ from RPA pilot numbers published by the Air Force Personnel Center because we omit RPA trainees and RQ-4 pilots and we include traditional pilots who are in RPA assignments (i.e., ALFA tours). We also used other fields in the data to identify and omit some UPT-direct 11U pilots who had returned to traditional assignments.

⁶ BAE stands for file part b (officer), active extract. This references the parts of the personnel files that contain data on active duty officers. There are similar files for active duty enlisted, and for reserve and guard officers and enlisted airmen as well.

pilots into career fields, (3) categorize MQ-1/9 pilots into duties and drop pilots who cannot be classified into a duty category, and (4) calculate the number of pilots in each career field and CYOS bin.

Keeping Only MQ-1/9 Pilots

First, we keep all RPA pilots, defined as pilots with a core⁷ or duty AFSC of 18X, 11U, or 12U. The duty AFSC is important because traditional pilots who are on an ALFA tour will maintain their home-community core AFSC. We apply a couple of rules to the BAE to keep only MQ-1/9 pilots: First, we use AFSC information where possible—duty or primary AFSC codes denote the MQ-1/9 pilots (e.g., 18AXA and 11UXA indicate MQ-1 pilots). However, some AFSCs are not specific to a primary aircraft. For example, core AFSCs are only three digits, so a pilot's aircraft cannot be determined from a core AFSC of 11U. Also, some duty AFSCs are not platform-specific (e.g., 18GX). We search through the aircraft histories of these pilots and add them to the MQ-1/9 population if they previously flew the MQ-1 or MQ-9 and they have nonzero flying hours in the airframe.

Categorizing MQ-1/9 Pilots into Career Fields

While most RPA pilots use 18X for their duty AFSCs, the core AFSC will accurately distinguish true 18X pilots from 11U and 12U pilots. ALFA tour pilots have an 11X core AFSC (other than 11U), but they are in the RPA population because they have an 18X or 11U duty AFSC.

Categorizing MQ-1/9 Pilots into Duties

Table C.6 shows the list of possible duties (see Chapter 2) and the rules for classifying RPA pilots and traditional pilots into them.

Even though the duty information does not factor into the initial inventory, it is important to run the duty categorization on RPA pilots before calculating the inventories because the leftover pilots who cannot be categorized are often not MQ-1/9 pilots. For example, the duty categorization method failed to classify a group of pilots who went directly to an RPA unit after UPT (and thus still had an 11U core AFSC) but had actually returned to assignments in other communities.

⁷ We used an algorithm developed by Air Force Personnel Center personnel specialists that imputes codes using other data fields, such as rated distribution and training management codes and aeronautical ratings, to determine core AFSCs for pilots.

Table C.6. Duty Categorization Rules for RPA Pilots and Traditional Pilots

Duty	Rules for RPA Pilots	Rule for Traditional Pilots
URT/UPT instructor	Authorization AFSC or DAFSC has T, Q, or W prefix and part of 558th Flying Training Squadron	Authorization or DAFSC has T, Q, or W prefix, part of a sq-level unit on a UPT base ^a with API code 1 or has Intro to fighter fundamentals authorization or DAFSC
FTU instructor	Authorization AFSC or DAFSC has T, Q, or W prefix and part of an FTU unit ^b	Same as RPA
LRE instructor	Authorization AFSC or DAFSC has T, Q, or W prefix and part of LRE FTU unit ^c	N/A
Line pilot	Part of an operational unit ^d and API code 1	Part of an operational unit and API code 1, or API code is missing and DAFSC is 11X
Line instructor	Line pilots who are in an authorization with a T or K prefix and have nonzero instructor hours	Same as RPA
Line examiner	Line pilots who are in an authorization with a Q prefix and have nonzero examiner hours	Same as RPA
Ops squadron DO	Part of an operational unit and authorization AFSC or DAFSC has B prefix	Same as RPA
OSS/training DO	Part of a non-operational unit and authorization AFSC or DAFSC has B prefix	Same as RPA
Ops squadron CC	Part of an operational unit and authorization AFSC or DAFSC has C prefix	Same as RPA
OSS/training CC	Part of a non-operational unit and authorization AFSC or DAFSC has C prefix	Same as RPA
Group CC/CD	Group commander DAFSC (10CX, 20CX, 30CX, 91C)	Same as RPA
Wing CC/CV	Wing commander DAFSC (91W)	Same as RPA
Wing/below staff/spt	API code 3 or 6 with 18X DAFSC	API code 3 or 6 with 11X DAFSC
GP/WG exec	Unit is at the wing or group level and has either 97E DAFSC or exec in duty title	Same as RPA
Above-wing exec	Unit is above the wing level and DAFSC indicates exec (97E) or aide de camp (88A)	Same as RPA
Air Force staff	Not previously classified and unit type indicates HAF, staff, center, or command	Same as RPA
Joint staff	Not previously classified and unit type indicates joint, headquarters, or other DoD	Same as RPA
Special duty	DAFSC indicates special duty (80X-87X), part of an ROTC unit, base is USAFA, part of a test unit or has test pilot DAFSC, has regional affairs DAFSC (16X), part of a weapons school unit, ^e or part of an ASOS or has ALO DAFSC	Same as RPA
Full-time student	Full-time student DAFSC (92S)	Same as RPA

^a UPT bases include Vance, Sheppard, Columbus, Laughlin, Fort Rucker, Pensacola, and Pueblo.

^b FTU Units include the 6 RS, 9 ATKS, 16 TRS, and 29 ATKS for RPA pilots. For traditional pilots, there are too many potential units to code individually, so we identified FTUs as units where more than 50 percent of the pilots were either formal instructors (T prefix), examiners (Q prefix), or had the word *student* in their duty title.

^c The 11 RS is the LRE FTU unit.

^d For RPA pilots, operational units included the following squadron types (except the units already identified as training units): attack, reconnaissance, special operations. For traditional pilots, we considered a much longer list of squadron types operational, e.g., fighter, bomb, airlift, air refueling, and rescue.

^e For RPA pilots, the Weapons Instructor Course unit is the 26th weapons squadron. For traditional pilots, we identified weapons school units as weapons squadrons in which more than 50 percent of the pilots are weapons officers.

Calculating the Number of Pilots in Each Career Field and CYOS Bin

This last step is straightforward once the career field and CYOS of each pilot in the September 2015 file are known. We count the remaining 11U pilots who appeared to have come directly from UPT as career 11Us because the length of time between initial qualification and their current assignment suggested that their return to a traditional flying assignment was indeterminate.

Benchmark Requirements from Other Career Fields

As discussed in Chapter 2, certain duty categories in the model require assumptions about future desired end-state requirements where current requirements for RPA pilots cannot function as a proxy. Instead of continuing on the current path for these functions, senior leaders seek an RPA career field where members have opportunities comparable to those in other career fields (or of other pilots). To calculate desired end-state requirements for the future RPA career field that are proportional to those in other communities, we developed a benchmarking methodology, using our previously defined duty categorization scheme. We tweaked the categorization rules to fit the traditional manned-aircraft pilot communities (see Table C.6., column 3), which provided a point of direct comparison. Then, the desired end-state requirement gaps for duties where current requirements are an unreliable proxy could be filled with requirements created from the proportion of the benchmark community in these duties, relative to those in line-flying duties.

Table C.7 summarizes the proportions the model employs. The values in Table C.7 are averages over the previous 10 years, and values from the RPA community over the previous 4 years are shown for comparison. We examined several potential benchmarks, ultimately settling on the benchmark of “all traditional pilots pooled together.” To apply the values in Table C.7 to generate a desired end-state requirement, we multiply the proportion of the benchmark community in the specific duty (relative to the number in line duties) by the number of line-flying desired end-state requirements in the model (which varies according to the model scenario). *Thus, scenarios requiring more line RPA pilots will also require more pilots in auxiliary staff and support duties to maintain proportionality with the benchmark community.*

The values in Table C.7 show that command, staff, and education assignments, relative to their size, are substantially less common among RPA pilots than among other major rated communities. Therefore, building an RPA career field that is similar to other rated communities necessarily involves increasing the number of officers filling desired end-state requirements in these areas.

Normal Levels of Crossflow

Setting limits on the reasonable levels of crossflow into the RPA community from other communities is another area where historical levels are abnormal and therefore not useful for

Table C.7. Benchmark Proportions for Selected Duties

Duty	All Non-RPA								
	Pilots	11B	11F	11H	11M	11R	11S	ABM	RPA
Ops sq/CC	0.031	0.025	0.050	0.050	0.023	0.025	0.036	0.015	0.021
OSS/training CC	0.029	0.058	0.069	0.031	0.016	0.015	0.012	0.016	0.018
Group CD/CC	0.047	0.075	0.097	0.053	0.031	0.025	0.043	0.021	0.010
Wing CV/CC	0.021	0.033	0.045	0.008	0.017	0.005	0.012	0.004	0.000
Above-wing exec	0.009	0.014	0.015	0.006	0.009	0.004	0.004	0.004	0.002
Air Force staff	0.190	0.258	0.263	0.241	0.171	0.153	0.127	0.194	0.047
Joint staff	0.097	0.149	0.146	0.109	0.077	0.076	0.100	0.077	0.017
Special duty	0.094	0.223	0.198	0.076	0.062	0.044	0.047	0.094	0.031
Full-time student	0.072	0.108	0.147	0.059	0.051	0.038	0.055	0.034	0.023

modeling norms in the future. For ALFA tour pilots, the annual numbers have been determined by policy, and thus we accepted the annual maximum of 146 as a given. This leaves crossflow levels for 11U and 18X RPA pilots in need of suitable maximums.⁸ Because the most accurate way to determine a pilot’s true community is by his or her core AFSC,⁹ we opted to create crossflow benchmarks by tracking core AFSC changes over time in other communities.

11U Crossflow

Since 11U pilots are pilots from other communities who become career RPA pilots, we look to other flying communities to get a benchmark for how common it is for pilots to cross between communities. Using a panel of all traditional manned-aircraft pilots from 2006 to 2015, we calculate the percentage of each community (as well as the pooled percentage of all pilots) in each year that is made up of pilots who had a different core AFSC in the previous year. Then we average these percentages over the nine years (since year one is the baseline) to arrive at community-specific crossflow percentages, with one additional percentage for all pilots pooled together. To get the maximum number of pilots allowed to crossflow, we multiply this percentage by the total size of the RPA community as determined by the desired end-state requirements. Similar to the selected duties in Table C.7, the actual number used in

⁸ We explored benchmarking 12U crossflows off the rate of traditional CSO crossflows into traditional pilot core AFSCs but ultimately decided to allow 12Us to phase out with no replacements. Both 12X to 11X and nonrated to 11X transitions are rare in the data (much rarer than core changes among traditional 11X communities), so this assumption is not likely to make a large difference in the results.

⁹ According to AFI 36-2101, *Classifying Military Personnel*, “Once a Core ID is established, it cannot be changed unless the officer formally applies and is approved to retrain, is designated for involuntary cross flow (IAW AFI 36-2626) or is approved to transfer to another competitive category IAW AFI 36-2106.” For pilots who had no core AFSC (which is common in earlier waves), we imputed core AFSCs using other fields in the data, such as rated distribution and training management codes.

the model depends on the size of the community in the particular scenario. Table C.8 lists the percentages that can be applied for any community size.

18X Crossflow

18X RPA pilots are pilots with no experience in traditional flying communities who enter the RPA training pipeline from the nonrated sector. One potential difficulty in examining crossflow history from nonrated AFSCs to benchmark rated communities is that crossflow demand over the past 10 years has been artificially high in the RPA community, and these crossflows may have come at the expense of crossflow into other rated communities. This reality would mean that recent data on nonrated-to-rated crossflows outside of the RPA community are abnormally low. One potential solution is to use crossflow from nonrated AFSCs into all pilot communities (18X included). For comparison, we also calculated crossflow rates from nonrated to combat systems officer (CSO), from nonrated to ABM, and from nonrated to any rated AFSC. The result (proportional to the size of the total population) is similar regardless of which benchmark is chosen (the values were 0.2 percent for pilot, CSO, and all rated AFSCs and 0.5 percent for ABMs). For the model input, we use the “all rated” percentage of 0.2 percent multiplied by the long-run total size of the community.

Commissioned Years of Service for New RPA Pilots

The starting point for a new RPA pilot who enters any of the RPA career fields depends on how long it takes him or her to complete training, which varies even for pilots in the same commissioning year group. This starting-point distribution, which is the CYOS of each “new” RPA pilot, also represents a parameter that needs to be grounded in historical data. To find these values, we used a file that merged all RPA pilots who appear in the September 2015,

Table C.8. Historical Crossflow Proportions in Traditional Pilot Communities

Community	Average Proportion That Held Different Pilot Core AFSC in Previous Year
11B	0.008
11F	0.001
11H	0.018
11M	0.003
11R	0.029
11S	0.065
All traditional pilots	0.010

September 2014, or September 2013 BAE (i.e., each pilot appears once).¹⁰ We calculated each RPA pilot's CYOS on the day he or she was "produced," using the pilot's training-completion information and the associated dates. For most RPA pilots, only formal IQT completion date was recorded, so it was necessary to add 60 days to account for transition to a unit and MQT completion. For pilots in AFSOC, mission-qualification training dates were recorded in the BAE as formal training, so no adjustment was necessary.

We have described how pilots are classified into career fields (e.g., 18X, 11U), but some additional explanation is necessary regarding how to identify newly produced 18X pilots from cross-trainees and how to identify pilots who come directly from UPT. We examined each 18X pilot's history of duty AFSCs to identify those who previously held a nonrated officer AFSC. Those who had nonrated officer experience are cross-trainees. The RPA pilots who arrive directly from UPT are assigned the core AFSC of 11U, yet they would have never served in a traditional flying assignment. Thus, the UPT-direct pilots in the BAE are those who never held an 11X duty AFSC prior to their first RPA assignment.

The left panel of Figure C.9 shows the raw percentage of new RPA pilots in each CYOS for each career field group from FY 2013 to FY 2015. These percentages represent a possible option for parameter values that could be plugged directly into the model. In other words, since 86 percent of the pipeline 18X pilots from FY 2013 to FY 2015 were in CYOS 1 when they completed training, the model could allocate 86 percent of all new 18X pilots into CYOS 1 for each simulated year, while doing the same for the other career fields and percentage values.

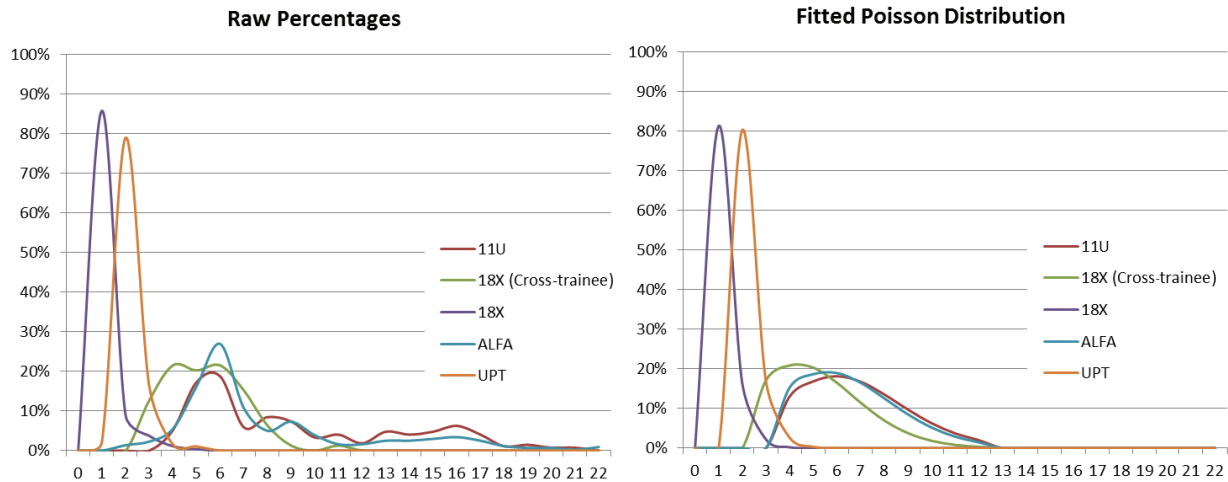
However, it is possible that recent history is not representative of the actual state of affairs, especially in the way many 11U and ALFA tour pilots started their RPA careers at relatively high CYOS points. It also may be preferable to smooth the distribution for each career field rather than to assume that the empirical percentages of recent pilots represent the long-term norm. To circumvent these potential issues, we take the final step of fitting a probability distribution to the CYOS values in the data. After exploring several options, we chose to use a Poisson distribution for each career field (which is a natural fit for a variable that takes only integer values, as CYOS does), and we truncate the distribution to prevent the anomalous values in the tails from skewing the fit. Figure C.9 shows these fitted distributions for each career field in the right-side panel.

Determining Appropriate Assignment Patterns

Finally, before the model is able to function, it must be programmed with a set of rules for determining how to assign RPA pilots to fill desired end-state requirements. There are two

¹⁰ Each person has only one start date, and that date does not change over time, so there was no need to use waves of cross-sectional data to calculate CYOS at time of entry into the RPA pilot field.

Figure C.9. CYOS Distribution for New RPA Pilots



forces that potential assignment rules need to account for. First, qualification restrictions may limit the pilots who can fill certain duties (e.g., a pilot in CYOS 5 cannot be a commander). Second, it is necessary to constrain the overall pattern of assignments so that it matches a normal, healthy career field. For example, pilots in CYOS 15–26 are all technically qualified to fill line-flying duties, but a solution that assigns too many senior pilots to these duties would depart from norms in healthy career fields and thus may have negative consequences not captured in the model if policymakers were to implement it.

We solve these problems by guiding RPA pilot assignments with a set of upper bounds, calculated from the previous 10 years of personnel data. For each CYOS, there is an upper bound that limits the percentage of the inventory that may go toward each duty. If no one in a given CYOS is qualified to fill a duty, the upper bound would be zero. For CYOS-duty pairs where assignments are more common, the upper bounds will tend to be higher.

To calculate the upper bounds, we again apply the duty categorization process to the historical data for a given benchmark community. The upper bound for each duty is the maximum percentage of the benchmark community assigned to that duty over the 10-year period. While we explored many possible benchmark communities, including each individual pilot community, ABMs, and space/missile officers, we settled on the pooled traditional pilots as the preferable benchmark.

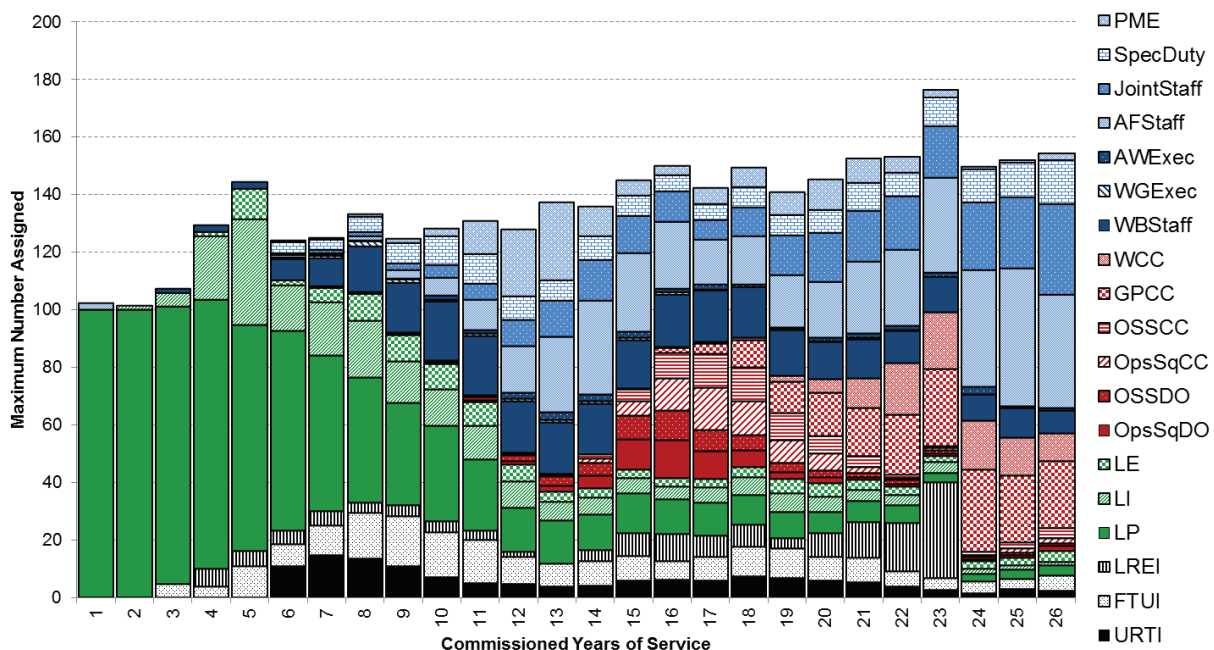
The final values used in the model make a few additional adjustments. We insert upper bounds based on recent RPA pilot assignments for CYOS 0–5, since recent patterns in the RPA community are likely to be more accurate than benchmark values from an outside community for officers very early in their careers. We use these same RPA pilot assignments to govern the LRE instructor duty for all CYOS values, since this duty does not exist in other rated career fields. Finally, we add flexibility in filling leadership duties by raising the upper

bounds to one for all CYOS values in the range in which officers are traditionally eligible for these duties. We made this change so that the model solution would not produce additional officers to fill leadership requirements where eligible RPA pilots might have been available.

Figure C.10 illustrates the assignment possibilities for each CYOS under the pooled traditional manned-aircraft pilot benchmark. The sections of the stacked bars represent the maximum number of pilots that the model would be permitted to allocate to the respective duties if there were 100 RPA pilots in each CYOS. The duties are functionally grouped, so that black/white represent the training pipeline, greens represent line-flying duties, reds represent leadership duties, and blues represent staff and support duties. The overall heights of the bars sum to more than 100 because the upper bounds do not sum to one, as they are maximum values across 10 cross-sections of data.

In general, the assignment patterns in Figure C.10 conform to expectations. In the first eight years of a pilot’s career, he or she is limited to mostly line-flying duties, support assignments below the wing level, or assignments in the training pipeline. The proportion of pilots allocated to line-flying duties then rapidly decreases, as officers in CYOS 10 through 14 are more likely to serve in staff assignments. Staff assignments remain common through the

Figure C.10. Maximum Number Out of 100 RPA Pilots in Each CYOS Assigned to Each Duty Under the Traditional-Pilot Benchmark



NOTE: The color scheme in this figure corresponds to the previous categorization in the following way: light blue represents other development and support duties, dark blue represents development and support duties outside of RPA operations, red represents leadership duties, green represents line-flying duties, gray/black represent training duties.

rest of the pilot's career, although the fraction decreases and gives way as a significant proportion of assignment capacity is allocated to leadership and command assignments at different levels.

The model limits the assignments that RPA pilots can fill depending on their career field. We assume that 18X and 11U pilots are interchangeable and ought to be assigned according to the benchmark career field shape across commissioned years of service. ALFA tour pilots and temporary 11Us who came directly from UPT, however, are meant primarily to augment unit-level desired end-state requirements and are not a permanent part of the community.¹¹ Therefore, we limit their assignments to line flying, FTU instructor, and LRE instructor. Even with these limitations, CYOS-specific limits on the proportion assigned to individual duties relative to others are also necessary, so we calculate upper-bound values in the same manner as before, but using only pilots in the allowed duties.

¹¹ Limiting the use of ALFAs in this way is consistent with views about the purpose of ALFAs expressed by our sponsor and other Air Force leaders who participated in our interviews.

Appendix D. RPA Model Formulation

RAND has developed a family of inventory models, implemented as SAS-based linear programming models, with very similar characteristics. The first of these was built to project total force (active and reserve components) aircrew inventories. In Air Force aircrew management matters, line graphs depicting projected manpower requirements and inventories conventionally use a red line for the requirements and a blue line for the inventories. Consequently, this aircrew inventory projection model became known as the Total Force Blue Line (TFBL) model. The TFBL model has since been adapted for three different projects that all involve projecting inventory against requirements: The first project extended TFBL, which modeled the rated community, to model the aircrew community (rated plus career enlisted aviators); the second tested Force of the Future kinds of policies on the Air Force active duty force; the third is the project reported here, which developed a linear programming model to project the short-term (over the next 5 years) and long-term (10 or 20 years down the road) consequences of career field planning decisions on the health of the active duty RPA force. This appendix gives the technical details of this linear programming model.

A linear programming model can be specified using the following constructs:

- *Scalars* are single values defined for recurring use in various expressions. For example, the scalar *fyfirst* is defined here to have a value of 2015, which is the first FY represented in the model.
- *Indices* identify the various arrays of values—parameters and variables—used in the model. For example, the inventory is indexed by career field, CYOS, and FY dimensions. In the expressions used in this appendix to define the model, indices appear as subscripts.
- An *index set* specifies the members of a multidimensional index or a combination of indices.
- *Parameters* are fixed values provided as inputs to the model. Inputs to the RPA model include arrays of requirements, historic or forecasted rates, historic distribution by CYOS of production or crossflow, historic crossflow rates, the initial inventory as of 30 September 2015, and other empirical or policy-related values.
- *Variables* are values that change as the linear programming algorithm seeks an optimal solution.
- By systematically changing the values of the variables, the model minimizes an *objective function*, a value equal to a sum of stated variables.
- *Boundary conditions* fix the values of certain subsets of variables. For example, inventories in the first FY are set equal to the initial inventory, which is entered as a parameter in the model.
- The model adheres to *constraints*—equations expressed using parameters and variables that represent real-world conditions (such as not being able to have negative values of inventory).

For consistency, sets are denoted by an s_* , parameters are denoted by a p_* , and variables are denoted by a v_* .

Data Dimensions

The model includes three dimensions for desired end-state requirements—career field, duty, and FY—and three dimensions for officer inventories—career field, CYOS, and FY. Thus all desired end-state requirements and inventories can be described by three-tuples (career field, duty, FY) and (career field, CYOS, FY), respectively. These dimensions are defined as follows:

- *Career field*. The model considers five officer career field categories. In the expressions below, the subscript c identifies this dimension.
- *Duties*. The model considers 17 duty categories, listed in Table 2.2. The subscript d identifies this dimension.
- *CYOS*. The model includes up to 26 CYOS. This model employs $CYOS = 0$ for inventory with less than one complete year of service, and $CYOS = 1$ for inventory with service greater than or equal to one but less than two complete years. The subscript y identifies this dimension.
- *Fiscal year*. The model can be extended for any number of FYs into the future. For this project, the starting inventory was taken as the end of FY 2015 and projections are made through FY 2085. The subscript f identifies this dimension.

Technical Model Formulation

A detailed description of the RPA model is presented below. We specify the scalars, index sets, parameters, and variables that constitute the objective function and constraints of the RPA model.

Scalars

- $cyfirst = 0$, first CYOS
- $cylast = 26$, last CYOS
- $fyfirst = 2015$, first FY
- $fylast = 2085$, last FY
- $RPA_tour_length = 4$
- $smooth = 0.1$, percent production is allowed to deviate year to year
- $STIratio2018 = 2.55$, student-to-instructor ratio for FY 2018 and beyond.

Index Sets

The main index sets upon which all other sets are built are the following:

- s_career is the set of career fields, where $s_career = \{11U, 12U, 18X, ALFA, UPT\}$, where UPT refers to UPT directs and ALFA refers to ALFA tour pilots.
- s_duties is the set of modeled duty categories as defined in Table 2.1.
- s_cy is the set of CYOS, where $s_cy = \{cyfirst, \dots, cylast\}$, where $cyfirst$ and $cylast$ represent the smallest and largest possible CYOS, respectively.
- s_fy is the set of FYs, where $s_fy = \{fyfirst, \dots, fylast\}$, where $fyfirst$ and $fylast$ represent the first and final FYs considered in the model, respectively.

The remaining index sets used in the model are subsets of the sets above or their Cartesian products:

- $s_Rqmts = (c, d, f)$ is the set of desired end-state requirements for career field c in s_career and duty d in s_duties in fiscal year f in s_fy .
- $s_AsgnMatrix = (c1, c2, d, y, f)$ is the set of assignments of an officer in $c1$ in s_career to $(c2, d, f)$ in s_Rqmts in y CYOS in s_cy .
- s_Inv is the set of inventory categories defined by career field, CYOS, and FY.
- s_AggInv is the set of aggregate inventory categories defined by career field and FY.
- s_Cross is the set of inventory categories for crossflows defined by career and FY.
- s_trans_ALFA is the set of inventory categories for the current ALFA and UPT directs defined by career, CYOS, and FY.
- $s_CheatGertrude$ is the set of assignments to enforce the upper-bound assignment percentages; the assignments are representative of the total number of assigned officers and not the total inventory defined by $s_AsgnMatrix$.

Parameters

- $p_rqmt_{c,d,f}$ is the desired end-state requirements for (c, d, f) in s_Rqmts .
- $p_initinv_{c,y}$ is the number of individuals who are currently serving in career field c in s_career , with y CYOS in s_cy in FY $fyfirst$, and is the actual inventory from 30 September 2015.
- p_prod_f is the student-to-instructor ratio for assigned FTU instructors in FY f in s_fy .
- $p_prodcap_f$ is the upper-bound number of FTU graduates in FY f in s_fy .
- $p_prodcap18X_f$ is the upper-bound number of 18X FTU graduates in FY f in s_fy and was provided by AF/A3T.
- $p_dstprod_{c,y}$ is the historical CYOS distribution of FTU graduates that enter the inventory with y CYOS in s_cy for career field c in s_career , where $\sum_{y \text{ in } s_cy} p_dstprod_{c,y} = 1$.

- $p_{cross_{c,f}}$ is the maximum number of officers that can be crossflowed in for career field c in s_{career} in FY f in s_{fy} .
- $p_{cross_{LB_{c,f}}}$ is the lower-bound percentage on maximum crossflow for any career field c in s_{career} in FY f in s_{fy} , where $0 \leq p_{cross_{LB_{c,f}}} \leq 1$.
- $p_{dstcross_{c,y}}$ is the CYOS distribution of crossflowed officers into career field c in s_{career} with y CYOS in s_{cy} .
- $p_{surv_{c,y,f}}$ is the survival rate for officers in career field c in s_{career} with y CYOS in s_{cy} in FY f in s_{fy} . Though the term *survival* connotes life (and death), the term is used to describe individuals who remain in the system (or have survived the FY) and have not separated/retired from the Air Force.
- $p_{asgn_{matrix}_{UB_{c1,c2,d,y,f}}}$ is the upper-bound fraction of officers in career field $c1$ in s_{career} assigned to valid requirement $(c2, d, f)$ in s_{Rqmts} with y CYOS in s_{cy} where $(c1, c2, d, y, f)$ in $s_{AsgnMatrix}$.
- $p_{trans_{ALFA}_{c,y,f}}$ is the number of ALFA and UPT directs in the inventory as of 30 September 2015 who will leave the RPA community for career field c in $\{ALFA, UPT\}$ with y CYOS in s_{cy} in FY f in s_{fy} .
- $p_{DutyPriority_{c,d,f}}$ is the penalty placed on unmet desired end-state requirements for (c, d, f) in s_{Rqmts} . The higher the desired end-state requirement, the more important the duty category and the more likely for that duty category to be filled.^{1,2}
- $p_{GoodCrossflowPriority_{c,f}}$ is the penalty placed on crossflow for career field c in s_{career} in FY f in s_{fy} . The higher the penalty, the less likely crossflow is in that

¹ In the ASAP scenario, unmet desired end-state requirement weights start at 1,000 and decrease by 100 per year until 2026, when weights bottom out at 1. Line and FTU instructor duties receive 10 times the weight of other duties (i.e., they start at 10,000 and decrease by 1,000 each year until 2026, when they level out at 100 per year). This is to reflect the policy preference that line and FTU instructor positions must be filled at 100 percent, while other kinds of duties will be filled with the remaining available personnel, and the goal is to meet requirements as quickly as possible. In the balanced scenario, unmet desired end-state requirement weights match the ASAP scenario through 2017, before they are reduced to 10 for line and FTU instructor desired end-state requirements and 1 for all other desired end-state requirements.

² We tried discounting future desired end-state requirements while still penalizing production. However, that scenario in the model actually changes the relative prioritization of the goals in the objective function for future years. This then causes model output to not reflect a steady-state solution, which is the main feature of the optimization approach. In other words, we found in our early model runs that it changes the steady-state picture, which in turn causes the model to come out of steady-state behavior and adapt and drive toward a new steady-state behavior where the future desired end-state requirements are discounted. That ultimately leads production to drive to zero and leaves unmet desired end-state requirements because they were discounted—neither of which are conditions that are consistent with the healthy steady-state desired end-state we were aiming for in our model. We therefore decided not to discount future desired end-state requirements. Instead, we opted to leave unmet desired end-state requirements at the same penalty throughout time and penalize production the same way throughout the model horizon.

type of RPA pilot. The 11U, 12U, and 18X crossflows receive an equal weight of 1, while ALFA tour pilots receive a weight of 100 to reflect the policy preference of phasing out the use of ALFA tour pilots.

Variables

The previous subsections described the sets and parameters that are input to the model; this section describes decision variables whose values are determined when the linear programming solver finds an optimal solution. Because the variables represent officers or desired end-state requirements or the assignment of officers to desired end-state requirements, all the variables must be greater than or equal to zero:

- $v_{inv_{c,y,f}}$ is the number of officers who will serve in career field c in s_{career} with y CYOS in s_{cy} in FY f in s_{fy} , (c, y, f) in s_{Inv} .
- $v_{sep_{c,y,f}}$ is the losses from career field c in s_{career} with y CYOS in s_{cy} in FY f in s_{fy} , (c, y, f) in s_{Inv} .
- $v_{prod_{c,f}}$ is the number of FTU graduates who enter the system into career field c in s_{career} in FY f in s_{fy} , (c, f) in s_{AggInv} .
- $v_{cross_{c,f}}$ is the number of officers who crossflow into career field c in s_{career} in FY f in s_{fy} , (c, f) in s_{Cross} .
- $v_{asgn_{c1,c2,d,y,f}}$ is the number of officers in career field $c1$ in s_{career} assigned to desired end-state requirement $(c2, d, f)$ in s_{Rqmts} with y CYOS in s_{cy} where $(c1, c2, d, y, f)$ in $s_{AsgnMatrix}$.
- $v_{unfill_{c,d,f}}$ is the number of unfilled desired end-state requirements, which is also the shortage of personnel, for the desired end-state requirement corresponding to (c, d, f) in s_{Rqmts} .
- $v_{ghost_{c,d,f}}$ is the number of unfilled FTU instructor requirements that are not required to be filled due to the enforced student-to-instructor ratio for the desired end-state requirement corresponding to (c, d, f) in s_{Rqmts} . These unfilled FTU instructor requirements are not penalized in the objective function.
- $v_{unasgn_{c,y,f}}$ is number of unassigned individuals, which is also the surplus of personnel, for the officers corresponding to (c, y, f) in s_{Inv} .

Objective Function

The model includes four goals in the objective function, which can be thought of as multigoal programming: to match the inventory to the desired end-state requirements exactly (i.e., zero shortage and surplus) and to produce or crossflow the smallest number of RPA pilots to accomplish the match, while adhering to a desired assignment pattern. The shortages are represented by the sum of all unfilled or unmet desired end-state requirements. The surplus

is calculated as the sum of all unassigned individuals. To minimize training, salary, and future retirement costs (without directly calculating these costs), the model minimizes the total number of produced RPA pilots, while trying to meet desired end-state requirements. Because RPA pilots who crossflow into a career field often require additional training, the model also minimizes the total number of RPA pilots who crossflow into the RPA career field (per leadership and stakeholders' vision to phase out ALFAs and limit crossflow into the community to levels similar to those in other rated communities). Therefore, taking these goals into consideration, the objective function is the summation of the following:

$$\begin{aligned} \min \quad & \sum_{(c,y,f) \in s_Inv} v_unasn_{c,y,f} + \sum_{(c,d,f) \in s_Rqmts} p_DutyPriority_{c,d,f} * v_unfill_{c,d,f} \\ & + \sum_{(c,f) \in s_AggInv} v_prod_{c,f} + \sum_{(c,f) \in s_Cross} p_GoodCrossflowPriority * v_cross_{c,f} \end{aligned}$$

Objective Function Implications

Since the objective function reflects multiple goals, it is necessary to determine the relative importance of each goal in order to produce meaningful results. A purely objective model would capture this importance with weights that reflect the policy goals (e.g., marginal costs for a model that sought to minimize total cost). This sort of objectivity was not feasible in this case, as precise parameters representing the prioritization of the goals do not exist. As an alternative, we view the relative importance of the goals as tuning parameters, and we experimented with different values until we found a set that aligned the model behavior as closely as possible with policy goals (e.g., to phase out ALFA tours) and career field planning practices (e.g., to avoid large numbers of unassigned personnel). To ensure full transparency, we vary these assumptions and discuss their implications. For example, the two scenarios in Chapter 3 vary the importance of unmet desired end-state requirements relative to other goals in the objective function.

However, these assumed values carry other implications. For example, our results assign the same weight to producing a new RPA pilot as to carrying an unassigned pilot in a given year. This implies that the optimal solution reflects what a planner would choose if he or she viewed those two things as equally costly. These relative costs may not match reality in a literal sense, but we believe the model behavior that generated the results is aligned with realistic expectations for how the RPA career field will evolve over time.

Constraints

Constraints are mathematical formulations of real-world limitations that should be taken into consideration or, at the very least, the best approximation to the real-world limitations that we are able to model. Any valid or practical solution in real life should satisfy these limitations, so they are enforced in the model to ensure that any model solution makes sense in

real life and to the decisionmaker. As previously noted, the model calculates inventory from one FY to the next in a typical inventory-control model formulation as applied to this specific situation. The main constraints that define meaningful model solutions given our objective function are the following:

1. The inventory for each pilot type for a particular FY and CYOS is equal to the inventory in the previous FY and CYOS plus total gains in the current FY and CYOS minus total losses in the current FY and CYOS:

$$\begin{aligned}
v_inv_{c,y,f} &= v_inv_{c,y-1,f-1} \\
&\quad - v_sep_{c,y,f} \\
&\quad + p_dstprod_{c,y} * v_prod_{c,f} \\
&\quad + p_dstcross_{c,y} * v_cross_{c,f} \\
\forall(c, y, f) &\in s_Inv
\end{aligned}$$

2. The number of assigned personnel (which is equal to filled desired end-state requirements) plus the number of unfilled desired end-state requirements equals the total number of desired end-state requirements for each duty and FY:

$$\begin{aligned}
\sum_{c_1 \in career, y \in cy} v_asgn_{c_1, c_2, d, y, f} + v_unfill_{c_2, d, f} v_ghost_{c_2, d, f} &= p_rqmt_{c_2, d, f} \\
\forall(c_2, d, f) &\in s_Rqmts
\end{aligned}$$

3. The number of assigned personnel plus the number of unassigned personnel is equal to the total inventory for each career field, CYOS, and FY:

$$\begin{aligned}
\sum_{(c_2, d) \in s_Rqmts: (c_1, c_2, d, y, f) \in s_AsgnMatrix} v_asgn_{c_1, c_2, d, y, f} + v_unasgn_{c_1, y, f} &= v_inv_{c_1, y, f} \\
\forall(c_1, y, f) &\in s_Inv
\end{aligned}$$

4. FTU production (which includes newly produced 18Xs and 11U/12U/ALFA crossflows) is no more than maximum FTU capacity:

$$\begin{aligned}
\sum_{c \in s_career: (c, f) \in s_AggInv} v_prod_{c, f} + v_cross_{c, f} &\leq p_prodcap_f \\
\forall y &\in s_fy
\end{aligned}$$

5. 18X production is no more than the maximum number of expected graduates from URT:

$$\sum_{c \in \text{s_career} : (c,f) \in \text{s_AggInv} \wedge c = 18X} v_prod_{c,f} \leq p_prodcap18X_f$$

$$\forall y \in \text{s_fy}$$

6. Production for a career field in a particular FY must not vary significantly from the production in the previous year, which smooth-flows the production from year to year, making production and training-capacity planning easier.

$$v_prod_{c,f-1} - v_prod_{c,f} \leq 1 + \text{smooth} * v_prod_{c,f-1}$$

$$\forall (c, f) \in \text{s_AggInv} : f > \text{fyfirst} + 4 \wedge c = 18X$$

$$v_prod_{c,f-1} - v_prod_{c,f} \geq -1 - \text{smooth} * v_prod_{c,f-1}$$

$$\forall (c, f) \in \text{s_AggInv} : f > \text{fyfirst} + 4 \wedge c = 18X$$

7. The specified student-to-instructor ratio is maintained as determined by the number of assigned FTU instructors:

$$\sum_{c_1 \in \text{s_career} : (c_1,f) \in \text{s_AggInv}} (v_prod_{c_1,f} + v_cross_{c_1,f}) \leq$$

$$p_prod_f * \left(\sum_{c_1, c_2 \in \text{s_career} \wedge y \in \text{s_fy} : (c_1, c_2, \text{FTUI}, y, f) \in \text{s_AsgnMatrix}} v_asgn_{c_1, c_2, \text{FTUI}, y, f} \right)$$

$$\forall f \in \text{s_fy}$$

8. The model is not penalized for unfilled FTU instructor desired end-state requirements if those requirements are not necessary to meet the level of production within the specified student-to-instructor ratio (without this constraint, the model can fill more FTU requirements than needed, which can then result in as high as a 1:1 instructor-to student-ratio):

$$\frac{\sum_{c_1 \in \text{s_career}} (v_prod_{c_1,f} + v_cross_{c_1,f})}{-STIRatio2018} + p_rqmt_{c_2,d,f} = v_ghost_{c_2,d,f}$$

$$\forall (c_2, d, f) \in \text{s_Rqmts} : f \geq 2018 \wedge d = \text{FTUI}$$

9. The number of personnel who crossflow into the RPA career field does not exceed the upper bound, which is the average historical crossflow rate for traditional pilots multiplied by the desired end state (a proxy for inventory with the 1:1 assumption):

$$v_cross_{c,f} \leq p_cross_{c,f}$$

$$\forall (c, f) \in \text{s_Cross}$$

10. The number of personnel who crossflow into the RPA career field must be greater than the lower bound, which is a user-specified rate for traditional pilots multiplied by the desired end state (a proxy for inventory with the 1:1 assumption) and can be zero:

$$v_cross_{c,f} \geq p_cross_LB_{c,f} * p_cross_{c,f}$$

$$\forall(c, f) \in s_Cross$$

11. The model returns the future (i.e., created by the model) ALFA tour and UPT direct pilots to their original traditional pilot career fields once they have finished serving the four-year tour:

$$v_sep_{c,y,f} = p_dstcross_{c,y-RPA_tour_length} * v_cross_{c,f-RPA_tour_length}$$

$$\forall(c, y, f) \in s_Inv : f \geq fyfirst + RPA_tour_length$$

$$\wedge y \geq cyfirst + RPA_tour_length \wedge c \in \{ALFA, UPT\}$$

12. The model returns the current ALFA tour and UPT direct pilots to their original traditional pilot career fields once they have finished serving the four-year tour:

$$v_sep_{c,y,f} = p_trans_ALFA_{c,y,f}$$

$$\forall(c, y, f) \in s_trans_ALFA$$

13. Losses are equal to the inventory multiplied by the loss rate:

$$v_sep_{c,y,f} = v_inv_{c,y-1,f-1} * 1 - p_surv_{c,y,f}$$

$$\forall(c, y, f) \in s_Inv : c \notin \{ALFA, UPT\}$$

14. Assignments of RPA pilots to desired end-state requirements by duty category should not exceed the maximum upper-bound percentage of the desired assignment pattern for ALFA tour pilots:

$$v_asgn_{c_1,c_2,d,y,f} \leq p_asgn_matrix_UB_{c_1,c_2,d,y,f} * v_inv_{c_1,y,f}$$

$$\forall(c_1, c_2, d, y, f) \in s_AsgnMatrix : c_1 = ALFA$$

15. Assignments of RPA pilots to desired end-state requirements by duty category should not exceed the maximum upper-bound percentage of the desired assignment pattern for non-ALFA-tour pilots:³

³ The set s_CheatGertrude refers to the fact that the RPA model is affectionately referred to as Gertrude, thanks to our point of contact, Lt Col Calvin (PT) Powell. The Cheat part refers to the fact that the assignment-matrix proportion of the inventory is different from the total assigned and Gertrude was finding a way to distort the model-assigned proportions. This change keeps the intent of having the assigned population mimic the traditional pilot pool.

$$\sum_{c_1 \neq \text{ALFA}} v_{\text{asgn}}_{c_1, c_2, d, y, f} \leq \sum_{c_1 \neq \text{ALFA}} p_{\text{asgn_matrix_UB}}_{c_1, c_2, d, y, f} * \left(\sum_{c_z \in s_{\text{career}}, d_z \in s_{\text{duties}}} v_{\text{asgn}}_{c_1, c_z, d_z, y, f} \right)$$

$$\forall (c_2, d, y, f) \in s_{\text{CheatGertrude}}$$

Boundary Conditions

The following constraints initialize certain variable values in the model that we know to be fixed or set variables that are at the boundaries of certain constraints to values to make sure the model behaves properly:

1. Initializes the inventory at CYOS *cyfirst* by equating $v_{\text{inv}}_{c, 'cyfirst', f}$ to zero for all career fields and FYs:

$$v_{\text{inv}}_{c, 'cyfirst', f} = 0 \quad \forall (c, f) \in s_{\text{AggInv}}$$

2. Initializes the inventory by equating $v_{\text{inv}}_{c, y, 'fyfirst'}$ to $p_{\text{initinv}}_{c, y}$ for each career field and CYOS in FY *fyfirst*:

$$v_{\text{inv}}_{c, y, 'fyfirst'} = p_{\text{initinv}}_{c, y} \quad \forall c \in s_{\text{career}}, y \in s_{\text{cy}}$$

3. Ensures there are no separations in CYOS *cyfirst*. Since the inventory-flow constraint is not enforced for CYOS *cyfirst* (as there is no CYOS prior to *cyfirst*), we include this constraint to make sure the model behaves appropriately:

$$v_{\text{sep}}_{c, 'cyfirst', f} = 0 \quad \forall (c, f) \in s_{\text{AggInv}}$$

4. Forces production for 11U/12U/ALFA/UPT is equal to zero. In this model, we define production for 18X. All others are crossflows:

$$v_{\text{prod}}_{c, f} = 0 \quad \forall (c, f) \in s_{\text{AggInv}} : c \neq 18X$$

5. Ghost requirements are not allowed until FY 2018, since we slowly ramp up the FTU instructor requirements from FY 2016 to FY 2018 per our sponsor's request:

$$v_{\text{ghost}}_{c, d, f} = 0 \quad \forall (c, d, f) \in s_{\text{Rqmts}} : c = 18X, d = \text{FTUI}, f \geq 2018$$

6. Ghost requirements for all duties not equal to FTU instructor are zero, so those requirements will be penalized if they are not filled:

$$v_{\text{ghost}}_{c, d, f} = 0 \quad \forall (c, d, f) \in s_{\text{Rqmts}} : d \neq \text{FTUI}$$

Appendix E. Optimal Mix of 18X, 11U/12U, and ALFA Tours

Using the balanced scenario described in Chapter 3, we examined the effect of increasing the crossflow of traditional pilots into the RPA community. Results presented in Chapter 3 capped the crossflow of traditional manned-aircraft pilots into the RPA community at 18 per year, based on what was normal among those pilots. To examine the potential benefits of increasing crossflow levels, we lifted this cap to 50 per year—a level consistent with patterns observed in the reconnaissance-pilot community (11R), where crossflow is more common (see Table C.8). While this change in our assumptions will not *require* an increase in crossflow, it will allow the model to bring in more crossflows if that is expedient.

With a higher cap on crossflows, the solution produces similar numbers of new pilots each year but does take advantage of the higher cap by substituting additional 11U pilots for 18X production (Figure E.1). With the option of bringing in up to 50 11Us per year, the solution reaches the point where unfilled or unmet desired end-state requirements are minimized one year sooner, in FY 2030, while the number of unfilled desired end-state requirements falls by an average of 13 per year (Figure E.2). Increased crossflow reduces unfilled desired end-state

Figure E.1. Annual Production with a Higher 11U Crossflow Limit in the Low-Loss Scenario

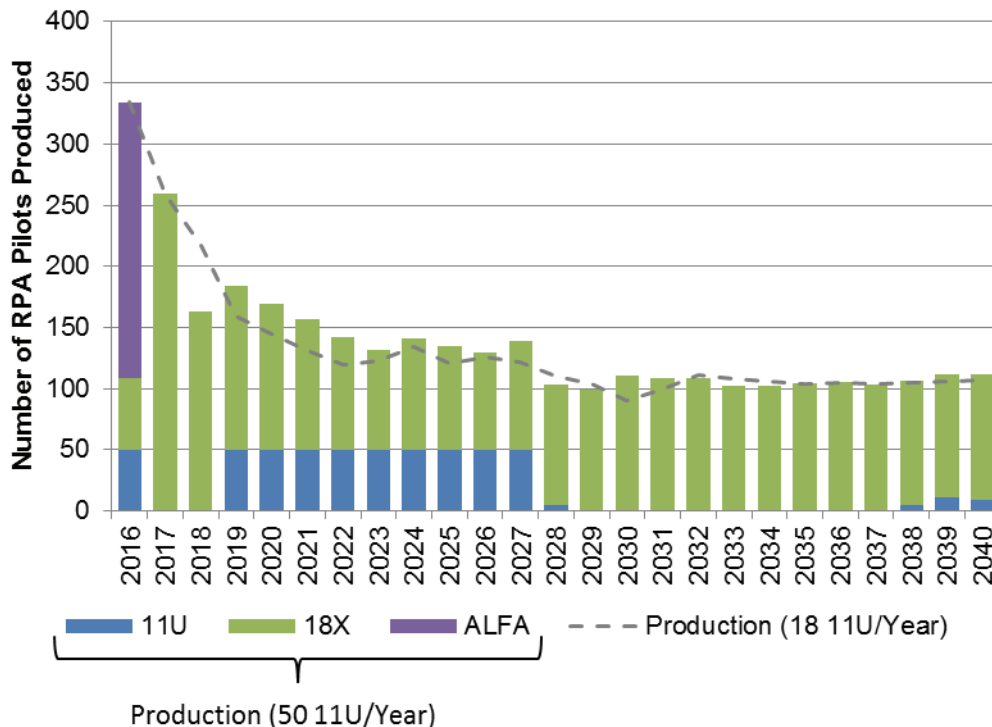
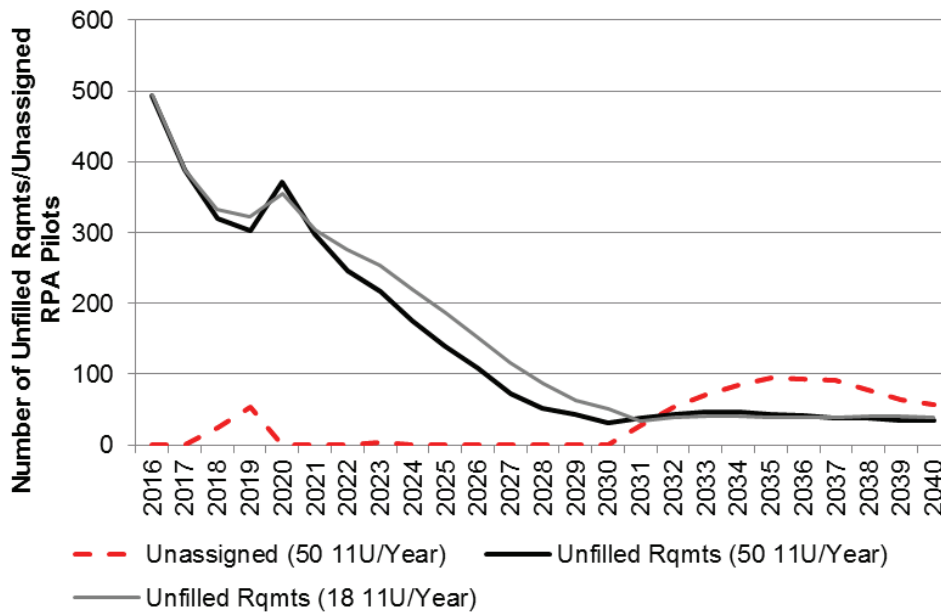


Figure E.2. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots with Higher 11U Crossflow Limit in the Low-Loss Scenario



NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

requirements because the experience distribution of new 11U pilots differs from that of those emerging from the 18X production pipeline. Because crossflowed pilots join the RPA community later in their careers, these pilots can be used to fill more-senior desired end-state requirements sooner. Since the development and support desired end-state requirements outside of RPA operations tend to be the most difficult to fill, an increase in crossflow reduces the time required to meet the requirements.

Finally, Figure E.2 shows a buildup of unassigned RPA pilots starting in FY 2031 that increases up to 100 around FY 2035. This buildup is the result of good retention past 20 CYOS. Good retention later in the career results in officers who are not needed in the duties to which they can be assigned based on experience (development and support duties), and their experience does not align with traditional manned-aircraft pilot assignments for the unfilled line examiner positions. This issue could be addressed by the Air Force through force management actions. However, this could also highlight that retention after retirement eligibility has been estimated too high, and in fact, this group of senior officers would not exist if retention is not as high as our estimates.

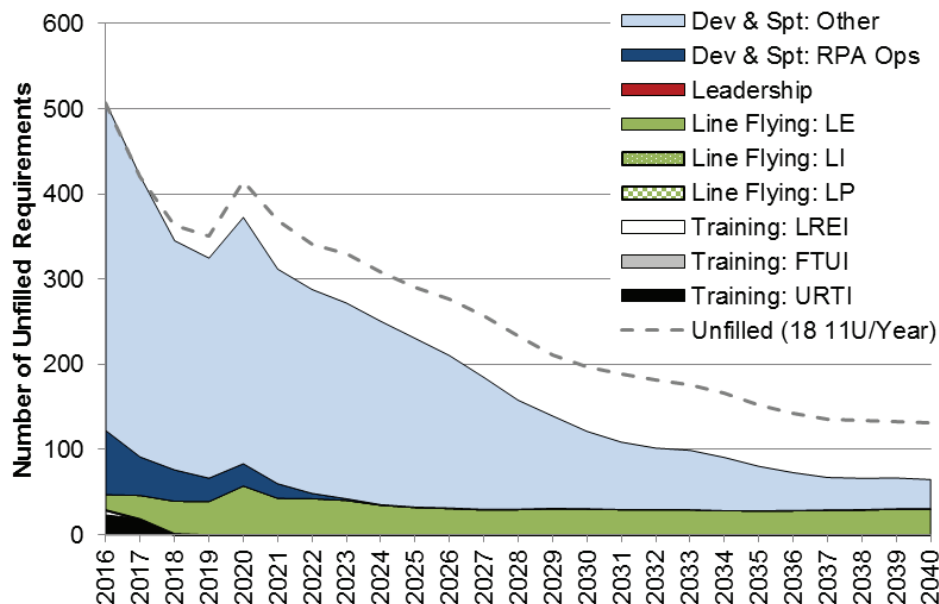
Not only does raising the limit on crossflowed RPA pilots reduce the time required to reach the goal in the low-loss case, additional crossflow could act as a buffer against higher-than-expected losses among 18X pilots. Recall that in the medium-loss case, the scenario solution did not meet all requirements, leaving some development and support desired end-

state requirements unfilled. Increasing the limit on crossflows reduces the number of desired end-state requirements that go unmet each year, because more crossflowed pilots who have appropriate experience and relatively high retention can fill those desired end-state requirements. Allowing 50 crossflows per year is not quite enough to enable the balanced scenario to fill all development and support desired end-state requirements by FY 2040 (Figure E.3), but the result is a significant improvement over the case where crossflows could not exceed 18 per year.

The potential drawback of increased crossflow from traditional manned-aircraft pilot communities is that it delays the point at which the RPA career field would achieve 90 percent 18X pilots (the goal currently set by senior Air Force leaders). As shown in Figure E.4, in the increased 11U crossflow scenario with low losses, the career field crosses the 90-percent threshold in FY 2034 (compared with FY 2029 for the baseline scenario). In FY 2026, only 74 percent of RPA pilots are 18X, so even 10 years into the transition, a significant minority population of 11Us remains.

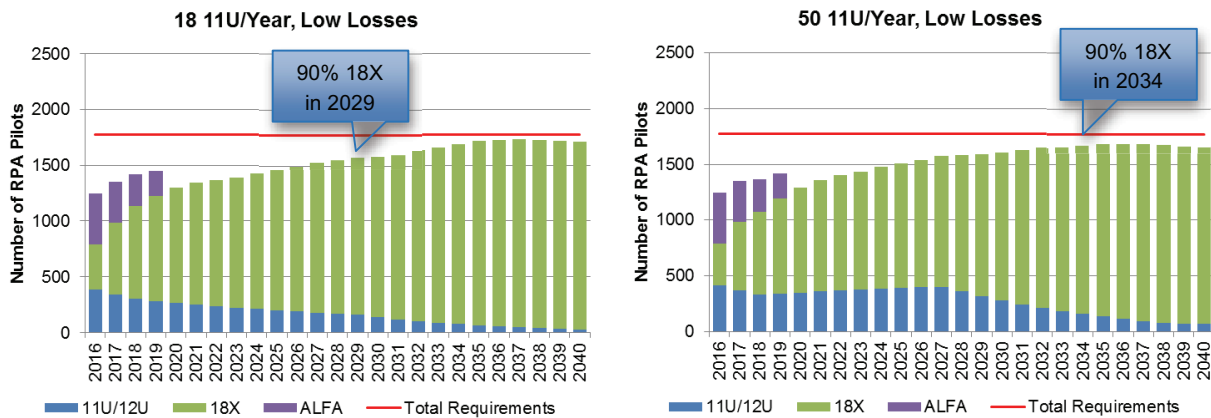
While the increased production tempo associated with the ASAP scenario (discussed in Chapter 3) did not tend to create a better path to career field health than the balanced scenario, this set of results illustrates how changing the mix of pilots can positively affect the optimal solution. Allowing additional 11U pilots to fill RPA pilot desired end-state requirements not

Figure E.3. Effect of Increasing Crossflow on Unfilled Desired End-State Requirements by Duty (Balanced Scenario with Medium Losses)



NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

**Figure E.4. RPA Pilot Inventory with Increased Crossflow vs. Baseline
(Balanced Scenario with Low Losses)**



only reduces the time to reach the desired end state but also serves as a way to inject experience into the RPA career field, which helps fill development and support positions sooner than in the baseline scenario. Using 11Us is preferable to using ALFA tours for achieving this outcome, since ALFA tours are intended primarily to augment unit-level RPA pilots. This increased level of crossflow also represents a source of stability that would help the RPA career field meet desired end-state requirements in the event that 18X losses are higher than ideal.

However, increasing crossflow prolongs the transition to the point at which 90 percent of RPA pilots are from the 18X career field. It also may not be optimal for the traditional manned-aircraft pilot career fields to be losing 50 pilots a year, as the increased crossflow could negatively affect the communities that donate these pilots. High levels of crossflow could be viewed as a waste of resources, given that UPT for traditional pilots is far costlier than URT. Therefore, policymakers will need to carefully weigh the advantages gained by increasing the 11U crossflow minimums that merit consideration against the potential disadvantages for rated force management as a whole and for achieving the desired end state of a nearly entirely 18X force (which was strongly valued by leadership and stakeholders in our interviews).

Appendix F. Alternative Assignment Patterns and Desired End-State Requirements

In the results presented in the main text and the previous appendices, the model draws on the patterns of traditional manned-aircraft pilots to inform how pilots in the RPA inventory should be matched to the desired end-state requirements in building a healthy and sustainable career field. We also considered whether alternative assignment patterns and desired end-state requirement benchmarks would significantly change the model outcomes and create a stable RPA career field more quickly.

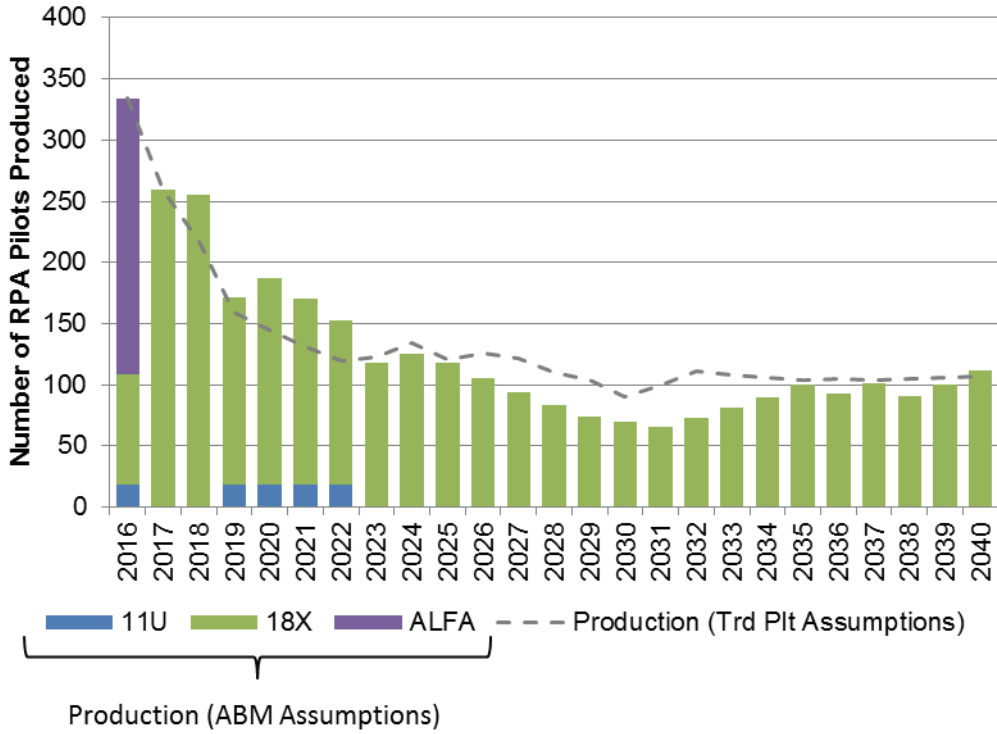
Previous results sought to shape the RPA career field according to traditional manned-aircraft pilot patterns in two ways. First, they relied on a traditional manned-aircraft pilot benchmark for determining desired end-state requirements in certain career development and support duties. Second, they determined which duties RPA pilots could fill in each CYOS according to what is normal for traditional manned-aircraft pilots.

To examine the effects of an alternative set of assumptions, we calculated the same inputs governing development and support desired end-state requirements, as well as assignment patterns, using ABMs as the benchmark. Using this benchmark yields similar inputs to those of the traditional manned-aircraft pilot benchmark, except the ABM benchmark results in fewer joint staff and in-residence PME opportunities (see Figure 2.1). In terms of assignments, the ABM career field differs from the traditional pilot career field in some important ways. More ABMs tend to be in line duties beyond CYOS 10, and it is more common for ABMs to be in both line-flying duties and development and support duties throughout their careers. In addition, ABMs have fewer command opportunities than traditional pilots, who fill a greater variety of command positions across the Air Force.

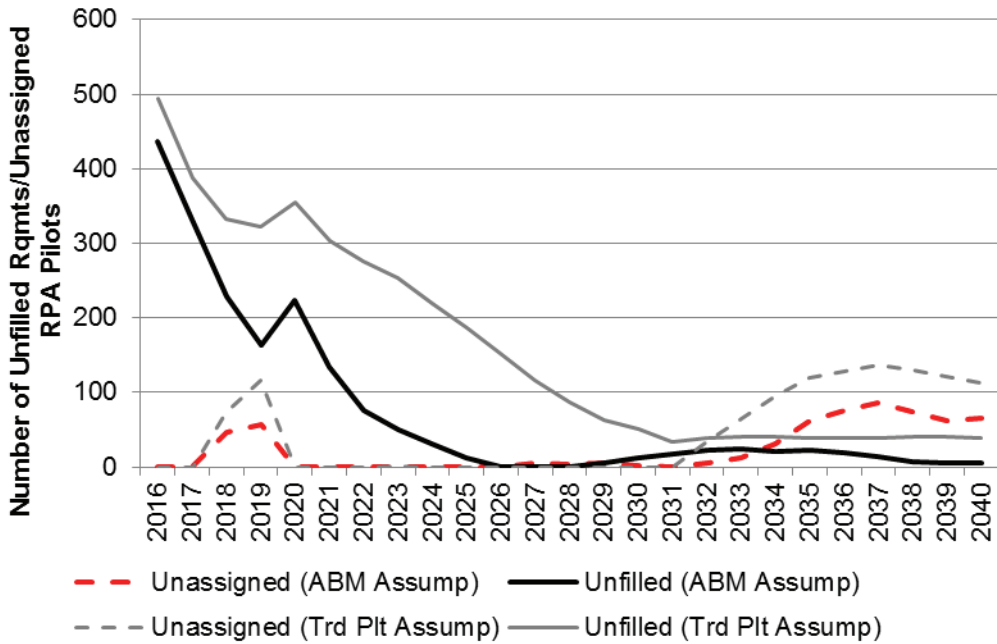
All else being equal, these patterns should enable a solution that fills development and support desired end-state requirements sooner, for several reasons. First, the ABM benchmark results in fewer such requirements to fill. Second, because it is more common for ABMs to be in development and support duties, the benchmark would allow more RPA pilots to be allocated to those requirements at each CYOS level.

When we program the model to use ABM assignment policies instead of traditional pilot practices, it renders a solution with similar levels of annual production (Figure F.1). However, the ABM assignment patterns offer additional flexibility that allows all desired end-state requirements to be filled by FY 2026 (Figure F.2).

**Figure F.1. Annual Production Using ABM Patterns and Desired End-State Requirements
(Balanced Scenario with Low Losses)**



**Figure F.2. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots with ABM
Assignment Patterns and Desired End-State Requirements
(Balanced Scenario with Low Losses)**

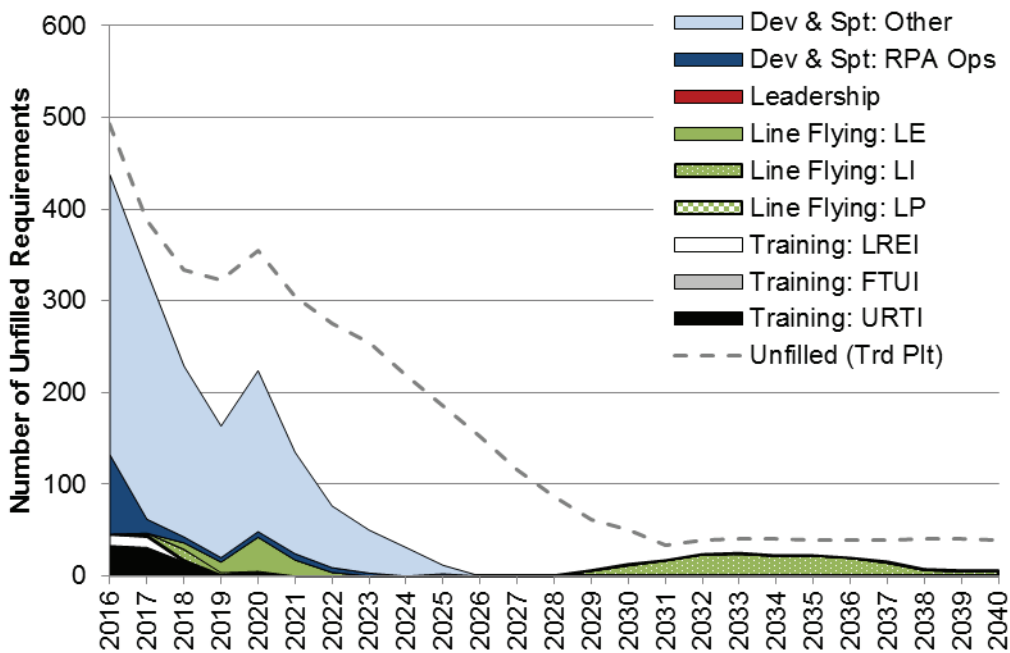


NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

It is also worth noting that the solution requires fewer 11U pilots because there is less need for more experienced pilots to fill development and support desired end-state requirements. Nevertheless, even in the balanced scenario, where we program the model to avoid unnecessary overages, the optimal solution includes some unassigned personnel in the later years. Unlike in the ASAP scenario, however, these unassigned personnel are more senior RPA pilots nearing the end of their careers.

The improvement in the time required to meet all desired end-state requirements is even more evident when looking at unfilled or unmet desired end-state requirements by duty (Figure F.3). Prior results showed that significant numbers of unfilled development and support desired end-state requirements would linger until FY 2031, but with different assignment policies, all desired end-state requirements could be met by FY 2026. The prior results also showed that a small number of desired end-state requirements were difficult to fill under traditional manned-aircraft pilot norms, but the ABM solution does not have this problem, as unfilled desired end-state requirements actually reach zero in FY 2026. Still, it is important to view these results in light of the fact that development and support assignments that ABMs typically fill are qualitatively different from those filled by traditional manned-aircraft pilots. Thus, although this solution fills desired end-state requirements more quickly, it

Figure F.3. Unfilled Desired End-State Requirements by Duty Using ABM Assignment Patterns and Desired End-State Requirements (Balanced Scenario with Low Losses)



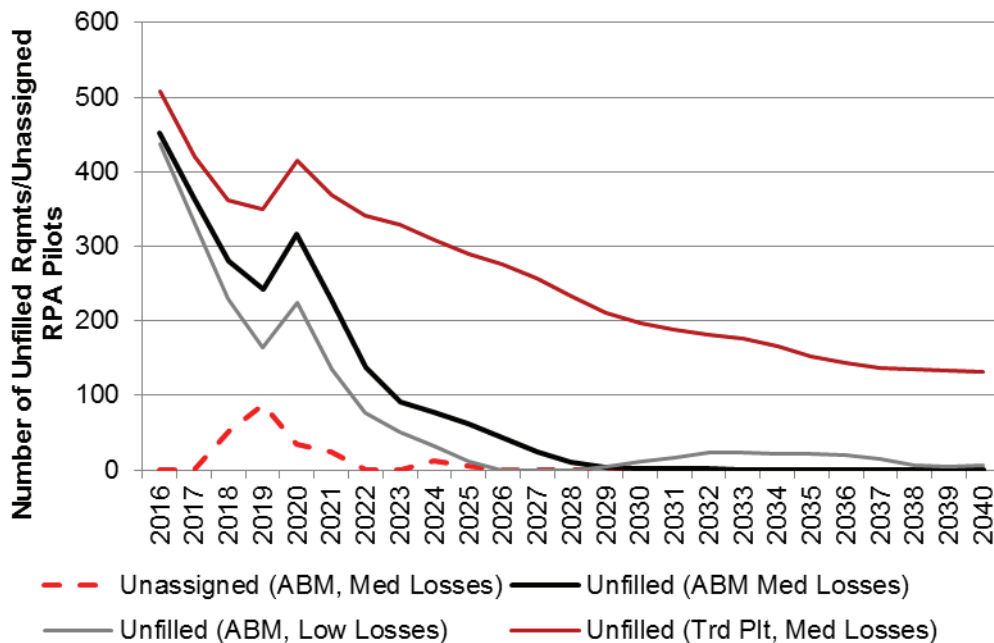
NOTE: Unfilled desired end-state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

may not provide the right career broadening and developmental experiences to make RPA personnel competitive with traditional manned-aircraft pilots for leadership positions down the road as compared to traditional manned pilots.

The ABM results also differ from those in the traditional manned-aircraft pilot model in the event of higher losses. Under traditional pilot assignments, there is no balanced-scenario solution that fills all desired end-state requirements in the case of medium-level losses. With ABM assignments, the possibility of reaching the goal does not unravel under medium losses, although medium losses cause a delay in meeting those requirements relative to the low-loss case (Figure F.4). The medium losses also help the inventory balance, as there are no unassigned RPA pilots beginning in FY 2032.

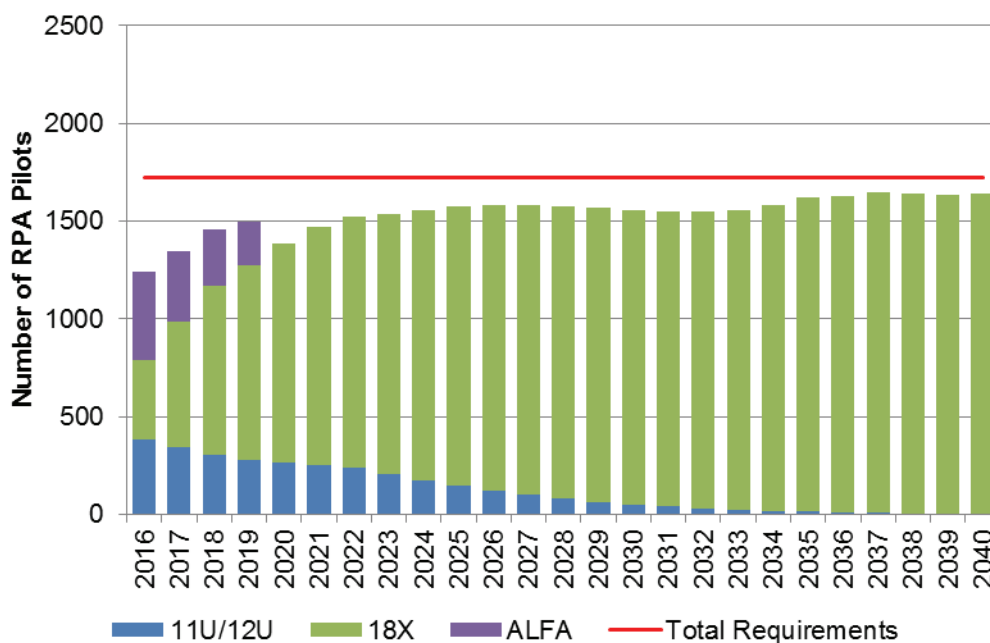
Since higher levels of crossflow are unnecessary in the ABM case, the optimal solution leads to an RPA career field that is 90 percent 18X by FY 2025 and all but phases out 11U pilots in the long run (Figure F.5). This finding is also favorable, given the goal of sustainability, since it is unlikely that other manned-aircraft pilot communities would support a long-run equilibrium in which they must perpetually donate manned-aircraft pilots to the RPA community.

Figure F.4. Unfilled Desired End-State Requirements vs. Unassigned RPA Pilots Using ABM Assignment Patterns and Desired End-State Requirements (Balanced Scenario with Medium Losses)



NOTE: Unfilled desired end state requirements constitute the gap between the projected inventory in a given FY and the desired end state filled at 100 percent.

**Figure F.5. RPA Pilot Inventory Under ABM Assignment Patterns
(Balanced Scenario with Low Losses)**



When we compare the results using ABM norms with those of the traditional manned-aircraft pilot models, the ABM solution would appear to have some mechanical advantages in reaching the goal. With ABM assignment patterns and benchmarked desired end-state requirements, the desired end state can be reached earlier, is more robust under elevated losses, does not require higher levels of 11U crossflows, and achieves a 90/10 mix of 18X pilots by 2025. This end state is more difficult to reach under traditional manned-aircraft pilot norms.

However, the ABM assignment patterns differ from traditional manned-aircraft pilot patterns because ABMs fill qualitatively different requirements than those filled by traditional manned-aircraft pilots and offer different developmental opportunities than other pilot career fields. These differences could have consequences for the health of the RPA career field. If RPA developmental opportunities are not comparable to traditional manned-aircraft pilot opportunities, RPA pilots may be less competitive for senior leadership positions (colonel and general officer selection and joint assignments), and thus their operational experience would be underrepresented at the highest levels of the Air Force. Further, lack of opportunities at the senior levels of the Air Force could make RPA pilots feel undervalued, affecting morale in the RPA community, which might have ripple effects for retention and recruiting. The model cannot account for these complex policy considerations, so the results described in this appendix are not intended to imply that the ABM benchmark is superior to the traditional pilot benchmark. Leadership and stakeholder interviews suggest that even if the ABM profile is a better fit, it is not consistent with the leadership’s views about how the 18X career field of the

future should be structured. Moreover, when asked about this scenario, some of our interviewees suggested that the ABM community is not as competitive for higher-level leadership assignments and, therefore, following the ABM profile would not be good for the 18X community. For that reason, we caution readers against interpreting the findings here to suggest that the ABM profile is a better approach to managing the MQ-1/9 community.

References

- Air Force Instruction 11-412, *Flying Operations: Air Crew Management*, Secretary of the Air Force, August 1, 1997.
- Air Force Instruction 36-210, *Classifying Military Personnel*, Secretary of the Air Force, June 25, 2013.
- Air Force Personnel Center (AFPC/DP3ST), *Air Force Officer Classification Directory (AFOCD): The Official Guide to the Air Force Officer Classification Codes*, April 30, 2016.
- Bigelow, James H., and Albert A. Robbert, *Balancing Rated Personnel Requirements and Inventories*, Santa Monica, Calif.: RAND Corporation, TR-869-AF, 2011. As of July 31, 2017:
http://www.rand.org/pubs/technical_reports/TR869.html
- Carlisle, General Herbert J., Commander, Air Combat Command, *Presentation to the Senate Armed Services Committee Subcommittee on Airland*, March 16, 2016. As of July 31, 2017:
http://www.armed-services.senate.gov/imo/media/doc/Carlisle_03-16-16.pdf
- Everstine, Brian W., “Don’t Fear the Reaper,” *Air Force Magazine*, February 2016. As of September 29, 2016:
<http://www.airforcemag.com/MagazineArchive/Documents/2016/February%202016/0216reaper.pdf>
- Hardison, Chaitra M., Eyal Aharoni, Christopher Larson, and Alex Hou, *Stress and Dissatisfaction in the Air Force’s Remotely Piloted Aircraft Community: Focus Group Findings*, Santa Monica, Calif.: RAND Corporation, RR-1756-AF, 2017. As of July 31, 2017:
https://www.rand.org/pubs/research_reports/RR1756.html
- Hardison, Chaitra M., Michael G. Mattock, and Maria C. Lytell, *Incentive Pay for Remotely Piloted Aircraft Career Fields*, Santa Monica, Calif.: RAND Corporation, MG-1174-AF, 2012. As of July 31, 2017:
<http://www.rand.org/pubs/monographs/MG1174.html>
- Martin, Kiel M., Daniel J. Richmond, and John G. Swisher, “Sustaining the Drone Enterprise: How Manpower Analysis Engendered Policy Reform in the United States Air Force,” *Interfaces* (forthcoming), pp. 137–149. As of July 31, 2017:
<http://pubsonline.informs.org/doi/full/10.1287/inte.2016.0882>

- Robbert, Albert A., Anthony D. Rosello, Clarence R. Anderegg, John A. Ausink, James H. Bigelow, Bill Taylor, and James Pita, *Reducing Air Force Fighter Pilot Shortages*, Santa Monica, Calif.: RAND Corporation, RR-1113-AF, 2015. As of July 31, 2017:
http://www.rand.org/pubs/research_reports/RR1113.html
- Robbert, Albert A., Tara L. Terry, Alexander D. Rothenberg, Anthony Lawrence, and Neil Brian Carey, *Air Force Officer Management Flexibilities: Modeling Potential Policies*, Santa Monica, Calif.: RAND Corporation, RR-1921-AF, 2017. As of January 2, 2018:
http://www.rand.org/pubs/research_reports/RR1921.html
- Secretary of the Air Force Public Affairs, “Air Force Approves RPA Initiatives,” Official United States Air Force Website, April 11, 2016. As of July 31, 2017:
<http://www.af.mil/News/ArticleDisplay/tabid/223/Article/717598/air-force-approves-rpa-initiatives.aspx>
- Terry, Tara L., James H. Bigelow, James Pita, Jerry Sollinger, and Paul Emslie, *User’s Guide for Total Force Blue Line (TFBL) Model*, Santa Monica, Calif.: RAND Corporation, TL-233-AF, 2017. As of July 31, 2017:
<https://www.rand.org/pubs/tools/TL233.html>
- U.S. Government Accountability Office, *Actions Needed to Strengthen Management of Unmanned Aerial System Pilots*, Washington, D.C., GAO-14-316, April 10, 2014.

Remotely piloted aircraft (RPA) and the personnel that operate them are well understood to be crucial to mission success in today's Air Force, and demand for skilled pilots continues to grow rapidly. However, recent studies suggest that personnel in the RPA pilot career field are dissatisfied with aspects of the job and are experiencing stress as a result. Although a variety of workplace factors lead to the stress and dissatisfaction, a large portion of them relate to issues associated with career field planning.

These career field planning issues exist, in part, because of the newness and rapid growth of the RPA enterprise. The 18X RPA pilot force (those whose first and only rated job is as an RPA pilot) is only six years old, and plans for the future of the career field are still evolving. Moreover, as the rapid growth in demand for 18X pilots has outpaced the Air Force's ability to produce them, the Air Force is now struggling to train and retain enough personnel to meet the demand. Recognizing that a more thoughtful and stable plan for managing the career field is needed to ensure the future health of the force, Air Force leadership asked RAND to assist in building a long-term career field planning model that addresses those force health issues and the timeline required to build a healthy, sustainable career field. This report documents RAND's efforts to develop that model; explains its main features, underlying content, and data inputs; and describes its key technical aspects.



PROJECT AIR FORCE

www.rand.org

\$36.00

ISBN-10 0-8330-9874-8

ISBN-13 978-0-8330-9874-0



9 780833 098740

53600