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Research Report

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# How the U.S. Air Force Can Incorporate New Data Technologies into Its Talent Management System

## Framework and Use Cases for Technology-Enabled Talent Management

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# About This Report

Technology-enabled practices have potential to greatly enhance how the U.S. Air Force (USAF) manages its people. These technologies include data management, information technologies, and artificial intelligence (AI). These technologies can enhance human resource management by making available new sources of data and by using AI to extract new information and guide decisions using these data. By adopting technology-enabled practices, the USAF can shift from being governed by broad, standardized policies informed by periodic analyses to a system in which decisions are continually refined to meet goals using the best available information. This report builds on prior research to present a framework to help policymakers understand the distinctive elements of technology-enabled practices, along with descriptions of use cases in each area of talent management. The report closes with a description of three broad implementation challenges and a structured approach to move forward with adoption.

This report is one in a set aimed at helping the USAF understand the elements necessary for technology-enabled talent management. Other reports in this set are

- Douglas Yeung, Elicia M. John, Jeannette Gaudry Haynie, James Ryseff, Bonnie L. Triezenberg, and Nelson Lim, *Implementing Technology-Enabled Human Resources Capabilities in the U.S. Air Force: Insight from the Private Sector and Military Services*, RR-A1198-1, 2022.
- Don Snyder, *Funding Technology-Related Business Initiatives in the Department of the Air Force*, RR-A1198-3, 2022.

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# Summary

The U.S. Air Force (USAF) and the other military services have a long history of innovation in human resource management (HRM). The recent industry boom in data-related technologies has prompted USAF leaders to sponsor research on how these technologies could further improve HRM decisions. This report describes the common theme of this research portfolio, which is that adopting HRM practices that are *technology-enabled* could lead to more-effective talent management. Of course, technologies exist on a spectrum, and the USAF, like all other organizations, already rely on some technologies to perform HRM functions. However, by pursuing the latest technological advances, the USAF can continue to improve the efficiency and effectiveness of HRM processes.

To help policymakers understand the contrast between technology-enabled practices and practices already in place that make use of rich data, we describe industry practices that fit under the umbrella of technology-enabled talent management and present a framework highlighting their distinctive features. We focus principally on the use of artificial intelligence (AI) and other analytic techniques to derive insight from data at speed and scale. Then, we present use cases in which recent research has demonstrated technology-enabled practices in the USAF context, discuss barriers to further implementation, and present an implementation structure for moving toward greater adoption of these practices. In researching the path to a technology-enabled talent management system, we found the following:

- Large industry firms, such as IBM, use technology-enabled techniques to improve employee experiences by customizing talent management decisions at a large scale.
- All firms face challenges in applying technology-enabled techniques to talent management, but features of USAF talent management processes and associated data place the organization in a good position with regard to technical feasibility.
- Recent research has demonstrated the functionality of elements of technology-enabled business practices, and particularly of AI, in most areas of talent management.
- Legacy policy structures, existing culture, and limitations in the USAF data infrastructure stand out as barriers to fully leveraging emerging technologies for HRM.
- A structured implementation approach to adoption of technology-enabled practices would address (1) organizational and policy foundations; (2) the technological foundation; (3) data curation, data management, and data services; (4) analysis systems, methods, and services; and (5) enterprise integration and deployment.

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CHAPTER 1

# Introduction

Like corporations across the globe, the U.S. Air Force (USAF) is exploring the benefits of moving away from a traditional human resources (HR) system that emphasizes standardization and process efficiency toward a more-responsive and more-personalized system empowered by data, information technologies (IT), and artificial intelligence (AI) (Wright et al., 2020). Although the USAF has requirements, missions, and policy structures that make it difficult to fully leverage emerging technologies for human resource management (HRM), there are many important uses for new capabilities in talent management in the service.

This report—one in a set aimed at helping the USAF understand the elements necessary for success in transforming IT and business systems for HRM[1]—concerns the elements necessary for success in pursuing greater adoption of data technologies in talent management. Technologies exist on a spectrum, and the USAF, like all other organizations, already relies on some technologies to perform HRM functions. However, by pursuing the latest technological advances, the USAF can continue to improve the efficiency and effectiveness of HRM processes.

After providing a framework for understanding the distinctive features of these new technologies (which we term *technology-enabled* practices), we describe several applied use cases from recent research, followed by a discussion of potential barriers to implementation. We focus principally on the use of AI, which depends on data and supporting IT. The companion reports to this one examine best practices for implementation and address strategies for securing sufficient funding and resources for digital transformation (Snyder, 2022; Yeung et al., 2022).

In recent years, advances in data management, IT, and AI have transformed talent management and other business practices (Cappelli, Tambe, and Yakubovich, 2018). For example, 50 percent of respondents to the 2020 McKinsey Global Survey of businesses reported that their companies had adopted AI in at least one business function (McKinsey Analytics, 2020, p. 2).[2] About 10 percent adopted AI for "optimization of talent management" (such as recruiting and retention), and about 7 percent for "performance management" (McKinsey Analytics, 2020, p. 3). Many of the applications were apparently highly effective: Among the companies that adopted AI for talent management, more than one-half reported that doing so had increased revenue or decreased cost. In the USAF context, the effectiveness of such applications goes beyond efficiency and includes whether the applications are aligned with organizational values and the rule of law. (For a more detailed discussion of these issues, see Appendix C of National Security Commission on Artificial Intelligence, 2021.)

The USAF and other military services have a long history of innovation in applications of (what is now called) data science to talent management problems. For instance, in the 1960s and 1970s, U.S. Department of Defense (DoD) research pioneered the Armed Services Vocational Aptitude Battery (ASVAB) to solve the difficult problem of how to predict recruit success in one of the hundreds of potential occupations in which they

[1] Note that these closely related volumes share some material, such as descriptions of USAF priorities, study approach, and private-sector and government-technology landscapes.

[2] A sample of 2,395 organizations participated in an online survey in 2020 (McKinsey Analytics, 2020, p. 13).

might serve (Welsh, Kucinkas, and Curran, 1990). In the early 1990s, the USAF developed its own custom test battery for pilot selection (Carretta, 2011).

How could the industry-hyped data technologies of recent years add value to a USAF system that already has a set of customized quantitative methods for HRM and, thus, is highly attuned to the power of data? Taking advantage of new technology-enabled techniques requires a shift in thinking about AI applications to business practices. When discussing applications of AI to DoD *missions*, strategy documents emphasize that AI will generate transformational capabilities that contribute to military advantage. On the business side, however, the same strategy documents seem to emphasize that AI will enable incremental gains in the efficiency of processes without fundamentally restructuring them. Consider this quote from the DoD AI strategy (DoD, 2019, p. 6):

> The ability of AI to reduce inefficiencies from manual, laborious, data-centric tasks will be harnessed across the Department with the objective of simplifying workflows and improving the speed and accuracy of repetitive tasks.

A technology-enabled talent management system is not primarily one in which business processes operate more efficiently through automation; rather, it is a system that enables altogether new business processes.[3] The functions of these new business processes may remain the same—recruiting, training, promotion, and retention—but the way they are performed may be transformed. In this way, technology-enabled talent management fulfills the vision articulated by Brose (2020, p. 6):

> The question is not how new technologies can improve the US military's ability to do the same things it has done for decades but rather how these technologies can enable us to do entirely different things—to build new kinds of military forces and operate them in new ways.

A concerted approach to technology-enabled talent management coupled with an openness to think differently about HRM could open opportunities for performance gains in many areas, such as those that already use data extensively in decisionmaking.

## Technology-Enabled Talent Management Becoming a Commercial Reality

As companies apply AI to business functions for the first time, advances in technology and analytics are transforming all phases of talent management. O'Shea and Puente (2017) reported that talent management technologies are moving away from single solutions for isolated HR functions, and toward end-to-end systems that encompass all phases of talent management, from recruiting to separation.[4] "These more comprehensive solutions help promote a unified, holistic view of talent management within organizations and reduce the potential incompatibilities and redundancies inherent in the use of separate solutions for each talent management function" (O'Shea and Puente, 2017, p. 551). The authors also point out that these systems provide a "rich source of data [that] can be used to build statistical workforce-planning models and even

[3] Improving and integrating Air Force personnel enterprise resource management systems may produce cost savings and temporal efficiencies. However, this report focuses on the transformative potential of technology-enabled talent management rather than the evolutionary gains that greater automation would allow.

[4] The same is true of enterprisewide information systems for non-HR functions in industry.

recast traditionally episodic activities, such as assessment validation, into dynamic processes that can be evaluated over time" (O'Shea and Puente, 2017, p. 551; also see Oswald et al., 2020).

IBM is a case study in the application of technology-enabled business processes to all phases of talent management (Table 1.1; also see Guenole and Feinzig, 2018). IBM's HR function was among the first to adopt AI technology, and its use cases now span myriad HR functions. For example, chatbots are used to direct potential applicants to position openings, machine learning (ML) uses information gathered during the application process to predict performance of applicants, and AI assistants are used to deliver personalized training and career coaching. IBM reported that these applications netted not only positive HR benefits but also corporate savings of $107 million in 2017 alone (Guenole and Feinzig, 2018).

**TABLE 1.1**
**IBM Implemented AI-Enabled Talent Management**

| HR Function | Use Case |
|---|---|
| Attract | Chatbots that use natural language processing to answer job seekers' frequently asked questions about the company and to recommend relevant position openings. |
| Hire | Algorithms that (1) determine the match between an applicant's résumé and the job requirements and (2) predict future performance using information collected about the applicant during the application process. |
| Engage | Automated audits and alerts that nudge managers to act when appropriate. For example, a manager might be alerted that an employee has acquired the skills and experience necessary to be promoted. |
| Retain | Algorithms that use employee data and economic conditions to suggest competitive compensation packages. |
| Develop | Algorithms that (1) tag and index content in large corporate learning management systems and (2) track individual needs to personalize the training that is delivered. |
| Grow | An AI assistant that interacts with employees to shape career trajectories. Career coaching has traditionally been costly and time intensive, so it has historically been reserved for a limited number of people. |
| Serve | Intelligent assistants that guide employees through benefit enrollment decisions or performance management tools or that help employees navigate their organization by identifying the right point of contact for an inquiry. |

SOURCE: Guenole and Feinzig, 2018.

CHAPTER 2

# How the USAF Uses Data for Human Resources

The USAF has a long history of data-informed talent management. To meet human capital needs each year, the USAF must recruit tens of thousands of individuals, train and equip them to perform hundreds of occupationally specialized tasks, and retain them at the right levels to meet operational requirements while satisfying cost constraints. It would be impossible for the USAF to execute these talent management functions without making data-informed decisions.

*Data-informed decisionmaking* involves gathering and analyzing data on a specific case and using that information to make decisions about that case. In contrast, *technology-enabled business practices* continually gather and fuse data from diverse sources and use the information to adjust ongoing HR processes. Data sources are traditional ones, such as administrative databases (a staple of the USAF HR management), and nontraditional sources, such as data that users generate while interacting with IT systems (sometimes termed *digital exhaust*).

Figure 2.1 depicts how data-informed business processes support ongoing HR decisions in the USAF. Certain policy questions are revisited at regular intervals. Data are gathered and analyzed, and the results are used to inform recommendations and update policies. One example of a data-informed process is the USAF's approach to compensation, as illustrated in the selective retention bonus program. DoD authorizes the services to determine bonus eligibility criteria with the goal of shaping retention toward their skill and experience needs (DoD Instruction 1304.31). The USAF Directorate of Force Management Policy evaluates each enlisted specialty at least once per year to determine the appropriate level of bonus eligibility, factoring in data inputs on projected shortages; training costs; and research on the relationships among compensation, demand for the military skill in the civilian labor market, and retention (Air Force Instruction 36-2606). The data inputs and analysis inform recommendations on updated bonus offerings, and those new offerings are published in the form of new policies in an annual announcement.[1]

**FIGURE 2.1**
**Data-Informed Business Practices of the USAF**


[1] Other policy questions regarding compensation are addressed as the need arises. These questions may require different types of expertise, data sources, and analytic approaches. For example, the USAF has invested in research programs designed to help manage the pilot force (Robbert et al., 2015; Mattock et al., 2016), bringing them to the point where they can advocate appropriations that are based on cost-benefit analyses of different approaches to pilot production and compensation (Mattock et al., 2019). The USAF relies on internal offices (such as the Studies, Analysis and Assessments Directorate [AF/A9]) and external organizations (such as federally funded research and development centers, academia, and industry) to address these types of questions in a data-informed way.

## Technology-Enabled Business Practices: The Future of USAF Talent Management

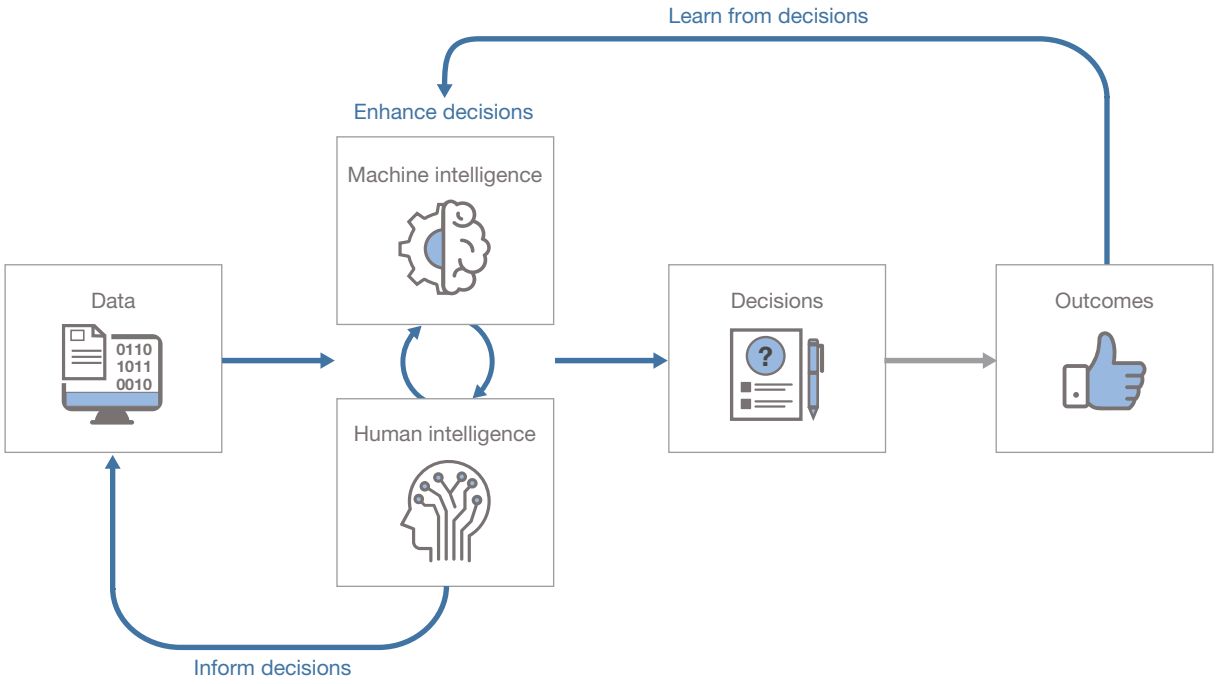
How would a data-enabled approach to compensation differ from existing USAF processes that draw heavily on data and models? In a recent report on this topic (Guenole and Feinzig, 2018), researchers at IBM described adoption of an AI decision-support system that provides managers with customized recommendations that are based on the market demand for skills and the organizational costs of replacement. The technology-enabled approach at IBM differs from the selective retention bonus process in that it uses AI to generate recommendations that are customized to individuals while continually learning from manager decisions to override those recommendations. The system also promotes transparency, and possibly retention, by providing the same information to employees so that they can see how their compensation relates to their market value.

Although compensation in the USAF is not set by frontline managers, the contrast illustrates that transitioning from data-informed decisionmaking to technology-enabled business practices allows for customization at a large scale, with continual learning, to potentially replace HRM practices that have historically been standardized. Figure 2.2 depicts a general mockup of how data-enabled business practices could support ongoing HR decisions in a relatively short time. These business practices do not simply use "big data" or "AI." **Rather, they depend on an integrated architecture that brings together data, machine intelligence, and human intelligence to improve decisions and outcomes.**

### Leveraging New Types of Data to Enhance Decisions

Data, the essential fuel of technology-enabled business practices, encompass all potential sources of information to improve decisionmaking. The data can take many forms, such as text in documents or emails, videos

**FIGURE 2.2**
**Essential Elements of Technology-Enabled Business Practices of the USAF**



or images posted to social media, audio recordings, readings from physiological sensors, and geolocation data from phones and satellites. Vast and continual data streams produce an unprecedented volume of data that can be used to inform HR processes.

If accurate predictions are the essential decision input, technology-enabled practices do not commit to a theoretical model that links certain variables, measured using specific data sources, to HR outcomes (Putka, Beatty, and Reeder, 2018). Rather, all available data are synthesized without specifying in advance how each element relates to a theoretical model, and those data are used to predict key HR outcomes. The term *big data* was coined to capture the volume, variety, and velocity of data accumulated and used in business practices (Diebold, 2021). In other applications, as our use cases show, such unstructured predictions can be combined with a structural representation of the HR mechanism or system to generate new insights.

## Leveraging New Forms of Machine Intelligence to Enhance Decisions

If data are the fuel for technology-enabled practices, machine intelligence is the engine. Specifically, machine intelligence describes the use of analytical algorithms to extract information from the data. Machine intelligence consists of traditional methods (such as operations research models or econometric techniques); AI; and ML, which is a subset of AI algorithms.[2] Chui, Kamalnath, and McCarthy (2020) defines *ML* as

> a collection of algorithms that detect patterns and learn how to make predictions and recommendations by processing data and experiences, rather than by receiving explicit programming instruction. The algorithms also adapt in response to new data and experiences to improve efficacy over time.

ML differs from traditional analytic approaches because it seeks to maximize the accuracy of predictions without manually coding or structuring the necessary relationships between input variables and HR outcomes. This allows the structure of ML models to grow increasingly complex if the complexity improves performance (Mullainathan and Spiess, 2017, pp. 87–88). Critically, when the volume and complexity of data exceed a human's processing capacity, ML can discover structure in the data to help improve decisions and outcomes.

## Introducing Interactivity Among Machine Intelligence, Human Intelligence, Data, and Decisions

If data are the fuel and machine intelligence is the engine of a technology-enabled business practice, human intelligence is the driver. As stated earlier, the purpose of machine intelligence is to extract information from data and to provide recommendations to decisionmakers. In complex real-world scenarios, the human decisionmaker may have information about context, constraints, and objectives that the machine does not, so the interaction between ML and the human is essential to ensure that decisions are robust.

There are three distinctive feedback loops between human and machine intelligence and other elements of technology-enabled business practices (Figure 2.2). The first feedback loop is from human and machine intelligence to data flowing into the system. Decisionmakers shape this flow via data collection techniques, data capture and storage, and the engineering of data features that may inform decisionmaking. Machine intelligence can also shape the data flow into the system. For example, adaptive sampling techniques, which

[2] *ML* refers to the collection of learning models (Alpaydin, 2016), whereas *AI* refers to a broader concept "defined as the ability of a machine to perform cognitive functions we associate with human minds, such as perceiving, reasoning, learning, interacting with the environment, problem solving, and even exercising creativity" (Chui, Kamalnath, and McCarthy, 2020).

underlie computer adaptive testing and adaptive design optimization, can be used to determine what additional data to collect to maximally disambiguate a decision (Myung, Cavagnaro, and Pitt, 2013).

The second feedback loop is between human intelligence and machine intelligence. Humans and machines interact in a variety of ways. On the most basic level, humans must select modeling techniques and identify business objectives for the machine to optimize.[3] In addition, humans may provide feedback on the quality of the machine's predictions or prescriptions so that the algorithms can learn from experience. If the outputs of the machine intelligence are delivered in an explainable manner, they may give the human new insights into the underlying decision process (Arrieta et al., 2020).

The interactivity between human and machine intelligence also addresses important concerns about bias and errors (Osoba et al., 2019; Osoba and Welser, 2017; Tambe, Cappelli, and Yakubovich, 2019). Humans and ML are both fallible, but they fail in different ways. In properly executed technology-enabled business practices, human and machine intelligence check one another. Although recent research has emphasized the concern over AI bias, algorithms can also be an effective countermeasure for human bias (Kahneman et al., 2016), which means that there are risks associated both with inaction and adoption. For these reasons, the National Security Commission on Artificial Intelligence recommended that the design of such systems should provide an explicit analysis of outcomes that would violate American values and that design efforts should consider explicitly incorporating value considerations into the objectives of the system (National Security Commission on Artificial Intelligence, 2021).

The third and final feedback loop is from business outcomes arising from the system to improved human and machine understanding of the decision space. In some sense, all research uses past data to explore lessons learned from decision outcomes. But not all policies are informed by research, and almost none are *continually* informed. The result is that policy practices become entrenched—they outlive the environment that justified the initial implementation.

The technology-enabled framework addresses this problem by supporting continual calibration and feedback to refine ongoing talent management decisions. By continually tracing granular decisions and outcomes, technology-enabled business practices allow decisionmakers to react more efficiently and effectively when circumstances change. Furthermore, technology-enabled business practices may incorporate constant experimentation (or *A/B testing*) to seek out changes that will produce better outcomes (Kohavi and Longbotham, 2017; Siroker and Koomen, 2013). Major firms, especially in the technology sector, routinely run A/B tests to discover effective changes (Luca and Bazerman, 2020).[4]

Experimentation entails some risk and must be used carefully, given the consequential nature of HR outcomes. Yet failing to adapt also entails risk. Interactivity between outcomes and human and machine intelligence reduces this risk in technology-enabled business practices.

## USAF Well Positioned to Join These Organizations

All firms face challenges incorporating new technologies into talent management processes. These challenges relate to the complexity and measurement difficulty inherent in HR outcomes (such as which attributes define a good employee), limitations on the availability of data, the fairness and transparency in algorithmic decision systems, and the reactions of affected employees (Tambe, Cappelli, and Yakubovich, 2019).

[3] Most ML applications are examples of *narrow AI*, in that ML is applied to part of the task defined by a human.

[4] IBM used this approach to determine whether an AI chatbot was more successful than the traditional process at converting interested people into applicants (Guenole and Feinzig, 2018). Google has also done extensive experimentation in the HR domain (Tambe, Cappelli, and Yakubovich, 2019). Finally, economists and consultants have used experimentation to test whether new management practices improve productivity (Bloom et al., 2013).

Although the USAF faces these same challenges, certain design elements of the historical personnel management system put the USAF in a good position to move forward with technology-enabled talent management. These elements fall into four areas:

- **Standardization and stability:** All USAF members fall under a standard management system, in which each aspect of the system that contains relevant information for decisionmaking—such as the occupational classification scheme, organizational structure, job titles, career development patterns, personnel skills inventories, and even compensation policies—is defined, documented, and relatively stable over time. For example, officers are considered for promotion after serving for a predetermined number of years at each rank, and the percentage selected for promotion is roughly constant from year to year. This structure makes the outcomes of the system much more predictable and increases the prospects for high-fidelity decision-support tools.
- **Availability of career histories:** The unique mission and demands of military service mean that the USAF must grow and develop talent from within. The benefit of this constraint for talent management is that the USAF has access to complete and ongoing career histories for all members. Demographic and aptitude data are collected about individuals starting with their first meeting with a recruiter; medical and performance data are collected as they advance through the training pipeline; career data are collected during each assignment; and performance reports are submitted on a routine basis. Provided that the USAF can capture and connect the information from all nodes of the HR system, this rich longitudinal data holds promise for technology-enabled talent management.
- **Measurable outcomes:** It is not easy to measure what constitutes a good employee (Tambe, Cappelli, and Yakubovich, 2019). A potential advantage for the USAF in developing its data-enabled talent management system is that it has a standardized performance management system that uses a common language with discernible performance signals (Schulker et al., 2020). These outcome measures create the potential for training models to optimize upstream HR processes (such as recruiting) to drive better outcomes.
- **Quantity of data:** Often, the size of an organization can limit its ability to apply data-enabled practices, because small firms may not perform enough HR actions to create the data needed to train ML models (Tambe, Cappelli, and Yakubovich, 2019). The USAF consists of over 300,000 active-duty airmen. Individual-level data are available about the current force and the historical force over several decades, comprising billions of observations. Even in the case of relatively rare outcomes (such as conduct or legal infractions) or relatively small personnel categories (such as female pilots at a certain rank), this amounts to thousands of observations for training ML models.

To understand why these natural advantages position the USAF to use new technologies for talent management, consider the example of skill validation, which touches on multiple elements discussed earlier. All firms need to validate the documented skills and expertise of external job applicants—whose performance they have not yet observed—so that they can prioritize scarce HR resources for the most-promising applicant. Thus, innovative efforts continue to produce new approaches to derive this information from social networks (Yan et al., 2019). The USAF does not generally have this problem, however, because its organizational elements develop nearly all occupational training content so that the USAF can train members according to its skill standards. Thus, most skills in the USAF HR system are prevalidated, and, in the long run, the USAF will have access to every training event, academic transcript, job experience, and performance evaluation each member has ever had. To fully capitalize on these advantages, the USAF must improve capabilities for collecting, managing, and operationalizing data (National Academies of Sciences, Engineering, and Medicine, 2020).

These advantages apply to the active component of the USAF and, to a lesser degree, to the reserve and civilian components. For instance, all active-duty component developmental experiences are captured by USAF personnel data systems, but part-time reservists and civilians have work experiences with other firms that are not recorded. Civilian and reserve career paths, performance measurement practices, and compensation policies also tend to be less standardized than those of the active-duty component. Nonetheless, technology-enabled talent management practices are still applicable to the reserve and civilian components of the USAF.

CHAPTER 3

# Use Cases for Technology-Enabled Talent Management in USAF

It is somewhat misleading to speak holistically of a technology-enabled talent management *system* because the reality we are describing is an iterative series of incremental improvements. Bringing quality technology-enabled decision-support to areas where none exist could be transformational, but improvements in areas that are already data-informed and highly optimized could be more incremental. For example, one of our use cases involves the officer assignment system. In the past, matching officers to new assignments has relied on the judgment of officer assignment teams without formal data capture on features that relate to match quality and subsequent business outcomes. This major HRM process is potentially ripe for a redesign in the technology-enabled mold (and such a redesign is underway). By contrast, the enlisted assignment system is already continually informed by data and algorithms. Improvements in those assignments might be possible by enriching the data and envisioning new ways to learn from outcomes, but the potential performance gains are less obvious. Therefore, embracing technology-enabled practices involves exploring use cases according to perceived business value, testing for feasibility, and measuring the impact of new processes (Guenole and Feinzig, 2018).

Much of this work has already begun. In the past several years, the USAF and other DoD services have sponsored a body of research exploring technological applications for each HR function shown in Figure 3.1. This effort established the technical feasibility of technology-enabled talent management concepts in most areas of HR. Collectively, these applications show that it is possible to improve the allocation of monetary and human capital resources, to increase the efficiency of HR practices, and to enhance the quality of HR decisions and outcomes.

Table 3.1 summarizes the research at a high level. The columns of Table 3.1 show that prior research has explored technology-enabled concepts in most HR functions. The rows of Table 3.1 show components of technology-enabled talent management. Cells shaded in solid blue indicate that technology-enabled talent

**FIGURE 3.1**
**Technology-Enabled Talent Management System Encompasses All Stages of HR Functions**

**TABLE 3.1**

**Technology-Enabled Talent Management Concepts and Research Results**

| ***Data-Enabled Talent Management Concepts*** | Recruiting (tactical) | Recruiting (strategic) | Specialty Classification | Development | Assignment | Promotion | Retention |
|---|---|---|---|---|---|---|---|
| Use of diverse and nontraditional data sources | Possible | Demonstrated | Demonstrated | Demonstrated | Possible | Possible | Demonstrated |
| Use of machine intelligence | Possible | Demonstrated | Demonstrated | Demonstrated | Possible | Demonstrated | Demonstrated |
| Human and machine interactivity with data collection | Possible | Possible | Possible | Possible | Possible | Possible | Possible |
| Human and machine interactivity for decisionmaking | Possible | Demonstrated | Demonstrated | Possible | Possible | Demonstrated | Demonstrated |
| Human and machine interactivity with outcomes | Possible | Demonstrated | Possible | Possible | Possible | Possible | Possible |

management concepts have been demonstrated in DoD; cells shaded in striped blue indicate that RAND researchers have examined the concepts and determined that they are potentially applicable. The key takeaway is that most concepts of technology-enabled talent management have been demonstrated in at least one HR area within DoD, and there are potential applications of all concepts to each of the HR functions that we have examined.

However, Table 3.1 also highlights that there is relatively little demonstration support for two of the technology-enabled talent management concepts: human-machine interactivity with data collection and human-machine interactivity with outcomes. These forms of interaction differentiate static analyses, which resemble the historical data-informed paradigm, from technology-enabled business practices. If the USAF lacks the ability to adjust the data flowing into the system, its performance will likely plateau. Similarly, if the USAF cannot use outcomes to adjust ML models and decision processes, the performance of the system will likely plateau.[1] In short, there have been many successful demonstrations of technology-enabled talent management in the USAF, but the USAF will be limited unless it can implement these remaining concepts.

In the following sections, we provide vignettes explaining the talent management challenge for each area of HR, and then describe the exploratory results developed by various divisions of the RAND Corporation.

[1] A classic example of this problem occurs with applicant screening rules, such as minimum ASVAB scores. Cognitively demanding specialties have high ASVAB requirements, reflecting the need for high aptitude to succeed in these fields. However, once policy sets a minimum score for screening, the subsequent relationship between test scores and success could be weak, or even negative. It would be wrong to conclude that this finding means the test is no longer a good predictor of success; rather, it occurs because the only opportunity to observe success after implementing the screening policy is among a select group of high-aptitude recruits. Experimentation addresses this problem by occasionally varying the minimum score to produce information on its continued effectiveness as a screening mechanism.

## Tactical Recruiting Challenge: Helping Recruiters Manage Their Time

The USAF recruiting enterprise must generate roughly 30,000 new recruits each year, and each recruit must meet an array of qualifications, such as health and physical fitness standards and minimum aptitude scores. The enterprise must accomplish this task while adapting to economic conditions and the seasonality that is inherent in recruiting primarily high school graduates. Historically, the USAF has met its recruiting goals with a footprint of roughly 1,200 full-time recruiters with budgets for enlistment bonuses, advertising, and other activities.

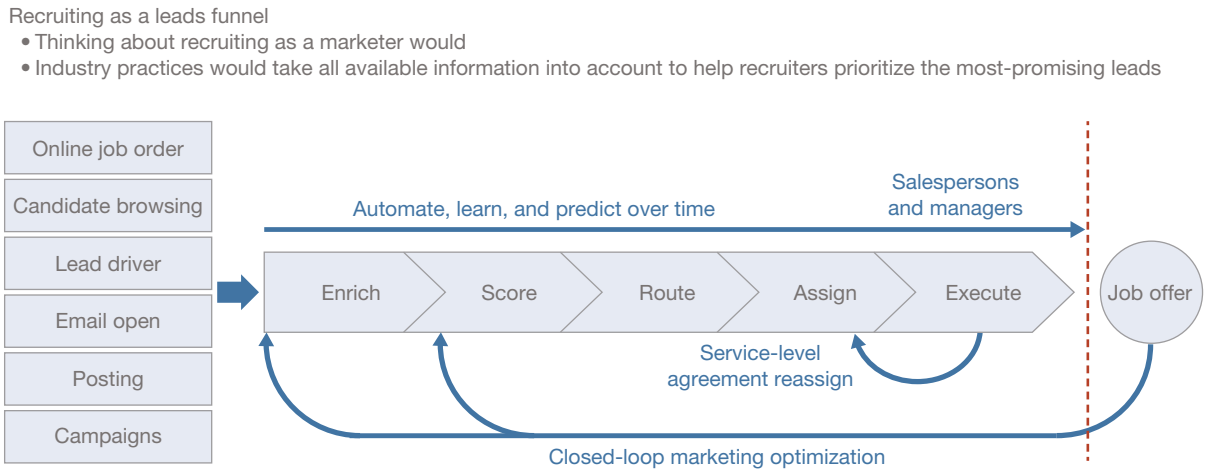
The USAF tasks individual recruiters with monthly goals for contracts, and recruiters then interview, persuade, and shepherd interested applicants, or *leads*, through the enlistment process with the hope of meeting monthly targets. Recruiters have expressed difficulty managing their workload (Knutson, 2019), potentially placing some at risk for burnout. Given that every locale is unique and there are a variety of potential sources for recruiting leads, it is unclear how recruiters should prioritize their limited time to focus on the most-promising applicants.

## RAND Research Shows How Technology-Enabled Recruiting Could Improve Recruiter Efficiency

The Office of Accession Policy within the Office of the Undersecretary of Defense for Personnel and Readiness asked researchers at RAND's National Defense Research Institute to assemble an advisory group of knowledgeable people from DoD recruiting organizations, marketing agencies, and the DoD Joint Advertising Market Research & Studies organization. The RAND team combined those perspectives with information from the business and academic domains on the use of technology to support marketing and recruiting (Lim, Orvis, and Hall, 2019).

In the conceptual technology-enabled recruiting process shown in Figure 3.2, technology enhances a recruiter's effectiveness by enriching the records of applicants with supplementary data gathered from such brokers as Acxiom, Experian, Equifax, and TransUnion, then scoring those augmented records based on

**FIGURE 3.2**
**Example of Technology-Enabled Recruiting Process**




SOURCE: Lim, Orvis, and Hall, 2019.
NOTE: Although not shown in this figure, downstream outcomes, such as success in training or job performance, would inform the scoring of recruiting leads.

applicant likelihood of accepting an offer or succeeding in the military. Using enriched data and scores, the algorithm routes promising applicants to the recruiters who are most likely to persuade those individuals. All these steps are upstream from recruiter actions. In this way, the system helps recruiters to spend their limited time attempting to attract the best prospects.

Feedback loops in this technology-enabled process provide a layer of interactivity so that the automated steps improve over time. Thus, a technology-enabled process has the potential to make individual recruiters more productive, which could lead to resource savings if fewer recruiters are needed. A technology-enabled process also has the potential to improve the quality of accessions (i.e., individuals entering military service) if recruiters can focus on more-qualified prospects. Finally, a technology-enabled process would help the USAF steer the lead-refinement process and allow recruiters to focus on other high-priority attributes that are difficult to prospect for, such as geographic or ethnic diversity. The conceptual model shown in Figure 2.2 has not yet been implemented for Air Force recruiting, but it provides a characterization of how technology-enabled talent management may be applied to this HR function.

## Strategic Recruiting Challenge: Providing Enough Resources for Recruiters

Because of the USAF's size and its need for a continual stream of new recruits, planners also face strategic decisions about how to posture the recruiting enterprise. Planners must seek Operation and Maintenance funding to purchase advertising and support local events (such as airshows or sponsorships), Military Personnel appropriations that fund enlistment bonuses, and even programming support for the number of recruiter positions. The most credible case for these resource requests will always be one that is backed by evidence, which can also be provided through technology-enabled methods.

### RAND Built a Model That Optimizes Recruiting Resource Levels

Researchers in RAND's Army Research Division developed a capability, termed the *Recruiting Resource Model* (RRM), that allows planners to translate resource plans (such as numbers of recruiters or funding for advertising) in each environment into expected contracts, accessions, and costs (Knapp et al., 2018). Planners can use the RRM to observe the expected outputs of different planning scenarios, or they can allow the model's optimization routine to adjust resource levels until it finds the most cost-effective bundle that meets recruiting targets. A key finding from this work was that the Army could reach its high accession targets (typically double the level needed in the USAF) at a significantly lower cost by shifting resources from bonuses to television advertising (Knapp et al., 2018).

## Specialty Classification Challenge: Matching Airmen to the Right Job

Each year, thousands of people enlist in the USAF and are assigned to hundreds of occupational specialties, denoted by Air Force Specialty Codes (AFSCs). To assign individuals to AFSCs, the USAF engages in activities beginning at recruiting and extending through basic military training. These activities and the corresponding programs and policies all compose the enlisted classification system (Air Force Instruction 36-2101). The existing system is an example of a data-informed process that uses past research to establish minimum standards for each AFSC to ensure an acceptable level of training attrition. Some qualified recruits enter with a job guarantee in their contract; others can choose among a limited set of available specialties in basic military training.

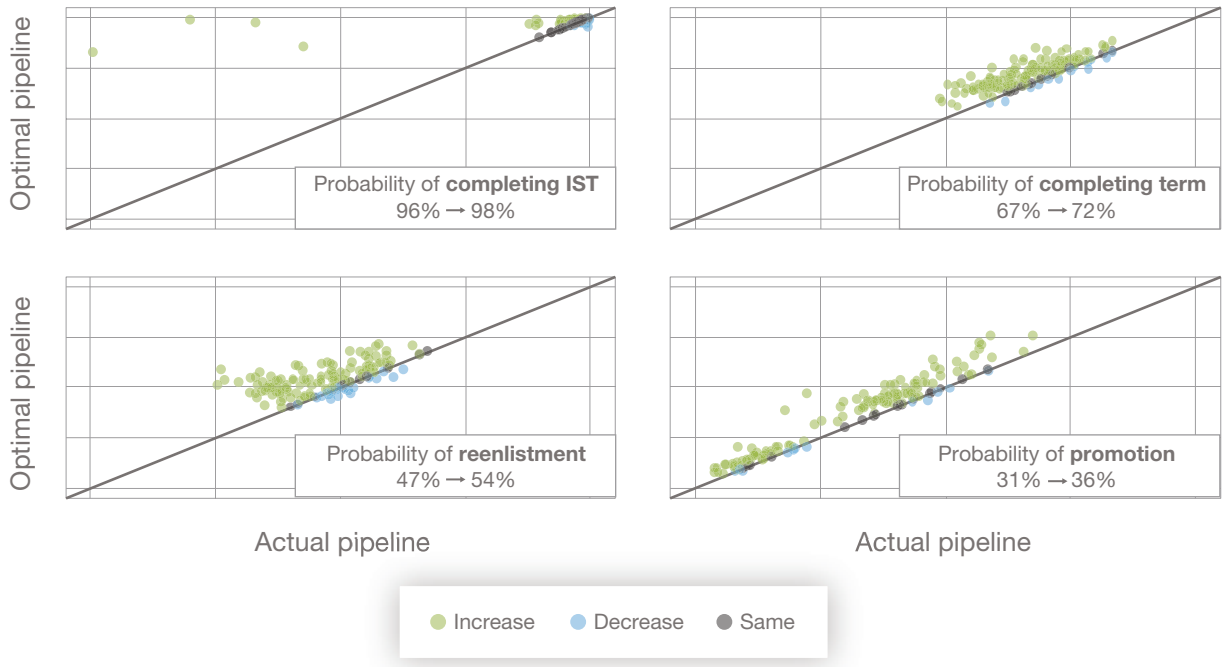
Although most airmen successfully complete initial skills training (IST), about 10 percent are eliminated because of performance deficiencies and for other reasons. These individuals are either separated from the USAF or reclassified into different AFSCs. Qualitative research findings suggest that airmen sometimes receive AFSCs without necessarily knowing what the specialty entails or possessing attributes required for success (Robson et al., 2022). These eliminations might have been preventable if the USAF had a more accurate process for matching the airmen to specialties. Even for the 90 percent of airmen who complete IST, the initial specialty they receive continues to affect subsequent job performance, first-term completion, and reenlistment.

## RAND Used Data Science Techniques to Match Airmen to Promising Specialties

Researchers at RAND Project AIR FORCE (PAF) explored the use of data science techniques to match airmen to specialties to optimize four training and early career outcomes: (1) IST graduation, (2) promotion to E-5 in the first term, (3) first-term completion, and (4) reenlistment. The RAND team identified more than 50 predictors spanning seven categories that are available when individuals first enlist, and they explored different ML techniques to achieve the best possible predictive performance for each metric (Robson et al., 2022).[2]

Once the RAND team fitted predictive models to the four training and early career outcomes, they used the models to prescriptively assign individuals to specialties to maximize the four outcomes. The results for each outcome are shown in Figure 3.3. Each point is an individual airman. The axis labeled "actual

**FIGURE 3.3**
**Results of Applying Prescriptive Assignment to Each Outcome Measure**




SOURCE: Robson et al., 2022.

[2] Predictor categories were enlistment contract, demographics, cognitive aptitude, career field preference, education, and physical and medical fitness. RAND PAF compared several ML algorithms. An approach called Bayesian Additive Regression Trees (BART) did best at predicting the four outcomes. BART learns sequences of yes-or-no decision rules, which form decision trees that can be used to predict outcomes. Rather than using just one decision tree, however, BART combines the predictions from an ensemble of trees. A Bayesian procedure is used to reduce the complexity of decision rules.

pipeline" shows the predicted probability of the outcome for each airman given the AFSC that they were assigned. The axis labeled "optimal pipeline" shows the predicted probability of the outcome if all airmen were prescriptively assigned. The analysis shows that prescriptive assignments could increase the probabilities of positive training and career outcomes for the average airmen by 2 to 7 percentage points. These gains are substantial when one considers the population size at stake. A "back-of-the-envelope" calculation that applies the improvement of 5 percentage points in first-term completion to a new cohort of 25,000 trained recruits would suggest that prescriptive assignments could result in 1,250 fewer early separations.

## Development Challenge: Labor-Intensive Board Selection Processes

Developing military officers to be ready to command at ever-higher levels is a 15- to 30-year process. The monumental HR task that the development system must accomplish is to fill all critical positions with qualified personnel *while at the same time* curating positions for individuals to meet developmental goals for the future. To manage the complexity of this problem, the development and assignment systems view officers through two lenses. The *macro* lens takes a very general view of the types of broadening experiences that members should have by using rough categories (such as a unit-level assignment versus a staff assignment). Assignment officers then look at each officer's experiences and seek to balance their résumé with each new assignment, if possible, depending on available opportunities. As officers become more senior and the numbers of officers become more manageable, development policy shifts toward viewing officers through a *micro* lens; a board of experienced leaders reviews records by hand and determines whom to select for professional military education, command, and promotion to the next grade level. The micro lens draws on higher-fidelity information on officer experiences and performance, but the processes are labor intensive and used sparingly. Moreover, the micro lens still depends on subjective human judgments and uses only a subset of information available about a given individual.

### RAND Built an ML Model That Automatically Finds Officers with Good Performance Indicators

Data science methods offer the opportunity to build a system that automates the micro lens and potentially applies it to development areas where the volume of records is too large for manual review. Researchers at RAND PAF examined the feasibility of such a system by extracting a large sample of officer records that had previously been through the micro lens process by O-5 and O-6 promotion boards (Schulker et al., 2020). The RAND team then used an ML model to learn which patterns of text in officers' performance reports were most closely associated with higher levels of development (as measured by the O-5 and O-6 promotion board decisions).[3] The results showed that the ML model could account for promotion outcomes based on the text-based performance reports, and they revealed that the model had keyed in on words and phrases that any experienced officer would recognize as important performance signals. The fact that the ML model parsed the language of performance writing without being told which words and phrases to look for is promising because the same techniques can adapt as the content and structure of evaluations evolve over time. Impor-

[3] The application involves applying bag-of-words techniques to convert free-text data into a record of the words that make up a performance report. RAND PAF compared several ML algorithms for predicting promotion board decisions based on words contained in performance reports. An approach called a *support vector machine* (SVM) did best at predicting outcomes. SVM finds a boundary that separates records with each of the two outcomes—promote versus non-promote—based on the words contained in the corresponding performance reports.

tantly, in this and other applications, the ML model could provide a recommendation or input to a human decisionmaker, so outcomes would not be fully determined by the model.

## Assignments Challenge: How to Best Use the New "Talent Marketplace"

The officer assignment system is at the center of many other HR functions. The system matches officers to each successive opportunity that will shape their careers and determine their competitiveness for senior leadership while indirectly affecting retention behaviors (Keller et al., 2018). In recent years, the USAF has shifted to an assignments approach, dubbed the "Talent Marketplace," that mimics a job market. In the new system, individuals can apply for positions and coordinate with job owners directly to inform them of special skills and/or to obtain a realistic preview of the job environment. The Talent Marketplace concept is ideal when jobs and locations must change on a regular schedule (as for assignments of O-5 and below), when a person's fit in a job (or *person-job fit*) is paramount to many human capital goals, and when the need to gather information required to accurately discern person-job fit exceeds the capacity of assignment officers.

### RAND Found New Opportunities for Information Exchange

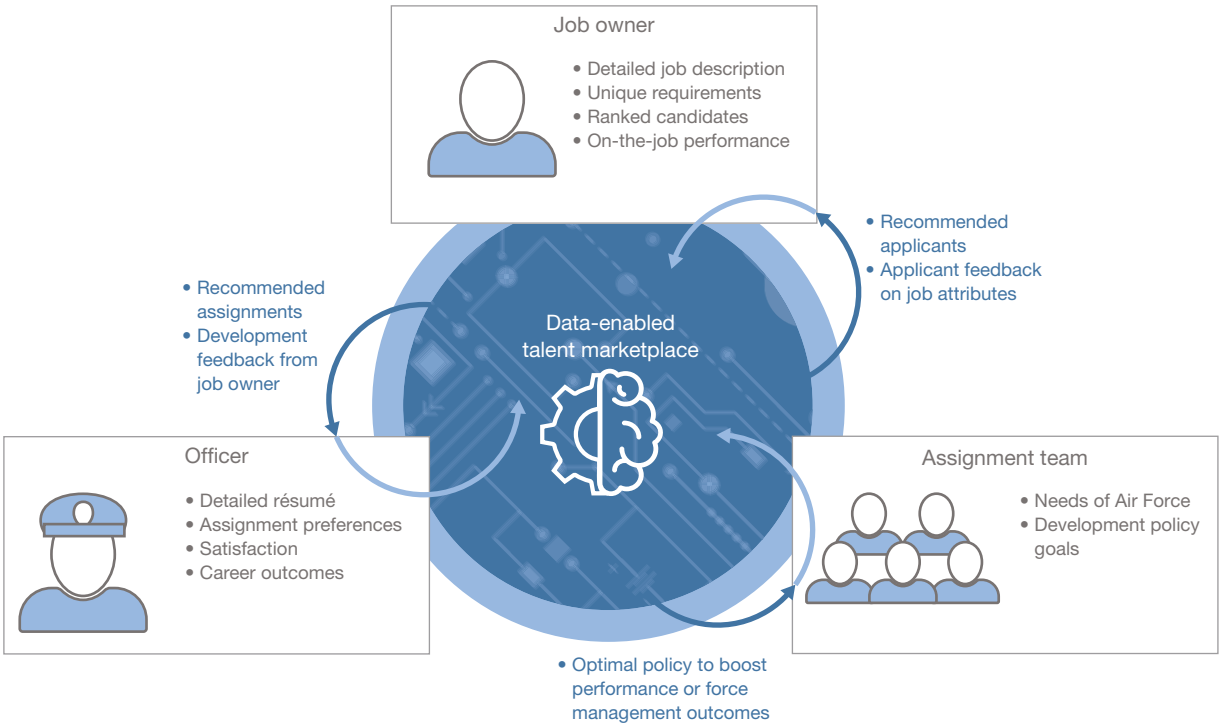
Researchers at RAND PAF analyzed new opportunities for improved decisionmaking made possible through the Talent Marketplace system.[4] The reason that the marketplace concept could deliver a better match in each assignment cycle is that it has the potential to generate more information about person-job fit than the old system (while relying on decentralized execution to process the new information). The implementation of the Talent Marketplace is still primitive in that it lacks necessary avenues for applicants and job owners to exchange information (National Academies of Sciences, Engineering, and Medicine, 2020). But a fully formed marketplace does provide a useful framework for the assignment arm of a technology-enabled talent management system (Figure 3.4). In such a system, the following occurs:

- Officers contribute a more detailed résumé to highlight relevant attributes to job owners that might increase their likelihood of getting a preferred position.
- The system captures those preferences and tracks job satisfaction and post-assignment outcomes (such as performance in the position).
- Job owners, in turn, provide detailed information about the advertised positions and preferred qualifications while ranking applicants and evaluating subsequent performance on the job.
- Assignment teams continue to provide developmental constraints and prioritize operational needs.

In the longer term, interactions between human and machine intelligence could become embedded in the system through the feedback loops. Historical satisfaction and performance data would inform recommendation engines for assignments that future officers should consider, and job owner rankings would provide feedback on what officers must improve to be competitive for their preferred positions. Mirror images of these feedback loops could also become available to job owners. Historical performance data can feed recommendation engines to suggest the most-promising applicants, and feedback from applicants can help job owners address negative characteristics of the work environment to better compete for talent. At the strategic level, this same information can help assignment teams understand how to steer person-job matches toward improved force management outcomes for the broader organization.

[4] Unpublished RAND research by David Schulker and Matthew Walsh.

FIGURE 3.4
**Technology-Enabled Assignment Marketplace**



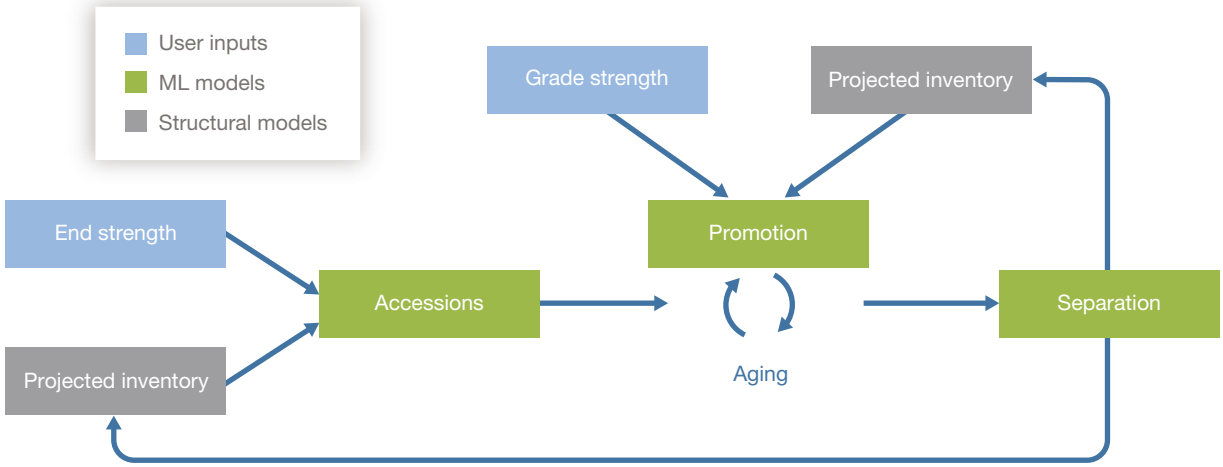

## Promotion Challenge: Unpredictable Effects of Policy Changes

The officer promotion process is somewhat unique among talent management functions in terms of the decision stakes. Whether and when officers reach the senior field grades determines not only which officers will command combat forces at increasing levels of responsibility but also which officers will be competitive for selection to the general officer ranks. Furthermore, nuanced structures governing how the USAF determines promotions, such as how the process addresses differences in officer functional backgrounds, make the effects of different policy changes on the promotion system very difficult to predict.

### RAND Developed a Tool to Predict the Inventory of Officers

The USAF is making changes to how it manages officer development and promotion. As part of these changes, the USAF has divided the Line of the Air Force—a single developmental category (DevCat) that previously accounted for over 80 percent of officers and 40 career fields—into six separate DevCats. The purpose is to allow officers in different career fields to pursue tailored developmental pathways while remaining competitive for promotion. The Deputy Chief of Staff for Manpower, Personnel, and Services asked RAND PAF to develop an inventory projection capability that presented essential features of the promotion system. The RAND team developed a Personnel Policy Simulation Tool (PPST) (Walsh et al., 2021), outlined in Figure 3.5, that combines smaller simulation modules, each representing mechanisms in the personnel system, to model the flow of individuals into the officer inventory (that is, up through the ranks after being promoted) and out of the inventory (such as after separating). Some of the modules re-create processes described in Air Force instructions on officer promotion; other modules incorporate ML models trained to predict fine-grained outcomes, such as promotion board decisions and individual separation decisions (Air Force Instruction 36-2501).

**FIGURE 3.5**
**Overview of U.S. Air Force Personnel Policy Simulation Tool**




SOURCE: Adapted from Walsh et al., 2021.

The PPST allows planners to explore the policy outcomes of changes in promotion timing and officer functional groupings through a representation of the developmental patterns in each specialty and ML-based retention rates learned from granular data on historical promotion outcomes.[5] PPST's holistic representation of the planning problem yielded immediate value, as researchers discovered many unforeseen "self-correcting" properties of the system. For instance, when researchers used PPST to analyze the effects of lower retention, the system revealed that initial decreases in retention create more vacancies, which drive higher promotion rates to maintain grade strength. It further helped the USAF anticipate potential diversity impacts of policies that affect career fields differently, since demographics vary greatly across career fields.

## Retention Challenge: Preventing Personnel Shortages or Surpluses

Managing retention is especially critical to USAF talent management because of the requirement to grow talent from within and because of the time and resources needed to develop individuals for technical and leadership positions. Losses can be extremely costly, especially when the *per-person* training cost for certain skill sets can approach $11 million (Mattock et al., 2019). Maintaining adequate numbers of skilled personnel across the diverse spectrum of military occupations is a complex, long-term planning problem that spans many organizations within the USAF. To manage personnel shortfalls or overages, HR planners must effectively use a variety of retention tools, such as service commitments, contracts, and incentives.

### RAND Created a Retention Early Warning System

Given the scope of this talent management challenge, USAF planners requested an early warning system that would alert them to areas of acute concern. Following the analogy of an early warning radar, the

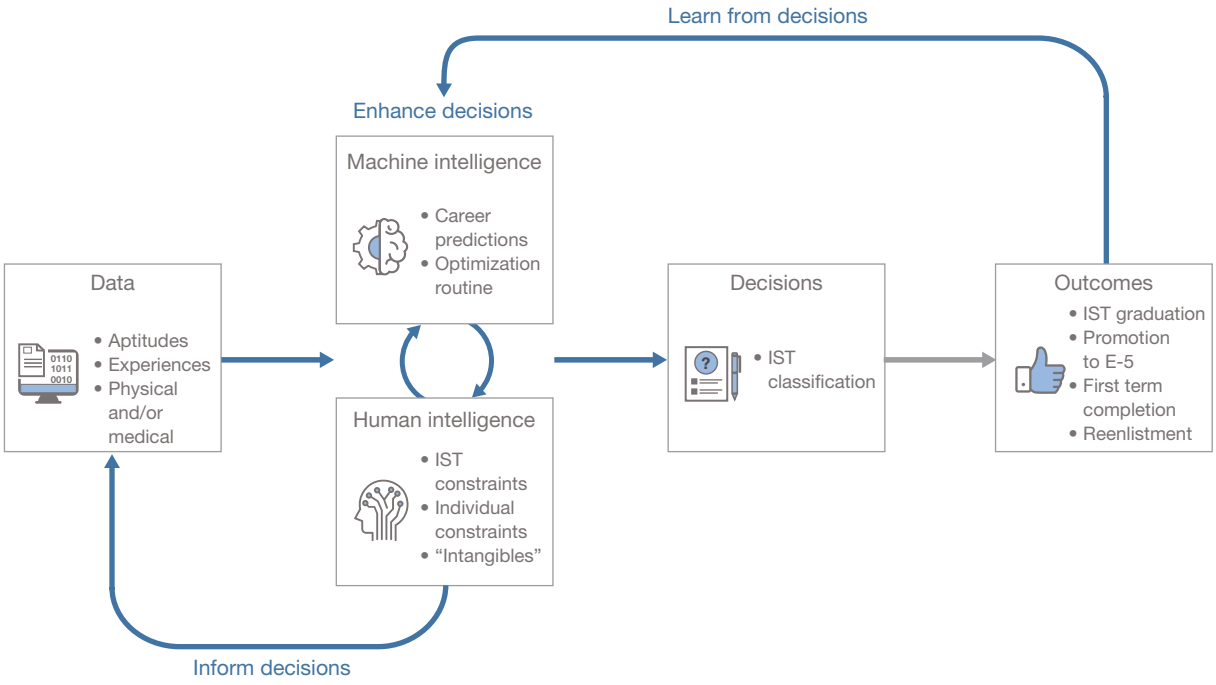
[5] Once again, RAND PAF compared several ML algorithms for predicting annual separation decisions. An approach called *Extreme Gradient Boosting* (XGB) performed best. XGB learns an ensemble of decision trees, which are sequences of yes-or-no decision rules used to classify outcomes. Each new tree in the ensemble reduces the residual classification error that remains after applying all the earlier trees.

retention early warning system (REWS) that RAND PAF developed provides low-resolution information about targets at a great distance—in this case, the forecasted number of individuals in a personnel category at a future date (Schulker et al., 2021). The forecasts are based on ML models trained from historical data about officers, enlisted personnel, and annual retention behavior. The early warning system triggers other systems to evaluate and select responses—in this case, policy options to shape retention in the affected personnel categories. When using REWS, planners in any office can (1) select the personnel dimensions, such as career fields or education and experience levels, that are relevant to their decisions; (2) apply ML-based forecasts to highlight areas of concern; and (3) explore policy options to mitigate the warnings. Compared with the standard approach used by the Air Force, which accounts only for career field and service tenure, the ML-based approach was more sensitive to variations in other personnel categories that are associated with retention behavior.

## The Path to a Technology-Enabled Capability

The main takeaway from these case studies is that technology-enabled talent management is applicable and achievable across the complete USAF HR life cycle (Table 3.1). However, a gap remains between conducting a proof-of-concept study and operationalizing the concept as an HRM decision-support system. For example, Figure 3.6 shows how the principles demonstrated in the case study on specialty classification could be integrated into a business intelligence tool for recruiting and initial classification. Data about new accessions are passed to training pipeline managers and the ML models. The ML model may suggest that the manager gather additional information about an accession to disambiguate the ideal classification by, for example, giving a special skills test to an accession who may be suited for a cyber career field. The manager provides constraints related to IST seat availability, accession constraints, and other factors not otherwise considered by the ML model. Using information about the accession and the set of constraints, the ML model recom-

**FIGURE 3.6**
**Technology-Enabled Initial Skills Training Classification**



mends a list of occupations, which the manager and recruit select from. The individual enters IST and progresses through their first enlisted term. As this happens, outcomes related to IST completion and early career outcomes are passed back to the ML model to enable continual learning. To begin to create real value for the USAF, the specialty classification idea, along with the others described in the case studies, must be built out into decision-support systems that cover all the bases in the technology-enabled framework from Figure 3.2.

The case studies illustrate several common themes about the path to technology-enabled capabilities:

- Data about USAF goals, current and prospective personnel, and environmental conditions (such as the number of individuals in a certain personnel category that the USAF must retain, the characteristics of individuals in that category, and economic conditions) must be automatically provided to the system.
- Decisions may be informed by gathering additional data (such as a special skills test given to a new accession or a survey of intentions given to individuals approaching retention decisions) to address blind spots.
- The system interface must allow the HR decisionmaker to provide additional priorities, assumptions, and constraints (such as the amount of human and monetary resources available to meet recruiting goals or number of training seats and length of training pipelines in different occupations) to the machine.
- The interface must also allow the machine to return predictions and recommendations (such as the recruiting outcomes expected given different resource allocations) to the decisionmaker.
- The system must track outcomes, such as feedback from the decisionmaker, to allow ML models (such as changes in accession, promotion, and retention rates in different career fields and demographic categories over time) to be continually updated.
- Novel data sources require new methods to extract information. For example, natural language processing can extract information from textual data, and this information can be used to develop a richer profile of individuals for assignment purposes or to characterize an individual's career development based on performance reports.

Of the applications considered, four were demonstrated as partial end-to-end system prototypes (that is, specialty classification, development, promotion, and retention). However, as Table 3.1 shows, none incorporated all the distinctive features of technology-enabled talent management. Still, the implication is that, given further development and validation, the Air Force could use these systems to great effect in the near term. The remaining applications (that is, recruiting and assignment) have been demonstrated in industry and could be used by the Air Force in the midterm. Notwithstanding this potential, several implementation challenges must be overcome to remain at the leading edge of technology-enabled talent management technologies.

## Implementation Challenges for a Technology-Enabled Talent Management System

Technology-enabled business practices can already enhance the quality of decisions by providing front-line decisionmakers with operationally relevant information in real time, and the potential of these practices will become even greater as technology improves and ML algorithms mature. Relatively few organizations have been able to realize the full potential of technology-enabled business practices using modern data management, IT systems, and AI. For instance, Ransbotham et al. (2017) found that 77 percent of executives reported that their organizations had not adopted AI-enabled business practices, and just 5 percent reported that their organizations had "extensively incorporated" them. Similarly, Bisson et al. (2018) found that executives who

responded to their survey reported that "their companies are struggling to capture real value" from investments in AI.

These findings invite an obvious question: If technology-enabled practices are so beneficial, why are broad adoption and value-generation relatively uncommon? The answer is that there are significant organizational challenges that need to be overcome before such organizations as the USAF can capitalize on potential benefits (Fountaine, McCarthy, and Saleh, 2019). We can categorize the challenges that the USAF will face in implementation of new technologies for talent management into three areas: policies, practices, and technology.

## Policies Can Hinder Application of New Technologies to Talent Management

We discussed earlier how technology-enabled practices feature the continual gathering and fusing of diverse data from a variety of sources through an interactive relationship between human-machine intelligence and data collection. The results in Table 3.1 illustrate that research has not tested and demonstrated the value of this element of a technology-enabled system. The reason for this gap is that policy structures greatly limit the flexibility of USAF data collection. In the USAF HR domain, any data pertaining to individuals fall under the policy frameworks of official record-keeping. These policies were not designed for technology-enabled talent management, and the USAF lacks the authority to modify these policies because they are rooted in statutes and federal regulations. For example, Lim, Orvis, and Hall (2019) documented several challenges associated with the use of technology-enabled outreach and recruiting techniques in DoD. The Privacy Act of 1974 (U.S. Code, Title 5, Section 552a[4]) regulates the collection, maintenance, use, and dissemination of personally identifiable information that is maintained in DoD systems of records. Under the Privacy Act, all DoD agencies, including the Department of the Air Force, must publish a System of Records Notice in the Federal Register on the establishment and/or modification of a system of records to indicate what data are being collected, why, and how those data are intended to be used. In addition, the guidance on implementation of the DoD Privacy Program (Department of Defense Instruction 5400.11) further restricts the use of personal identifiers to link DoD data to other sources and iteratively explore the value of the new data for modeling. Thus, the idea of a technology-enabled system that has an iterative and exploratory relationship with HR records is incompatible with the structure of the policies governing the underlying data.[6]

## Existing Organizational Practices and Culture Can Hinder Applications of New Technologies to Talent Management

In addition to policies, existing organizational practices or other unique aspects of USAF culture can be a barrier to successfully applying technology-enabled practices. For technology-enabled practices to succeed, employees must understand the new practices and buy into the organizational goals. The technology-enabled framework makes this reality clear: It cannot function without a high level of interactivity between willing humans and other components of the system. Consequently, survey research has found that most companies that succeed in adopting large-scale AI practices spend more on the organizational activities related to adoption than they do on the analytics themselves (Fountaine, McCarthy, and Saleh, 2019).

Employees who do not buy into the utility of new technologies have a variety of means to undermine its transition. They can practice what information warfare professionals call *denial and deception*—either

[6] As we discussed earlier, the USAF is in a relatively good position for many HRM processes because it already has rich data stores to draw on. The privacy program limitations primarily affect new data collection and linking of DoD data with nontraditional data sources using personal identifiers.

hiding behavior from data capture or providing intentional noise into the system. One example of these challenges well known to those who study outreach and recruiting is that, although accurate information about recruiting leads is foundational, incentivizing recruiters to record accurate information is a long-standing challenge because recruiters alter data inputs according to how the data affect decisions (Lim, Orvis, and Hall, 2019). In addition to individual employees, organizational functions (and their data) can be stovepiped, lacking a strong incentive to pursue a cross-functional priority if doing so does not present clear benefits to the functional agendas. In short, the USAF may be more likely to adopt technology-enabled practices if it resourced the activities that technology adoption requires, such as additional staffing for new data entry and data management requirements in support of the organization's adoption goals.

## Data Management Infrastructure Can Hinder Applications of New Technologies to Talent Management More Than the Capabilities of Data-Driven Systems

In addition to policy and organizational limitations, existing data management infrastructure is likely to present challenges for applying the latest technologies to talent management. Various HR functions in the USAF own and manage functionally aligned data through separate transactions databases. For example, the Air Force Recruiting Service owns and manages a database that first identifies individuals when they sign a contract to serve in the USAF. Then, Air Education and Training Command is responsible for tracking any training that those individuals receive and how they perform. General HR records belong to several databases maintained by the Air Force Personnel Center, an agency that is directly subordinate to the USAF chief of HR. Academic transcripts reside in separate repositories maintained by commissioning sources (for undergraduate education) or by the Air Force Institute of Technology (for advanced academic degrees). Even within a USAF function, separate databases can be managed and maintained by industry partners whose contracts do not necessarily contain requirements for integrating with the rest of the ecosystem. Simply establishing a human capital history for an individual member would require an HR analyst to orchestrate permission and transfer and reconcile data from all these disparate organizations.

Establishing the right infrastructure for technology-enabled practices presents two further hurdles for the USAF. First, the USAF's infrastructure is already complex because of the size of the HR enterprise and the volume of business needs. In this situation, with a large amount of "technical debt," it can be difficult to identify incremental choices that can permit new approaches without reworking the entire system. A second hurdle is justifying the investment of resources to enable *cross-functional capabilities* that yield indirect and diffuse benefits, compared with a weapon system or military capability that directly benefits a functional stakeholder. To secure scarce funding to develop infrastructure for technology-enabled talent management practices, HR leadership must articulate the benefits of such technologies. DoD increasingly recognizes the value of data strategy and software architecture (DoD, 2020). The remaining question is whether the USAF will succeed in applying these principles to HRM.

CHAPTER 4

# A Way Forward for Technology-Enabled Talent Management

In the previous chapter, we discussed a variety of use cases for technology-enabled talent management in the USAF along with certain barriers to implementation. In the next chapter, we close by charting a way forward for digitally transforming USAF talent management. The DoD data strategy clearly articulates a vision for being able to use data "at speed and scale for operational advantage and increased efficiency," and it names business analytics as one of its three focus areas (DoD, 2020). The DoD services, including the USAF, are in the process of developing their implementation plans for this strategy, and we wrote this chapter to provide a high-level overview of factors for policymakers to consider in that process.[1]

The USAF can structure its approach to address ongoing and emerging HR needs by disaggregating the challenges into their component parts and taking an enterprisewide view to enable deployment of solutions to those challenges. Both organizational and technological aspects of infrastructure need to evolve. Table 4.1 charts the stages of development broadly, highlighting focus areas where the USAF should emphasize development efforts. The focus areas for each stage may serve as a checklist to evaluate proficiencies and outline future steps to enable more-advanced IT capabilities. As the table shows, the USAF can take a structured view of its approach to continuing to implement the latest technologies to HRM processes through five stages: (1) organizational and policy foundations; (2) technological foundation; (3) data curation, data management, and data services; (4) analysis systems, methods, and services; and (5) enterprise integration and deployment.

## Organizational and Policy Foundations

The first stage emphasizes development of the organizational and policy foundation necessary to execute a successful implementation, leveraging future warfighting concepts to align HRM with USAF operational readiness and motivate HRM system acquisitions. Major USAF operational concepts, initiatives, and programs are combined with stakeholder inputs from across the organization to specify the technology-enabled talent management strategy. Doing so informs which business processes will have the greatest benefit to operational needs. There is an existing set of policies that precisely defines the organizational roles for individuals or groups, their responsibilities, and the authorities necessary to execute processes. Implementation plans should adjust these policies and organizational structures or relationships to institutionalize the use of emerging technologies to enhance data-driven decisions while improving the analytic capacity of the HRM

[1] A significant challenge that we do not discuss in detail is evaluating the necessary changes in organizational structures and the alignment of responsibilities and staff under the new paradigm. Some of the emphasis areas in Table 4.1 will fall to the Department Chief Data Officer functional responsibility; others will necessarily be part of the HR function. Furthermore, certain areas of HR, such as operational aircrew training and staffing, are already shared with other functional authorities. This omission is not meant to suggest that these institutional concerns are not challenges; rather, they are difficult to address before the new HRM capabilities have been identified, designed, and tested.

**TABLE 4.1**
**Charting the Growth of Technology-Enabled Talent Management**

| Stage | Scope | Areas of Emphasis |
|---|---|---|
| 1 | Organizational and policy foundations | • Solicit and document stakeholder inputs and needs (operational and command level) to determine what changes will have the greatest short- and long-term benefit.<br>• Specify ties to major USAF and joint operating concepts, initiatives, and programs.<br>• Specify workforce roles and personnel considerations required for developing and sustaining technology-enabled business practices.<br>• Develop a quantitatively assessed maturity model applicable to all sites that incorporates operational stakeholder needs and strategies to reduce operational risks as maturity of the implementation increases.[a]<br>• Define policies that coherently define USAF roles, responsibilities, and authorities for multidisciplinary teams and individuals to implement technology-enabled business practices and requirements for cross-role collaborations. |
| 2 | Technological foundation | • Determine the major areas of technological infrastructure that will need to be built or will require change, and the role and extent of automation to be provided.<br>• Determine the USAF's ability to leverage existing USAF (such as The Air Force Research Laboratory [AFRL]), DoD, and federal capabilities, resources, and standards for technology-enabled business practices.<br>• Specify the software development and deployment practices that will be used to implement information security (such as zero trust)[b] relevant to DoD systems, and define the risk management practices (such as DoD Risk Management Framework) that are to be implemented in the technological foundation.<br>• Specify the operational architecture and development pipeline for incorporating foundational technological components and employing technology-enabled business practices. |
| 3 | Data curation, data management, and data services | • Specify standards and technical policies for secure data collection, information exchange and traceability,[c] and information storage across sites (DoD enterprise and the USAF).<br>• Enumerate the workflows that comprise existing and future business practices.<br>• Develop a detailed strategy for migrating data repositories to new repositories.<br>• Determine the specific performance, functional, and user experience requirements for technologically provided data services.<br>• Develop the necessary tools for curation and technical management of HRM data assets. |
| 4 | Analysis systems, methods, and services | • Specify USAF goals for leveraging advanced analytical methods, how they should function, and the requirements for employing new analysis tools.<br>• Develop comprehensive standards for analysis, such as metrics and supporting methodology measurement and analysis.<br>• Define quality-oriented requirements for using new analysis tools.<br>• Specify the architectural strategy for integrating new analytical processes into HRM systems and for enterprisewide analytics.<br>• Define the USAF's preferred approach to development and testing, such as the functional requirements for development and testing environments. |
| 5 | Enterprise integration and deployment | • Define the plan for user acceptance testing and operator training for all relevant workforce roles.<br>• Define the short- and long-term technical methods for deploying new technology and services into operations and sustaining their use. |

[a] A maturity model typically defines five levels of an organization's achievement in developing enterprise capabilities, such as Initial, Repeatable, Defined, Managed, Optimizing (Rosenstock, Johnston, and Anderson, 2000). The level of granularity in the model reflects the implementation complexity of the capabilities being sought. The degree of organizational achievement can be systematically measured and supported by quantitative assessments or gauged qualitatively.

[b] National Institute of Standards and Technology (NIST) Special Publication 800-207 (Rose et al., 2020) describes zero trust: "Zero trust refers to an evolving set of security paradigms that narrows defenses from wide network perimeters to individual or small groups of resources."

[c] In security, *traceability* generally refers to a systematic ability to reference all potential risks with security policies and control measures and to the ability to track security incidents as they occur and their impacts. For a broader introduction, see, for example, NIST Special Publications 800-37 Revision 2 (National Institute of Standards and Technology Joint Task Force, 2018) about the Risk Management Framework and Special Publication 800-160, Vol. 1 (Ross, McEvilley, and Oren, 2016), about Systems Security Engineering.

workforce through changes in hiring, training, and fostering a collaborative culture (National Academies of Sciences, Engineering, and Medicine, 2020). Prior structures, in which managers cluster around relatively narrow areas with very specific process knowledge, might need to become more flexible (Sanders and Wood, 2020). Policy changes to facilitate engagement with non-USAF stakeholders should also be addressed and used when possible. Finally, an effective strategy for communicating with stakeholders about implementa-

tion will need to be developed; so will an understanding of the USAF workforce required to execute and sustain the goals. Preparing a robust, full-cycle communication strategy about the implementation to promote adoption and provide the appropriate levels of transparency about the effort is also an important organizational consideration. All these tasks can be applied to develop a robust maturity model that is quantitatively assessable across USAF components.

## Technological Foundation

Modern, enterprisewide systems are typically built using foundational components that (1) promote flexibility in achieving operational goals, (2) deliver a secure infrastructure for information processing, and (3) enable automation in a way that is commensurate with business practices and analysis goals. It is important to prioritize the definition of the information architecture over individual enabling technologies. In this stage, the USAF has an opportunity to identify and leverage existing capabilities, resources, and standards from across the USAF (such as AFRL, Platform One, and Cloud One), DoD, and federal sources (such as NIST) to detail the operational architectural strategy and development pipeline for building technology-enabled decision-support tools.

## Data Curation, Data Management, and Data Services

Data analysis systems rely on comprehensive technical strategies for curating, managing, and providing data to organizational stakeholders. This entails enumerating the anticipated workflows for HRM talent management, technical policies for securely transacting information that is to be exchanged, and developing the tools necessary to work with, manage, and prepare data for analytical methods. The technological approach to migrating data into new repositories is resolved in this stage along with functional and operational performance requirements of the data-oriented systems themselves. Also important to resolve are requirements for user experience and usability requirements, interoperability and reporting services, personnel-centric analysis (such as recruiting career tracks, professional development, health services), and data services for readiness-oriented assessments of the operational force.

## Analysis Systems, Methods, and Services

Analysis systems are predicated on work developed in the preceding stages. That is, USAF efforts to provide an organizational, policy, and technological foundation—along with core operating capabilities for data-related services—inform the analytical capabilities being sought by the enterprise for technology-enabled business practices. In this stage, USAF efforts focus specifically on the topic of analysis. Given an adequate set of data resources, what are the precise analytical goals, methods, and standards to be implemented? Both the functionality of analysis systems and assurances about their outputs must be defined. Functional requirements define the operational goals of a system. In addition, a detailed strategy for integrating new analysis processes into HRM systems and the approach to their development and testing will be required. Analysis systems may require special consideration in the case of ML, for which training data sets may need to be robustly developed to achieve the expected performance benefit for enterprise and HRM talent management goals.

## Enterprise Integration and Deployment

The final broad category looks ahead to enterprise integration and deployment. The main courses of action focus on the technical framework for deploying technology for technology-enabled practices in the short and long term and prepare the USAF workforce to incorporate that framework into their operational activities and sustain it over time.

CHAPTER 5

# Conclusion

The USAF and other DoD services have established themselves over decades as leaders and innovators in capitalizing on data to improve HRM decisionmaking. These efforts have placed the USAF in a position where it is feasible to further adopt many HRM practices and technologies that are on the cutting edge. But homing in on true areas of value for the USAF amid the hype associated with industry practices can be difficult. Some possible decision-support systems would produce only marginal improvements compared with existing practices. Others may not apply to the military HRM context at all.

Our framework defining a technology-enabled talent management system provides some clarification on what it would look like if the USAF HRM community were to move incrementally toward AI and ML adoption. The next step involves moving away from periodic decision cycles informed by rerunning an analytic script and toward continual, highly customized decisions enabled by interactive systems that perform better and better over time through feedback from decisionmakers. The use cases from prior research also suggest that it has been easiest in the short term to explore ways to use machine intelligence with existing data on past outcomes. Reaping value from technology-enabled practices requires addressing barriers to dynamically adapting data collection or experimentally implementing policies to generate feedback for rapid improvements to the performance of HRM systems.

The overarching lesson from this research is not to allow past successes to lead to entrenched practices that become barriers to further improvements. Our use cases show that the USAF can continue to build on its legacy by integrating new data-centric technologies into talent management, but becoming more effective requires adjustments in many areas, such as technology, culture, and long-standing policy frameworks.

Companion reports in this series address key topics that will help the USAF grapple with these necessary changes. One report covers effective practices that similar organizations in government and industry have employed to successfully transform talent management systems and provides concrete and relevant examples (Yeung et al., 2022). The other report specifically focuses on factors that will help technology-enabled HRM initiatives succeed when competing for funding in the planning, programming, budgeting, and execution process (Snyder, 2022).

# Abbreviations

| | |
|---|---|
| AFRL | The Air Force Research Laboratory |
| AFSC | Air Force Specialty Code |
| AI | artificial intelligence |
| ASVAB | Armed Services Vocational Aptitude Battery |
| DoD | U.S. Department of Defense |
| HR | human resources |
| HRM | human resource management |
| IST | initial skills training |
| IT | information technologies |
| ML | machine learning |
| NIST | National Institute of Standards and Technology |
| PAF | RAND Project AIR FORCE |
| PPST | Personnel Policy Simulation Tool |
| REWS | retention early warning system |
| RRM | Recruiting Resource Model |
| USAF | U.S. Air Force |

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PROJECT AIR FORCE

The U.S. Air Force (USAF) and the other military services have a long history of innovation in human resource management (HRM). The recent industry boom in data-related technologies has prompted USAF leaders to sponsor research on how these technologies could further improve HRM decisions. This report describes the common theme of this research portfolio, which is that adopting HRM practices that are technology-enabled could lead to more-effective talent management. Of course, technologies exist on a spectrum, and the USAF, like all other organizations, already rely on some technologies to perform HRM functions. However, by pursuing the latest technological advances, the USAF can continue to improve the efficiency and effectiveness of HRM processes.

To help policymakers understand the contrast between technology-enabled practices and practices already in place that make use of rich data, this report describes industry practices that fit under the umbrella of technology-enabled talent management and presents a framework highlighting the distinctive features of those practices. The authors focus principally on the use of artificial intelligence (AI) and other analytic techniques to derive insight from data at speed and scale. The authors then present use cases in which recent research has demonstrated technology-enabled practices in the USAF context, discuss barriers to further implementation, and present an implementation structure for moving toward greater adoption of these practices.

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