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Facilities Staffing Requirements for the Veterans Health Administration—Resourcing, Workforce Modeling, and Staffing

PROCEEDINGS OF A WORKSHOP

Susan J. Debad, *Rapporteur*

Committee on Facilities Staffing Requirements for
Veterans Health Administration

Board on Infrastructure and the Constructed Environment
Division on Engineering and Physical Sciences

Board on Human-Systems Integration
Division of Behavioral and Social Sciences and Education

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Preface

A data-gathering workshop was held for the Committee on Facilities Staffing Requirements for Veterans Health Administration as part of a project to prepare a comprehensive resource planning and staffing methodology guidebook for the Facility Management (Engineering) Programs of the Veterans Health Administration (VHA). This workshop is part of several committee activities, which include examination of human factors and staffing methodology as well as facilities management. This workshop, in particular, was dedicated to human resource modeling. Other workshops focus on activities and staffing required to manage and operate facilities, with attention to health care. From these activities has come an understanding of the complexity of the VHA facility management task and of its current methods of staff modeling and planning.

The goal of the project is to support development of a methodology that VHA facilities can use across the system for establishing budget and staffing levels for Healthcare Facilities Management (Engineering) Departments. The Veterans Administration has identified workforce modernization as a priority. Standardized staffing models, such as for engineering services, contribute to providing a safe, appropriate, and reliable environment of care. Many clinical program offices already have implemented standardized staffing standards or policies.

We wish to express our deep appreciation to the members of the committee for their diligent and dedicated contributions to developing and participating in the workshop in an expedited time frame. The diverse expertise and experience offered by the members of the committee were indispensable to the formulation of the individual sessions. We also wish to thank, on behalf of the entire committee, the staff of the National Academies of Sciences, Engineering, and Medicine, whose expertise and skill were absolutely essential to our meeting the charge from our sponsor.

This Proceedings of a Workshop was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purpose of this independent review was to provide candid and critical comments that will assist the National Academies of Sciences, Engineering, and Medicine in making the published proceedings as sound as possible and to ensure that it meets the institutional standards for quality, objectivity, evidence, and responsiveness to the charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

We thank the following individuals for their review of this proceedings: Brian Norman, Compass Manpower Experts, LLC; Isolde Opphile, Facilities Services Directorate, Washington Headquarters Services; Julie J.C.H. Ryan, Wyndrose Technical Group; and Norman H. Sleep, Stanford University.

Although the reviewers listed above provided many constructive comments and suggestions, they were not asked to endorse the content of the proceedings nor did they see the final draft before its release. The review of this proceedings was overseen by Frederick Oswald, Department of Psychological Sciences, Rice University. He was responsible for making certain that an independent examination of this proceedings was carried out in accordance with standards of the National Academies and that all review comments were carefully considered. Responsibility for the final content rests entirely with the rapporteur and the National Academies.

Colin Drury and James Smith, *Co-Chairs*
Committee on Facilities Staffing Requirements for
Veterans Health Administration

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1

Introduction

BACKGROUND

This report summarizes the 2-day Workshop on Resourcing, Workforce Modeling, and Staffing, hosted by the Committee on Facilities Staffing Requirements for Veterans Health Administration, held in Washington, D.C., in January 2019. This workshop is one of several data-gathering sessions to support the committee's iterative study. The ongoing study was requested by the Office of Capital Asset Management and Engineering Support of the Veterans Health Administration (VHA) to identify and discuss the Facilities Management (Engineering) Program resourcing challenges faced by the U.S. Department of Veterans Affairs (VA).

The overarching goal of the study is to help the VHA assess the overall resource needs of its Facilities Management Program and to develop budget and staffing methodologies. Such methodologies can provide better justification for ensuring that local VHA programs are adequately and consistently staffed to accomplish the mission and meet all requirements.

The VHA is America's largest integrated health care system, providing care at 1,250 facilities, including 172 medical centers and 1,069 outpatient sites of care of varying complexity (VHA outpatient clinics), serving 9 million enrolled veterans each year. This portfolio is spread across 18 Veterans Integrated Service Networks and includes 5,639 buildings (2,107 of which are historic), covering more than 150 million total gross square feet and more than 16,000 acres.[1] The VA also manages 1,665 leases that include more than 18 million net usable square feet. In additional to the physical characteristics of VHA facilities—such as size, age, and equipment—medical center variables include program scope, the complexity of health care delivered, magnitude, and performance requirements. On top of these considerations are the management, demographic, and social and political contexts in which the fixed facilities must continue to operate.

The workshop did not focus on the unique situations of the VA; rather, it broadly considered approaches in workforce modeling by examining methodologies and inputs for facilities staffing models. Both health care and non-health-care industries and organizations were discussed. The participants did not need to specifically address unique features of the VA, but instead to provide a survey view of modeling techniques and considerations.

The VHA itself will have to reflect on the material presented and integrate it with organizational knowledge and policies. Unique features of health care providers or the VHA, such as staffed hours, health care services

[1] Veterans Affairs, "Health," http://www.va.gov/health, accessed February 2019.

provided, and veterans' demographics, may be addressed in a VHA-specific staffing model, the development of which is outside the scope of this committee's task.

The workshop was designed using a set of questions that were developed by the committee workshop planning team: Colin Drury, Alberto Galué, Cheryl Paullin, and Fred Switzer. In order to answer those questions, a panel of experts was convened from various disciplines to inform the committee of the methods most often used in their professions for determining workload and to discuss how those methods might be applied for facilities engineering staffing at VHA medical centers. For the workshop agenda, see Appendix A.

The role of the committee for this data gathering workshop was limited to planning and convening the meeting. The views contained in this document are those of individual participants and do not necessarily represent the views of all participants, the committee, or the National Academies. The rapporteur prepared this document. The workshop was attended by almost 50 people (including committee members and National Academies staff): see Appendix B for a list of in-person attendees; in addition, many other people watched via a live webcast.

WORKSHOP ROLE IN COMMITTEE'S WORK

Committee member Cheryl Paullin opened the workshop by welcoming attendees and introducing committee Co-Chair Colin Drury. Drury summarized some key points from the statement of task for the work of the committee; see Appendix C for the full statement. He noted that the committee's charge includes the development of a comprehensive resource planning and staffing methodology guidebook for the VHA Facility Management (Engineering) Programs; the identification of key variables that must be factored into the resourcing methodology; recommendations for staffing models; and the steps needed for the VHA to transition from its current staffing methods to the methods that the committee will propose. Drury stressed that the committee's charge is not to produce a staffing model, but to provide inputs that will assist the VHA in producing its own staffing model.

Drury explained that the objective of this workshop was to gather data to support the committee's work. He enumerated some areas in which data are needed, including the methods by which the VHA currently performs its operations and maintenance functions; details of the knowledge, skills, and abilities required to perform operations and maintenance; details about the complexity and diversity of VHA facilities; the way facilities staffing is currently performed; how modeling generally works for operations and maintenance functions; and the ways in which the VHA's situation might change in the future.

Drury described some elements of the VHA's scope that illustrate the complexity of the committee's task. As noted, the VHA has 172 medical centers, which are spread across 18 regions in the United States. These sites not only differ in size, but they also range in age from modern buildings to historic, protected structures. The medical functions that are provided also differ among sites: every site has a "complexity index score" reflecting the medical complexity of the types of treatment provided.

At each site there is a chief engineer who, together with staff and contractors, must ensure that the facilities remain operable and meet the requirements of both medical staff and patients. Drury emphasized that the significance of the committee's task is further highlighted by the general nature of facilities management functions. While some functions, like cleaning and routine maintenance, are predictable in terms of workload, much maintenance is not predictable, so that models are needed that can account for the unpredictable, stochastic nature of many maintenance functions.

Drury next detailed some of the skills and experience of the steering committee members, which include, but are not limited to, management, industrial and organizational psychology, human resources, staff modeling, and human-systems integration: see Appendix D for biographical sketches of all steering committee members and workshop presenters. Drury concluded his remarks by placing this workshop in the context of the work the committee will undertake to fulfill the statement of task, listing the topics for all of the committee's planned meetings and workshops.

STRUCTURE OF THIS PROCEEDINGS

Following this introduction, Chapter 2 discusses staffing modeling methodologies and work measurement techniques, along with factors influencing the choice of appropriate techniques. Chapter 3 discusses workforce modeling in the federal government, the Federal Aviation Administration, and in health care. Chapter 4 covers options for outsourcing facilities management and tools that can aid in the workforce modeling process. Chapter 5 discusses additional considerations for facilities staffing modeling, including the role of artificial intelligence in modeling and the importance of implementing change management techniques as part of a workforce planning process. Chapter 6 provides a discussion of the major themes of the workshop.

2

Modeling Methodologies

This chapter covers two presentations and a discussion on data collection and modeling considerations for facilities staffing at the Veterans Health Administration (VHA). The topics covered included modeling methodologies for staffing and various work measurement techniques, along with factors influencing the choice of appropriate techniques, as well as future trends important in workforce modeling.

MODELING FOR THE FUTURE

For the session on future trends in the applicability and aggregation of staffing models in both the field of facilities management and in the specifics of staffing models themselves, the committee had asked the speaker to address the following questions:

> How do you determine when a heuristic model is good enough? Can you have several models with different structures, even bases, for different groups of staff? And, how do you know what level of aggregation is "best" for a model: individual departments, groups of departments, or whole organizations?

Brian Norman (Compass Manpower Experts, LLC) began his presentation by responding directly to the guiding questions posed by the committee. For the first question, on when a heuristic model[1] is good enough for staffing modeling requirements, Norman said that, in his opinion, a model that can explain at least 80 percent of the staffing needed to perform the mission is a good model. He then noted, however, that whether a model is "good enough" actually depends on a number of factors including, but not limited to, the purpose of the model (strategic versus tactical); the precision required, in terms of acceptable levels of operational risk; what the organization can afford and the cost of getting it wrong; and whether or not the model is useful and straightforward enough to be applied by the organization.

As examples of heuristics that can be used for staffing modeling, Norman provided some of the staffing benchmarks for health care facilities from the International Facility Management Association/American Society for Healthcare Engineering, noting that these "rule-of-thumb" ratios are a recommended starting point for understanding the needs of a system. He suggested that, as a first step, current staffing data should be gathered VHA-wide

[1]Heuristic models are those that reflect the imprecise observed aspects of a modeled system, including uncertainties in the modeled environments that are not easily estimated mathematically (such as ignorance).

and compared with other campuses across the VHA. Once an overview exists of what is going on at each facility, variations of the staffing can be explored, and the staffing needs of facilities with varying needs can be used to refine the model ratios to prepare for a more advanced model.

Turning to the committee's second question, on whether one can have several models with different structures or even bases, Norman said that it is normal to use a mix of tools to build out models to quantify different work centers. In addition, he said, models can be bundled together into a larger model that depicts the whole requirement. To illustrate the use of multiple models in a given organization, he said that "an organization might have a chief position that is staffed with only one person and does not rely on a calculation. The modeler just gives them a 'one' in the model and moves on checking if they have support staff, etc. Support or indirect workers can be included as staff using ratios or percentages, but it is good to do time measure studies on those employees to better understand the various positions." Norman stated that what he really likes to tie his measures into is where one can count a "widget," an outcome, or some kind of specific production level to the staffing level. Norman reiterated that all of these core models are subject to workload variances, based on the unique situations present at different locations.

In response to the committee's third question, regarding the level of aggregation that is best for a model, Norman replied that, again, it depends on the purpose of the model. He stated: "I like models that you can take and roll up to higher levels but that you can apply locally to practically get a realistic operational answer." He warned that aggregation without understanding can sometimes provide unrealistic results, particularly when there are variations in processes and procedures, environment, and facilities.[2]

Norman then switched from the committee's questions to a discussion of future trends that will drive new staffing models. He first focused on trends in the field of facilities management. He explained that advances in information technology will move health care into an era of "smart" systems, similar to what has happened with airliners and military aircraft. These systems will let operators know when preventive maintenance should be performed or if a system needs to be repaired. Entire facilities will eventually be connected by "the Internet of (health) things" and mapped out in a virtual model that will make the entire system observable from a "dashboard"[3] at a high level. Such a model will require changes in the number and type of maintenance staff required for a facility.

Another trend in facilities management that will influence future staffing models is the use of advanced facility/maintenance management systems. Norman stressed that investing in a robust system not only decreases the paperwork burden on maintenance workers, but is also "very powerful, because that kind of data can drive good answers to what you need for staffing things." Norman explained that certain areas of health care facilities in which it is imperative that the systems function properly, such as outpatient surgery centers, might require a more robust, and therefore more expensive, maintenance management system than other areas of a facility. He acknowledged that, compared with other types of industries, health care facilities face a difficult task in terms of staffing because the nature of the work and the strict accreditation requirements, such as those of The Joint Commission,[4] which mandate that high maintenance standards must consistently be met to minimize risk.

Norman noted the trend toward viewing facilities management as an operational partner in the health care industry, rather than simply as a cost. He advised the VHA to treat its facilities management teams as if they are "vested in the life of that system," as a partner in delivering good outcomes for patients.

In terms of future trends in staffing models themselves, Norman mentioned the leveraging of "big data"[5] as a key aspect in the evolution of these models. Advances in data visualization tools now allow immediate identification of outliers and trends that can influence the building of models, including digital views of entire facilities. The use of big data can result in sophisticated machine learning that can be integrated into self-diagnostic systems software.

[2]See, for example, this seminal paper on the challenges associated with the mixing or aggregation of model variables when they are correctly different in purpose and definition: Robinson, W.S. (1950). "Ecological Correlations and the Behavior of Individuals." *American Sociological Review*, 15(3) pp. 351–357, doi:10.2307/2087176. JSTOR 2087176.

[3]A dashboard is a single view of useful information that is easily readable. It is usually a graphical display of the key performance indicators a team wants to monitor regularly.

[4]The Joint Commission is a U.S.-based nonprofit organization that accredits more than 21,000 U.S. health care organizations and programs.

[5]Extremely large data sets that can be analyzed computationally to reveal patterns, trends, and associations.

In concert with the rise of big data, Norman said he sees a trend in the rebirth of manpower modeling, which was effectively used as early as World War II, before the age of advanced computers. Traditional modeling practices, such as certain measurement techniques, are making a comeback, now coupled with today's powerful analytic tools. Norman noted that high staffing costs, which can be as much as one-third of the costs of any large system, are often the impetus for the rebirth of interest in modeling techniques. Furthermore, because of the increasing demand for modeling, very effective "boutique" types of modeling tools are being developed for very specific industries, such as law enforcement and call centers.

Another trend that will affect the future of staffing models, Norman said, is the changing workforce. In the past, the workforce consisted primarily of three classifications of workers: full time, part time, and contractors. Today, in contrast, there are many more classifications of workers, including, but not limited to, freelancers, seasonal, temporary, and job-share. For the VHA, Norman advised that the entire system should be examined in terms of the mix of workers involved, because this complexity affects the creation of a staffing model: "You've got to look at the whole thing. What are your responsibilities for facility maintenance, and are they in-house or are they outsourced? That's a big deal. You've got to look at the whole picture to get a whole-picture answer. And you have got to decide then what should be and should not be in-house or outsourced, and for what reasons."

Norman's presentation generated discussion on the importance of good data and accurate data labeling. He cautioned against accepting the data provided for modeling at face value, noting that, in addition to issues with inaccurate reporting, data pulled from different locations can be labeled differently, preventing accurate comparisons or meaningful aggregation. If an organization has not performed a proper review of its data, Norman suggested that time for that review be built into the modeling time. Relatedly, when systems are developed for collecting staffing data, he said, those systems should not be so difficult that workers entering the data get frustrated and "put in the wrong data, just to get through their day."

To conclude, Norman reiterated what he sees as a common theme of the session's discussions: staffing models need to be developed with a specific purpose in mind and created to operate within an organization's overall system of budgeting and planning. Moreover, the exact framework for the model—whether it will be implemented strictly or used as a guide only—should be determined up front, in order for the model to be of use to the organization. He concluded with a caution about building and using models: "You're looking at this as a system. You don't build a model just to have somebody maybe try to apply it. It has got to operate in your budgeting system and your planning system and how you fund things. It has got to have some muscle. You can't just say, 'I don't feel like using this.'"

WORK MEASUREMENT TECHNIQUES

For the session on work measurement techniques and the conditions that contribute to their success, the committee had asked the speaker to address the following questions:

> What is the measured validity of work measurement (WM) techniques? Job completion time may be highly variable for maintenance tasks: How do WM techniques take this into account when many were developed for short-cycle repetitive tasks? How do WM techniques deal with quality of task output? Is the traditional speed/accuracy trade-off considered? What are the costs and benefits of the various measurement techniques? Are archival data a valid predictor of how long a task should take, or just of how long it does take currently? Is the use of focus groups of subject matter experts (SMEs) a valid way of measuring time for a job? Are there automated measurement processes and what is their validity and cost? How granular are the measurements and how granular do they need to be? What are the respondents' reactions to the measurement process and to implementation of any measurement-based policies? Do the measurement techniques meet such basic measurement requirements as minimizing criterion deficiency and criterion contamination?

Neal Schmeidler (Grant Thornton) explained that, to model staffing, it is important to first understand how employees' time is spent, which can be accomplished through the process of work measurement. To clarify this basic prerequisite of a staffing model, Schmeidler illustrated the way that an employee's total assigned time is broken down: see Figure 2-1. Tight job time standards can be obtained by a study of accountable time, and all aspects of assigned time have to be considered for a staffing model.

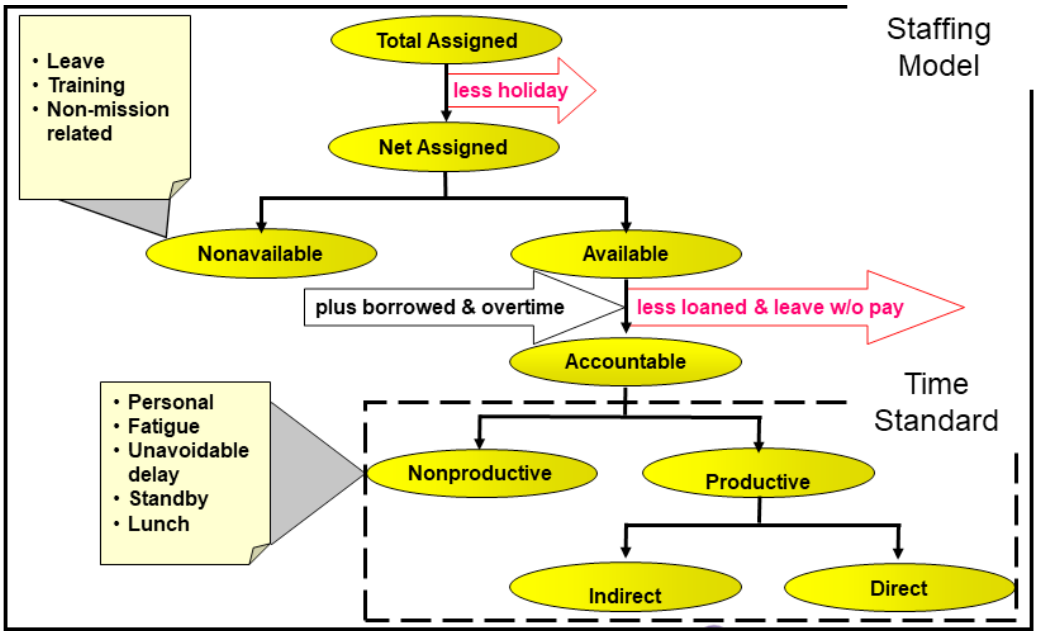

FIGURE 2-1 Breakdown of employee total assigned time in terms of creating time standards and staffing models. SOURCE: Schmeidler, N. (2019). *Work Measurement Operations Research*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #6). Reprinted with permission.

The second basic concept that has to be understood prior to performing work measurement for the purpose of a staffing model is the hierarchical levels of the work being performed. In order to accurately measure work, the method in which detailed-level work rolls up to the desired mission must be clearly delineated: see Figure 2-2. Schmeidler acknowledged that this is not always simple, but it is critical for structuring the measurement such that nothing is missed or double-counted.

Schmeidler described six techniques that can be used to measure work, first noting that work measurement techniques can be divided into three categories: analytical, measured, and engineered: see Figure 2-3. These categories of tools vary in precision and cost. Analytical tools are the least precise, with a confidence interval in his experience of 15 to 20 percent, but also the least expensive. Engineered tools have the greatest level of precision, plus or minus 5 percent, but they are the costliest. Measured standards fall between the two. The six techniques Schmeidler discussed, in descending order of precision, are predetermined time study, stopwatch time study, work sampling, standard data, historical data, and judgment estimating. Since these tools necessitate varying levels of investment, it is important to determine resource constraints—including the funding, staff, and time that are available for the effort—prior to choosing a work measurement tool.

In addition to resources, Schmeidler continued, a number of other factors need to be considered in the choice of a work measurement technique. Some of the factors relate to the general atmosphere of the workplace. For example, he explained, the relationship between management and labor plays an important role in the choice of technique. If this relationship is tense, a stopwatch study or a predetermined time study will be difficult because of worker resistance, and conversation-based methods, such as judgment estimating, will be easier. Schmeidler noted that even under the best conditions, employees tend to dislike measurement processes and the implementation of measurement-based polices; he suggested that management persistence, coupled with slow and gradual change, can lessen the resistance when these techniques are chosen.

To choose the appropriate measurement technique, the precision and accuracy requirements of the client also have to be understood, as well as any tools that have been used in the past and the client's belief system regarding which tools are the most accurate. Referring to the hierarchy of work (see Figure 2-2), Schmeidler explained that,

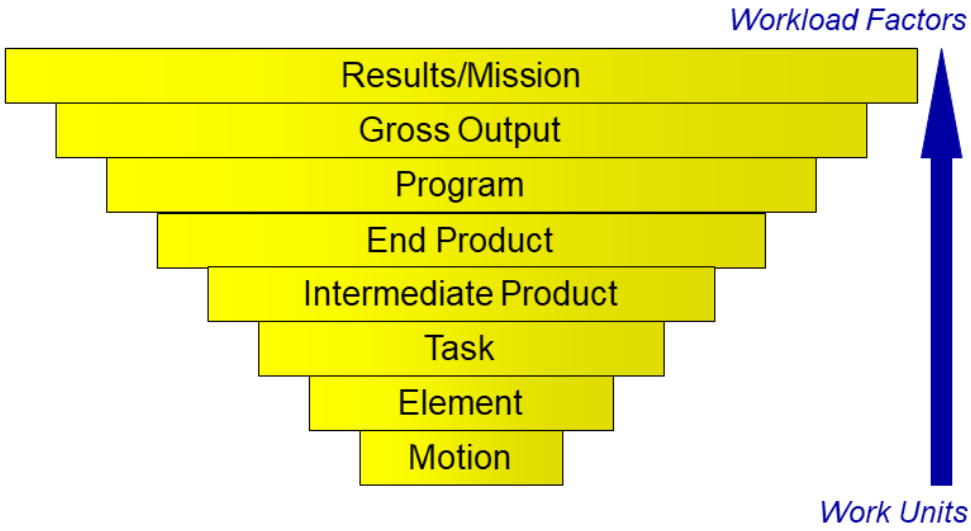

FIGURE 2-2 Hierarchical orders of work.
SOURCE: Schmeidler, N. (2019). *Work Measurement Operations Research*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #7). Reprinted with permission.

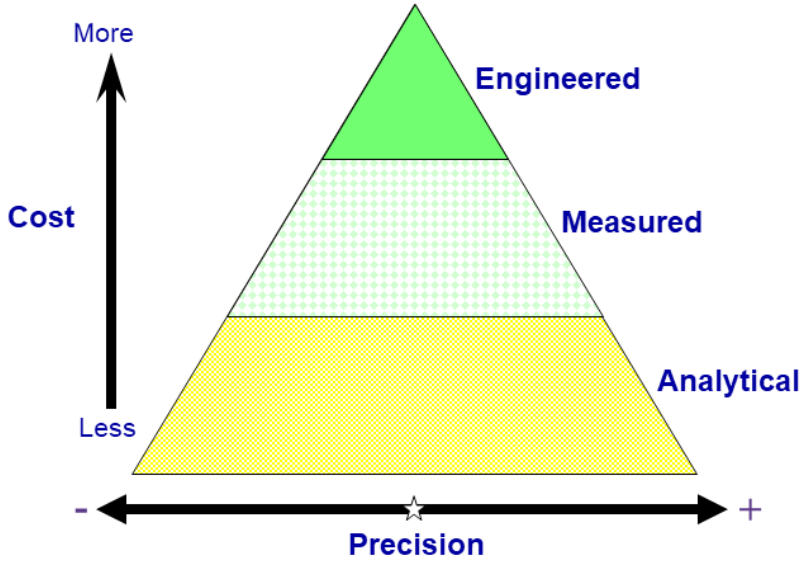

FIGURE 2-3 Categories of work measurement techniques.
SOURCE: Schmeidler, N. (2019). *Work Measurement Operations Research*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #8). Reprinted with permission.

for the purpose of a staffing model, maintenance work should be measured at the level of end product or intermediate product because measurement at deeper levels could be cost-prohibitive, and higher levels are difficult to model. He further suggested that data be collected at least one level "deeper" than the level at which results are desired, so that the underlying data will be easily available if questions about those data arise during model creation.

Other factors that need to be considered in the choice of a work measurement technique concern the character of the work itself. For example, to accurately capture the work process, the business cycle must be fully understood,

so that the proper information is gathered during the appropriate time. Details of the task to be measured, such as duration and variability, need to be well understood. For maintenance tasks, some can take days to complete, and some may be interrupted for long periods if a part has to be ordered. Because completion times can be highly variable for such maintenance tasks, precise measurement methods, such as predetermined time study, stopwatch study, and work sampling, may not be cost-effective or resource appropriate. Other work-specific factors to consider in the choice of a measurement method are the availability of data, the number of work locations available for an appropriate sample, and the location of all work crew members, both on-site and remote.

Schmeidler noted that one of the questions posed to him by the committee concerned the costs and benefits of each of the measurement techniques. He said that he could not provide a quantitative comparison, and he offered some data from a survey on work measurement of the members of the Institute of Industrial Engineers in 2003. This survey showed that, in the private sector, the time study technique is used most frequently, more than 80 percent of the time. In terms of the benefit-to-cost ratio, he noted that almost 80 percent of the survey respondents reported a "payback" ratio of two to one or greater.

Schmeidler then discussed several conditions that contribute to the success of work measurement techniques. Foremost is the support of the executive leaders, management, and key stakeholders. Referring to the 2003 survey he had just mentioned, Schmeidler said that leadership was found to be the primary motivator for work measurement in the private sector, higher than market influences, clients, or regulations. This was true for both large and small employers. Another condition for success of work measurement is the involvement of qualified individuals in the development, execution, implementation, and maintenance of a work study. He emphasized that teams should include experienced industrial engineers who understand the process and have solid interpersonal, analytical, and presentation skills. Qualified teams are critical for many aspects of the work measurement process, including the choice of appropriate measurement techniques; the selection of a representative sample; proper data collection; and detailed data analysis, validation, and documentation. In response to one of the questions posed by the committee, Schmeidler stressed that work measurement techniques can accurately predict job completion time only if these conditions of success are met.

Schmeidler next discussed in detail the two analytical work measurement tools: historical data and judgment estimating. In response to one of the committee's questions, on the validity of archival data as a predictor, Schmeidler answered that historical data can predict how long a task should take if a number of criteria are met. Those criteria include a high-performing workforce, good supervision, and a good work measurement system. In the absence of these criteria, he noted, the measurement will reflect a "does take" time, not a "should take" time. However, he said, even a "does take" time is a start, and, "if the system can't do anything about 'does take' time, what's the point in knowing that it could be 20 percent less? You're going to have to factor it back in."

Schmeidler next responded to the committee's questions about the judgment estimating method of work measurement. He said he does not favor focus groups composed of subject-matter experts because they can easily be swayed or dominated by a single individual, but he does think that individual interviews of subject-matter experts can result in valid data points. He illustrated this approach with an example of work measurement he did for the National Aeronautics and Space Administration. The agency wanted a time standard for a long-duration, low-repetition task. Schmeidler used a technique documented by Mundell called fractioned professional estimate.[6] In this technique, employees knowledgeable in the subject matter of the work describe the work using discrete steps, providing their estimates of the standard amount of time and the frequency of each step. Using this technique, a 1-hour employee interview resulted in 36 hours of labor data, which would have been extremely expensive to obtain with a time study. This example, said Schmeidler, makes the case that "a quick and dirty answer is probably pretty good. And you can always improve it once you get that reference point."

To wrap up, Schmeidler provided several recommendations for the committee's work. First, he suggested that the committee assess the VHA's understanding of work measurement and, if necessary, advise the agency of the importance of such understanding before work measurement is undertaken. The VHA needs to understand that money and staffing will be required for the measurement and that the process will need to be maintained over time in order to remain effective. Schmeidler's second recommendation to the committee was to conduct

[6]Mundell, M.E., and Danner, D.L. (1994). *Motion and Time Study: Improving Productivity, 7th Edition*. Englewood Cliffs, N.J.: Prentice Hall.

a literature review, as is standard for any study, and he noted several key sources. Third, Schmeidler suggested that the committee visit and learn from the top 5 to 10 health care companies that have good outcomes and are financially successful. Schmeidler also recommended that the committee collect information about computerized maintenance management systems.

Workshop participants and committee members asked several questions related to the process of judgment estimating. Brian Norman (Compass Manpower Experts, LLC) addressed the drawbacks of using a focus group of subject-matter experts rather than interviewing them individually, acknowledging that one personality often drives the discussion while other participants become disengaged. He noted that he has used a hybrid strategy, in which individual interviews are first performed to collect data, which are used to generate box plots with standard deviations. These data are then used with a focus group that is asked about possible reasons for the outliers, providing a "fine tuning" of the team's understanding of the dispersion. Schmeidler commented that 10 individual interviews allow the collection of 10 data points, from which an average can be calculated; in contrast, with a focus group of 10 people, it is unclear where each individual stands. He also cautioned that the presence of the supervisor during an interview can influence the responses given by employees.

Cheryl Paullin (committee member) stated that in the field of industrial organizational psychology, using subject-matter experts for estimating is often performed using surveys. The survey approach allows the collection of data from many individuals, making it more efficient than one-on-one interviews, but since surveys are filled out independently, it avoids the possible bias of a focus group. Schmeidler replied that he had not tried the survey approach, but that, in his opinion, the personal, participative nature of interviews can provide a lot of information in a short time and can often help with employees' buy-in.

Colin Drury (committee cochair) asked Schmeidler how particular subject-matter experts are chosen for work measurement studies. Schmeidler responded that in most facilities the managers will easily be able to identify the employees who are most appropriate to study for this process.

Robert Anselmi (committee member) noted that the VHA has a great deal of variability in terms of its facilities, the skill sets of employees, and yearly project workloads, all of which affect staffing. He asked Schmeidler to address this issue of variability in terms of work measurement. Schmeidler acknowledged the challenge that such variability brings and that differences in work ethic between locations will add to that variability. He said that the VHA should decide up front what the "national standard" should be and then begin the process of slowly moving all facilities toward that standard.

David Alvarez (VHA) asked Schmeidler what risk-averse government agencies generally do with work measurement data: "What sort of decisions are they making, what are they trying to solve when you provide these studies to them?" Schmeidler responded that some organizations use the standards to measure individual performance, but there are some labor agreements that do not allow work measurement data to be used against an individual, so it is important to understand what the bargaining units and individual agreements will allow. In the private sector, he noted, performance data can ultimately be used to discharge underperforming employees, but this does not happen in the federal government, where work measurement data are often used to determine staffing needs from a budgeting standpoint. These figures become a reference point for the organization and for Congress.

In Schmeidler's final recommendation to the committee, he strongly urged it to gain a full understanding of the overall situation for the VHA, in terms of funding, understanding the relationship between management and the bargaining units, and the commitment of management to the change process. He suggested that the committee's future recommendations should be appropriate to the VHA's situation because if they are not, or if the resources do not exist to support the recommendations, or if the end goal in the report is too far from the VHA's starting point, then the recommendations will not be followed or will only be partly followed.

DISCUSSION OF MODELING

In this workshop session, Norman responded to questions generated by his earlier presentation and to the questions the committee had asked him to address, which were touched on in the course of the session:

How do any unique aspects of a health care organization affect the structure of the model? What factors do you consider in staffing modeling for health care facilities engineering? And, how do you relate model outputs to performance parameters that matter to stakeholders?

Norman opened the discussion session with a slide outlining conditions for a better model: see Figure 2-4. He acknowledged that budget pressures often do not allow for all these conditions to be met but emphasized that meeting them would greatly improve the success of any modeling effort. In addition to the need for a standard organizational structure, Norman stressed the value of strong workload data systems: "Having really good, verifiable, accurate data to work from just has tremendous power." He also pointed out that as a modeler he spends a lot of time identifying the tasks and processes that need to be performed by each work center, stressing that documented performance goals not only set an organization up for measurement, but also allow a dashboard view of the organization's workload, the health of the processes, and how workers' time is spent. These two tasks alone—building a work center description and a list of "must-dos" and then deploying that list across the organization—can be of great help in terms of setting the stage for successful workforce modeling. Norman also noted the importance of standardizing work processes across locations and of implementing continuous process improvement methods.

In terms of the appropriate staffing necessary to collect quality manpower data, Robert Anselmi (committee member) began the discussion by noting that in many of the medical centers in which he has worked, there were no staff to oversee work orders in this way and, as a result, only the minimum amount of data were collected to keep the medical centers compliant with accreditation standards. Norman acknowledged this reality and stressed the importance of investing money up-front in the technology and the people needed to create a system for collecting good data. He emphasized the leverage that such data can bring to an organization in terms of strategic planning. Drury underscored Norman's point: "You invest up-front. Even borrow the money to do it. And you get the rate of return. It is absolutely standard. I do not see why anyone objects to doing this."

Following up on Drury's point, Norman suggested that organizations may object to investing in facilities management because it is seen as a cost instead of a partner in the organization's mission. He pointed out that the cost of *not* investing in these systems can be greater, in terms of lost billing time or even in terms of patient lives, than the cost of the investment. Oleh Kowalskyj (VHA) added to Norman's assessment, noting that, when an organization's leaders need to cut costs, they find it easier to cut employees who perform data collection than to cut electricians or plumbers. This choice, continued Kowalskyj, perpetuates the problem of poor data availability, quality, and validity. Norman agreed with Kowalskyj, cautioning that the VHA has peer competitors—both

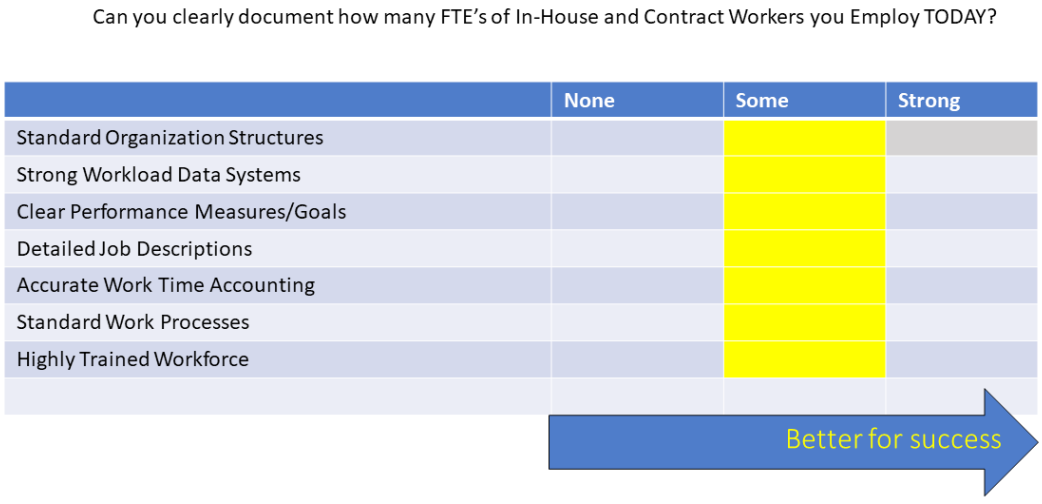

FIGURE 2-4 Conditions for a better model.
SOURCE: Norman, B. (2019). *Modeling Best Practices for the Future*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #34). Reprinted with permission.

corporate and large nonprofit health care associations—that have robust systems in place to measure workforce data, transaction data, cost per procedure or output and more, which gives these organizations an advantage.

The discussion turned to considerations for applying staffing models in VHA facilities, given that the enterprise is inherently diverse, decentralized, and nonlinear. David Alvarez (VHA) raised several questions: "How do you apply something this granular to such an organization that is inherently decentralized? What is the measurement model? How do you approach something like that?"

Norman responded that the process should begin with a "tremendous baselining effort" to obtain a full understanding of the diversity across the entire VHA enterprise. The data from that baseline effort should then be compared with that of similar organizations, he said, or even with peer organizations that are not medically oriented: "Using internal and external benchmarking for getting that order of battle ready right now . . . could be very productive," Norman said. Furthermore, such benchmarking will set the VHA up for a better chance for success with the subsequent modeling effort.

In terms of the inherent nonlinear character of the VHA, Wesley Harris (committee member) asked Norman how that should be accounted for in a staffing model. Norman acknowledged that in certain organizations with a high degree of nonlinearity, a linear model can sometimes be created that both the modeler and the customer believe is "good enough" in terms of the amount of risk assumed. However, Norman said, he recognizes that in other cases such risk is unacceptable, noting that "there are just certain things that cannot be wrong," and in such cases more resources have to be invested to make the model extremely precise. He explained that modeling can sometimes accommodate diversity in an organization using "bolt-ons" or variances in a model, noting that the diversity of functions across the varied locations in the VHA could potentially be accommodated by a model in which some locations get extra, customized pieces along with the standard model framework.

In discussing the use of a single model or multiple models, Fred Switzer (committee member) asked: "Where is the sweet spot between fitting your data into a single model or going ahead and biting the bullet and using multiple models for different parts of the organization?" Norman replied that there is no rule of thumb and that every organization must be examined individually to determine what it can afford, the amount of coverage desired, and the level of integration needed. For example, he said, there are cases in which a single model will not work for a complex organization because too many assumptions must be made, resulting in the loss of fidelity of the model at the lower levels. In these cases, Norman said, he prefers a model made of smaller pieces that are easy to maintain and can be fed into a larger model.

James Smith (committee cochair) observed that much of the prior discussion was focused on the process of building a model when one does not exist. He asked Norman how he would determine the shortcomings of an existing model—whether the model is not sophisticated enough or whether the data being collected are not accurate enough to support the modeling goal. Norman replied that the health of a model can be diagnosed primarily through discussions with the organization, with questions about what types of models have been attempted, an analysis of those models, and how effective they have been. In his words: "A lot of brilliant people have had these same problems before. There is no doubt in my mind that there are brilliant people in the VHA world who have already dealt with these kinds of things and could give me an earful. That is what I would want; I would go out and get them."

David Alvarez (VHA) asked whether the same staffing model could be used by various aspects of the organization for slightly different purposes, such as at the national level to forecast budgets, at the executive level to determine the amount of risk assumed, and at the facility manager level to determine staffing needs. Norman replied that this was in fact desirable, but it is only possible if the systems at each level are integrated to share data. In Norman's words: "What you do is you take the model results. You publish that in this big thing that can be rolled up at installation level or local level up to your district, up to the federal level and say, 'these are the total requirements. This is how many gapped. This is the risk we are taking, or this is the budget we need.' . . . It is so tremendously powerful, because you can quantify what it is you need and not only by just gross numbers, but by skill, grade, or whatever. Now you can send your staffing teams to wherever it is that you need to recruit and get those filled up. It is a whole system."

3

Workforce Modeling for Facilities Management

This chapter covers three presentations on workforce modeling in the federal government, the Federal Aviation Administration (FAA), and health care. Modeling methods and other factors important for the modeling process in each situation were discussed, as were the challenges involved in each case.

PERSPECTIVES ON STRATEGIC WORKFORCE PLANNING IN THE FEDERAL GOVERNMENT

The session's first presentation defined strategic workforce planning and described three historical examples of the application of such models in the federal government and the different challenges involved in each. For this session, the committee had asked the speaker to consider the following questions, which he touched on throughout the course of his presentation:

> How have workforce planning and analysis efforts evolved over time in government agencies, in terms of application, tools, and techniques? How have specific legislations driven the importance and legitimacy of these efforts, and the application of a methodology or approach? And, how have these efforts grown in sophistication, moving from manpower analysis to strategic workforce planning?

Alex Manganaris (consultant, public-sector human capital) began by describing strategic workforce planning as a "supply and demand exercise" in which the supply component consists of the available workforce and the demand component consists of the workforce that is needed or will be needed in the future. The ultimate goal of workforce planning is matching supply with demand. Understanding workforce supply, he explained, involves knowledge about several characteristics of the workforce, including the mix of workers (employees or contractors, blue collar or white collar, etc.), whether each worker is mission critical or support, and a consideration of the way the workforce will change over time as a result of retirement and turnover.

On the demand side, Manganaris said, understanding the workforce needed involves several components, including a strategic business plan that takes into account any foreseeable changes in business processes and technology or legislative demands, as well as stated workload measures and known budgetary constraints. He stressed the importance of integrating workforce planning with the budgeting process because resourcing ultimately influences the work that can be accomplished and the staff that can be funded to perform that work. He noted that multiyear budgeting is helpful for the process of strategic workforce planning.

Manganaris then provided three examples of federal government projects in which strategic workforce planning was used. The first project was undertaken for the Air Force in the early 1990s, at a time of cuts to funding. In order to decrease the number of layoffs in two large, civilian-dominated commands, a spreadsheet model was created to determine the minimum funding necessary to avoid forced layoffs, using a 2-year, month-by-month pro rata attrition rate and accounting for upcoming functional transfers between commands. This model showed that the resourcing needed to prevent the layoffs was unaffordable, prompting the decision to move funding for civilian pay from other commands with less use of civilians to avoid the large-scale layoffs.

The second example Manganaris described was a project for the Internal Revenue Service (IRS), following the 1998 IRS Restructuring and Reform Act. This act required a transition from a regional structure to a business-line structure, which affected approximately 65,000 employees, or about two-thirds of the IRS workforce. Manganaris's office designed a transition model that influenced both the new IRS structure and the personnel transition plan. The transition model used linear programming, which focused on matching the current workforce with the demand of the new structure, by grade, series, and location. The modeling process was iterative, with biweekly results briefed to the then-IRS commissioner, Charles Rossoti. On the basis of Rossoti's feedback on the model's personnel predictions, the design structure was altered to decrease the predicted number of unplaced revenue agents because those agents are a critical occupation for the IRS. Manganaris also noted that secondary methodologies were in place to calculate a method to transition out the remaining unassigned personnel.

For his third example, Manganaris briefly summarized work performed for the intelligence community. It was an attempt to impose a common structure on 17 decentralized intelligence organizations covering six different cabinet-level agencies. Manganaris noted the difficulty of this work due to the large variation in approaches and commitment demonstrated by the component organizations, and he explained that, because of this variation, negotiation was an especially important part of successful implementation.

To illustrate helpful ways to conceptualize workforce data, Manganaris presented several charts depicting various types of data and described the information that can be gleaned from each type of representation: see Figure 3-1. A years-of-service profile, plotting the number of employees against the number of years they have been with the organization, can both reflect events in the past, such as periods of decreased hiring, and predict future periods of attrition due to retirement eligibility. The figure also shows how bar graphs can be used to illustrate

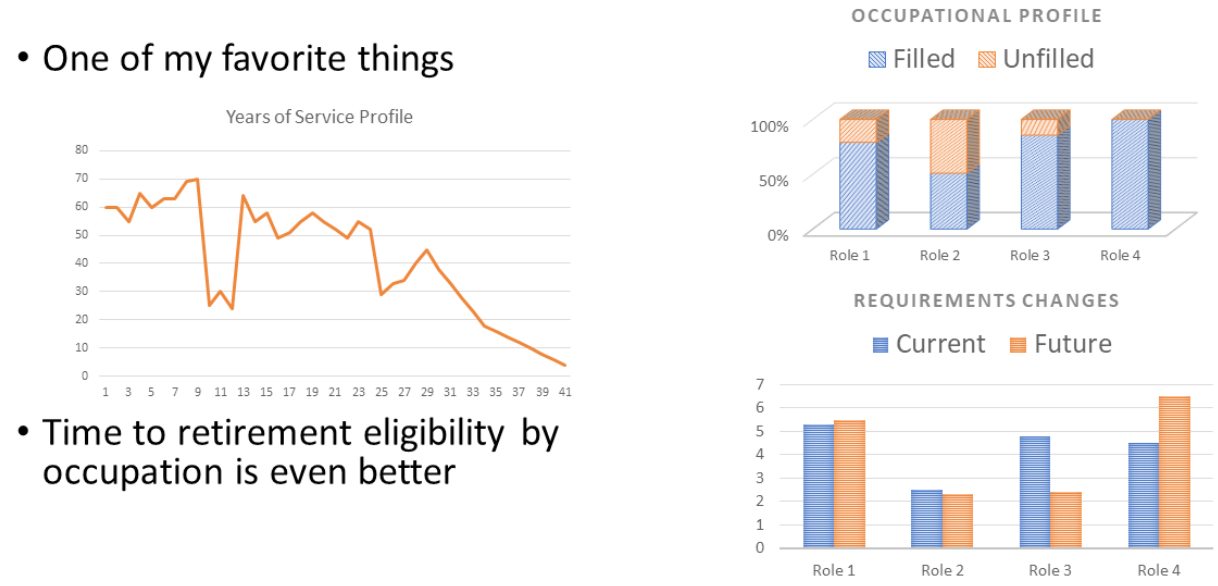

FIGURE 3-1 Helpful concepts of data visualizations.
SOURCE: Manganaris, A. (2019). *Perspectives on Strategic Workforce Planning in the Federal Government*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #7). Reprinted with permission.

the percentages of filled and unfilled positions in each role or to show the difference between present and future personnel requirements as workplace functions evolve.

In response to Manganaris's presentation, Cheryl Paullin (committee member) asked whether, during his 30 years of experience, he had noticed any trends in the way organizations perform workforce planning and staffing analysis. Manganaris answered that in the military and government sectors, he has seen less in-house capability in these areas in recent years, but that it is possible that these functions are being contracted out. He observed that people who are often hired to do workforce planning are pulled from other peripherally related positions and may not have a quantitative background. Manganaris also observed that although there are much more data available these days, "there is a tendency to think more about graphic displays and less about the nuts and bolts which go into that, or at least the modeling assumptions."

Robert Anselmi (committee member) commented that funding from the U.S. Department of Veterans Affairs (VA) is based on patient workload, and when there is an increase in a particular workload (such as mental health), Congress allocates additional funding, but none of that funding is specifically for facilities. Anselmi asked whether Manganaris has seen similar funding misalignments in his work. Manganaris replied that some organizations, including the IRS and the Department of Defense, use unit cost rates and modular costing methods to help prevent such misalignments. He noted: "So, yes, that is done a lot in the federal government, where you look at the total cost of the person instead of just, oh, we got more money to hire people. But somebody has to really make that argument. If it's in the budget proposal, that certainly can be taken care of. . . . I would hope the VA has some way of costing that when they do their budget request."

The discussion turned to qualitative aspects of decision making that can influence workforce planning. Manganaris used the example of the IRS, in which a 30 percent increase in staffing suggested by the staffing model was deemed "politically unsellable" by IRS decision makers, so the model was not implemented. Kim O'Keefe (committee member) asked whether the risk of understaffing was specifically addressed in such situations, and Manganaris replied that such a risk could be addressed through identifying and focusing on staffing the mission-critical occupations for the particular organization in question.

Much of the discussion focused on the details of the modeling process. Colin Drury (committee cochair) asked Manganaris about the validation process for the modeling examples he had offered. Manganaris replied that the process of validation is different when projects are not repeated, and instead, feedback on the model comes more in terms of "lessons learned." "[I]n the sciences, validation is very important and much more emphasized," but in the work he does "a lot of these things are one-off transitions. One and done. We didn't know if it was repeatable because we didn't intend to repeat the restructuring of the IRS anytime soon."

In terms of staffing modeling, William Marras (committee member) asked Manganaris's opinion on the most useful portions of models, in terms of which direction the committee should take when advising the Veterans Health Administration (VHA). Manganaris stressed the importance of accurate staffing requirements, and that the VHA should ask: "Do we have good models to reliably say, based on this plan to recapitalize our infrastructure, what critical elements of the workforce we need? This is really important, coming in." Anselmi asked Manganaris whether the VHA could use a linear programming model for building maintenance staffing in hospital settings, given the strict requirements for preventive maintenance and testing mandated by the accreditation process and the low level of acceptable risk. Manganaris responded that since a linear programming model simplifies systems, one could potentially be used for individual aspects of a hospital setting, but he advised that the entire system could not be modeled linearly because "there are too many different things going on in too many different ways."

To conclude, Manganaris stressed that predicting future workforce demand is a difficult challenge and that requirements for future staffing should be based on sound planning. Components of the plan should include workforce measures and forecasts of the changing needs of the organization. To deal with the challenge of predicting future workforce demand, Manganaris suggested the strategy of subdividing and simplifying the problem, focusing first on "mission critical" occupations, such as those that involve complex work that must be performed by trained individuals and thus cannot be easily accomplished through reassignment of personnel. He noted that less critical, support positions can be determined more easily, based on a ratio of overhead rates. Manganaris emphasized that strategic staffing planning must be linked to the resource allocation process in order to be effective and that cost models should be developed for that purpose.

FAA STAFFING MODEL STUDY

The session's second presentation covered a congressionally mandated staffing study for the FAA by a committee of the National Academies of Science, Engineering, and Medicine, which was completed in 2013.[1]

Bill Strickland, who was a member of the committee that carried out the study, explained that, at the time of the study, the FAA was staffing its facilities using an allocation model (a model aimed at distributing the available resources effectively, irrespective of their collective adequacy), rather than a sufficiency model (a model designed to predict the resources needed to sustain system performances at an acceptable level). During the study time frame, the total system specialist workforce was capped at 6,100 funded positions, so the allocation model just used certain parameters to distribute those out to districts. At the time, the FAA had access to a much better sufficiency staffing model, but it was not being used because the FAA was using the allocation model.

Strickland described key elements of the committee's statement of task, shown in Box 3-1. To clarify the second bullet point, Strickland reiterated that the committee's job was not to create a model, but to evaluate the FAA's current models and advise the agency on the elements that should be included in the model the contractor was developing. In describing the committee's final report, Strickland highlighted several key concepts and the committee's recommendations.

A key concept reflected in the committee's recommendations was that workforce planning models are not static. Strickland explained that this was particularly relevant for the FAA at the time because the agency was in the process of transitioning to a new system of air traffic control (NextGen) in which, within the next decade, satellite-based GPS [global positioning system] technology would replace ground-based radar as the method for tracking airplanes. Any staffing model developed for the FAA had to consider the staffing implications of such a system change. Strickland also noted that even appropriate models need continuous reviewing and updating in order to remain applicable and to accommodate technological improvements in data modeling. Thus, one of the committee's recommendations to the FAA was that the effectiveness of the developed staffing model should be continually monitored and adjusted to enhance accuracy.

Another key concept addressed in the committee's recommendations was that the FAA should plan for the effects of model development and implementation on employees. Stressing the importance of accurate data, Strickland described the committee's recommendation that the FAA should, through direct observation, systematically validate historical data and data obtained from estimates by subject-matter experts. However, he acknowledged, data collection is time intensive and if the data collection needed to develop a model or keep it current has a negative impact on employees, then the data might not be collected appropriately, if at all. For this reason, the committee recommended to the FAA that ongoing data collection should not place an unacceptable burden on data providers. To build employee trust in the model, Strickland said that the committee recommended that the outputs of the model should be understandable by FAA's internal users at all levels.

The committee also recommended that the FAA's staffing model should be robust enough to account for all the varied aspects of the systems specialist job, in addition to time spent directly on maintenance tasks. Those additional considerations are numerous: they include training and certification; time dedicated to military reserve service or other leave; travel time to and from remote worksites and the environmental challenges posed by some of those worksites; fatigue mitigation plans; deficiencies in data reporting; aging workforce and succession planning; and nontechnical task demands, such as paperwork.

Through an evaluation of the FAA's past models against the suggested model criteria, the committee was able to assess the shortcomings of the FAA's then-current staffing models and make recommendations for the development of a new model. Strickland noted that some of the considerations for the recommended model included equipment inventory, failure rates, time to perform each task, and any valid allowances or accommodations. Furthermore, he said, the recommendation requested that the model developed be based on the different specialties of systems specialists, rather than providing only an overall staffing level at each facility. The committee also recommended to the FAA that the model structure account for both deterministic and unpredictable, stochastic events.

[1] Available at https://www.nap.edu/catalog/18357/assessment-of-staffing-needs-of-systems-specialists-in-aviation, accessed March 2019.

BOX 3-1
Committee on Staffing Needs of Systems Specialists in Aviation: Excerpts from Statement of Task

- A description and evaluation of current FAA staffing models and standards for systems specialists;
- Recommendations for objective staffing standards that will maintain the safety of the National Airspace System going forward; and
- Recommendations for the steps needed to transition from the current staffing models and approaches used by the FAA to the plans for staffing recommended by the committee.

The committee also recommended that output reports from the model should be able to predict consequences in terms of deferred maintenance and overtime. In Strickland's words: "If the model says you need more people and the budget people say we cannot afford more people, then the model should say, 'here is what the implications are going to be, and you are going to end up paying overtime, and you are going to end up breaking systems that you are going to have to buy later. . . .'" In this way, he said, the proper use of the model data could provide justification for requesting funding to hire additional personnel.

Strickland concluded with another key point, based on the committee's recommendation of a timeline for model development and implementation: development of a useful model is a complex undertaking, involving a wide array of people and systems. He illustrated the complexity of the process with a diagram demonstrating that model development is only the first step, shown in Figure 3-2, and stressed that the FAA was informed that the process of developing and implementing a model takes time. "This will not be fast. And the FAA should prepare everyone for the fact that it is not going to be fast."

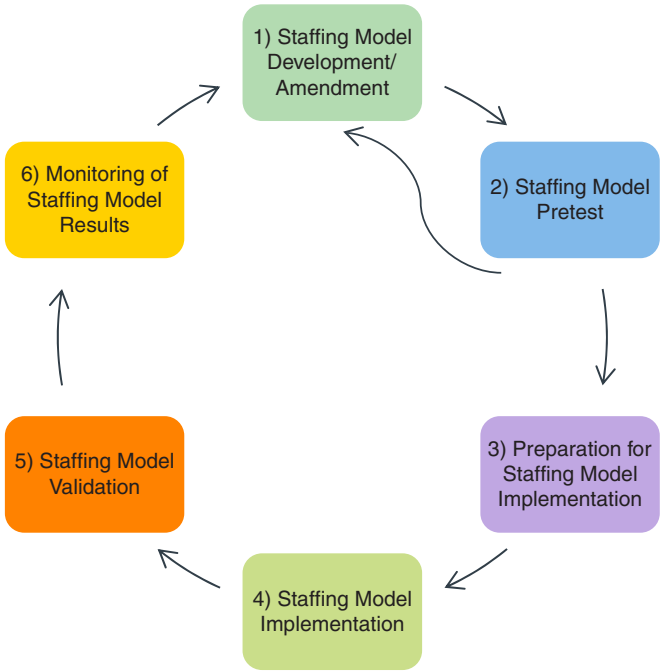

FIGURE 3-2 Development of a staffing model is only the first step in the process of workforce modeling.
SOURCE: National Research Council. (2013, Fig. 5-1). *Assessment of Staffing Needs of Systems Specialists in Aviation*. Washington, DC: National Academies Press.

Following Strickland's presentation, Drury concluded the session by listing the obvious similarities and one major difference between the VHA's staffing situation and the FAA's systems specialist staffing situation. In terms of similarities, Drury noted that the issues faced by both organizations are partly stochastic. Also, in both settings, training is specialized and is measured in weeks, months, or years. Drury listed complexity as another similarity between the two situations, pointing out that both organizations exhibit variability between different worksites. Another important similarity is the fact that both organizations are developing staffing models in the face of overarching changes—NextGen for the FAA and the transition from inpatient to outpatient care for the VHA.

In terms of differences, Drury observed that the FAA tracks some major outcome measures that could ultimately be used to validate staffing standards, such as the time the national air space is up and running or the response time to an airspace outage. In contrast, the VHA does not currently track patient outcomes in the same way. Drury stated his hope that the comparison between the two situations would be helpful for the work of the current committee.

REQUIREMENTS FOR MODELING MEDICAL STAFFING

The session's third presentation dealt with the application of workforce modeling in the medical industry, as well as methods that can be used for such modeling and other important factors that should be considered in the modeling process. A case study was provided to further illustrate many of these points. For this session, the committee had asked the speaker to address the following questions:

> Are there any reasonable standard models, or model structures, that have seen broad validation and acceptance by customers? How do you know what level of aggregation is "best" for a model: individual departments, groups of departments, or whole organization? What factors do you consider in the selection of the correct technique(s) among the range of forecasting possibilities? And, how does the solution integrate with other corporate programs, such as budgeting and planning, to ensure that the forecast is consistent with corporate resources and plans?

Joe Crance (consultant, medical facilities staffing) first addressed the committee's question regarding the existence of medical labor standards, stating that medical workforce requirements have been modeled since at least the 1980s by the Management Engineering Program of the U.S. Air Force.[2] In terms of the best level of aggregation for a model, Crance explained that staffing standards should first be developed at the lowest level, focusing on individual functions containing homogeneous tasks. Once this approach is complete, related functions can be grouped to begin to create labor standards for an entire system.

In response to another one of the committee's questions, Crance explained his view of how the requirements process should fit into the budgeting process. First, he said, an organization should clearly establish the levels of service that will be provided. Those levels of service should be used to create a lean organizational structure that will be able to deliver those levels of service. At that point in the process, Crance explained, staffing requirements to meet the established levels of service can be determined, and then the budget request for those requirements can be submitted. He stressed that the requirements must be based on workload content, illustrating this point with a circular diagram showing that levels of service should determine requirements, which should then in turn determine the budget received: see Figure 3-3. He acknowledged, however, that quite often the budget does not meet (i.e., fund) 100 percent of the requirements. In those cases, corporate decisions should be made to reduce levels of service and decrease workload in order to mitigate risk. Furthermore, Crance warned, unfunded requirements should be defined and kept in view because they are a key aspect of risk.

Crance next addressed the committee's question about the selection of appropriate methods for building workforce models, explaining that the selection of method should be determined by the nature of the work being performed. A number of methods for determining cycle time are available: see Figure 3-4. He explained that in a

[2]The Air Force Management Engineering Agency was the precursor to the current Air Force Manpower Analysis Agency (AFMAA), which was established in 1975; one of its units, the Air Force Medical Engineering Team (AFMEDMET), was designed to create manpower standards for medical activities. Although AFMEDMET no longer exists, the AFMAA continues to work with the medical community to build staffing tools for military medical activities.

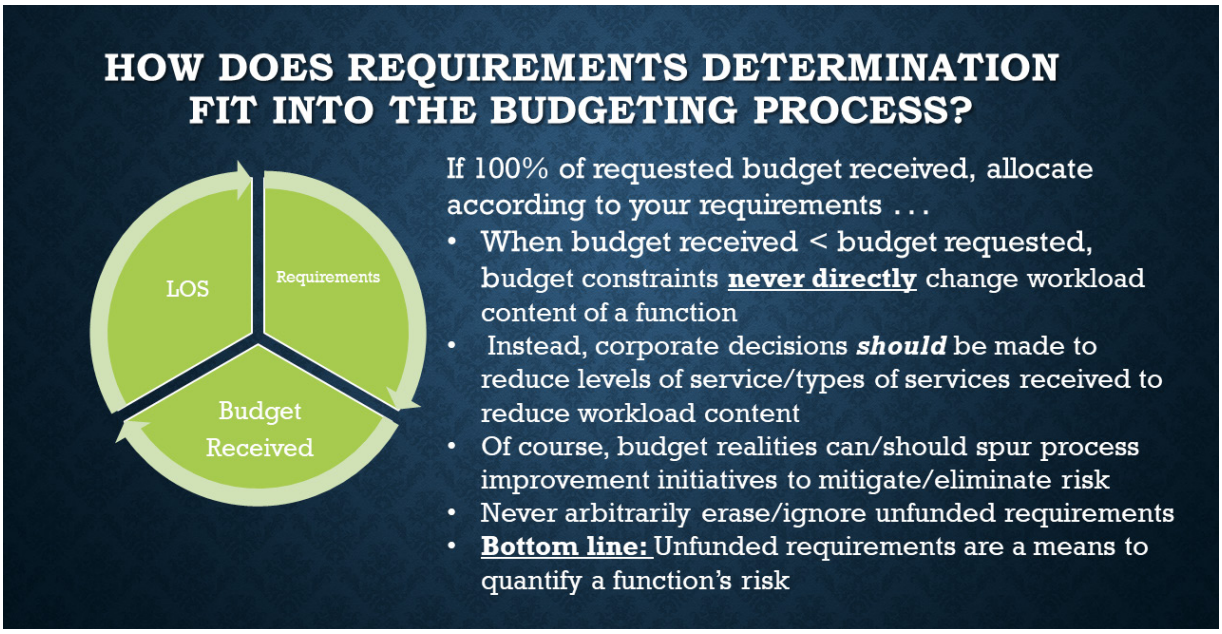

FIGURE 3-3 Requirements determination and the budgeting process.
NOTE: LOS = Levels of service.
SOURCE: Crance, J. (2019). *On Modeling Medical Manpower Requirements*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #8). Reprinted with permission.

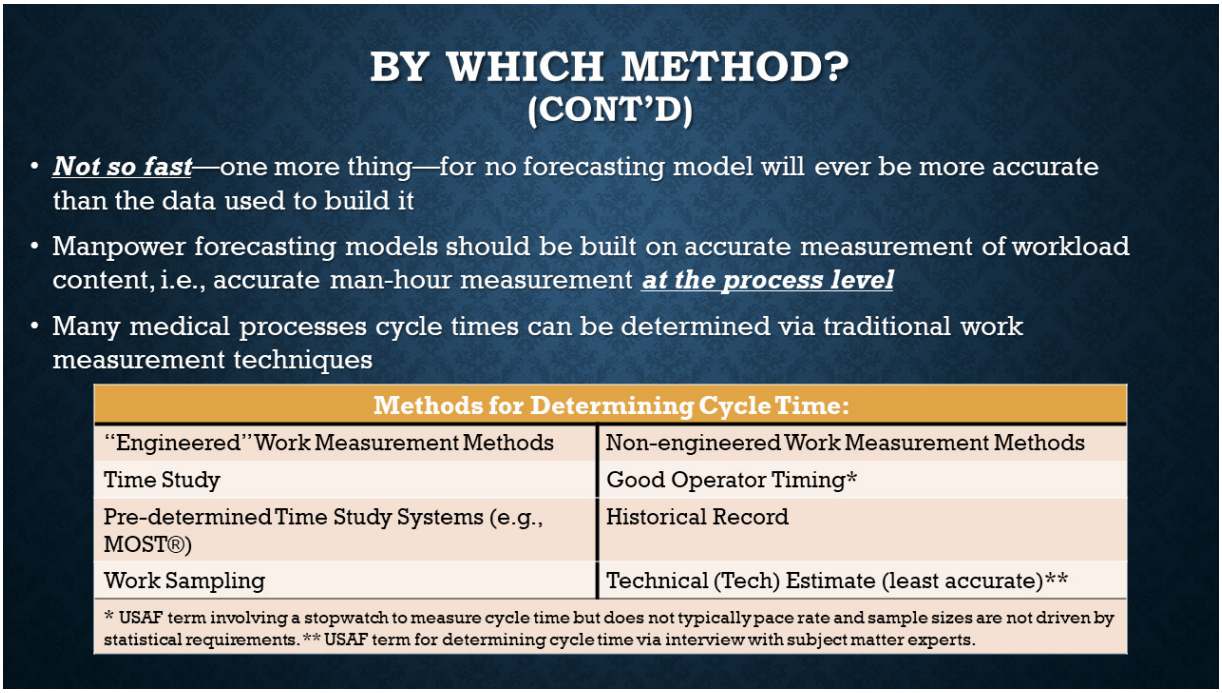

FIGURE 3-4 Methods for determining cycle time for use in manpower modeling.
SOURCE: Crance, J. (2019). Source: Crance, J. (2019). *On Modeling Medical Manpower Requirements*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #11). Reprinted with permission.

health care setting, patient-centric functions, such as primary care and internal medicine, can often be modeled by correlation-regression analysis or ratio unit times. If the function is highly transactional, such as a pharmacy or customer call center, discrete event simulation or queuing models can be used. If diligence is required, for example, for emergency departments or ambulance crews that must be on standby, the minimum staffing model can be used. Management, such as a department head or hospital administrator, can be modeled using a simple staffing pattern. Crance noted that the selection of a method should also take into account the ease of collecting the data necessary for that method for the selected model, along with the budget and time constraints for model building.

Crance stressed that, regardless of the modeling method chosen, data accuracy is critical. He pointed out that counts of a work unit, such as the number of patients seen, are reliable sources of data, but that little credence is put into data obtained from worker-hour accounting systems, primarily because workers tend not to report their idle time. Even at best, Crance continued, this type of historical data only provides information about the amount of time it took to perform a task, not the amount of time it should have taken. To gather accurate worker-hour measurement data, Crance suggested spending the time to collect data properly at the process level, using traditional work measurement techniques.

Crance explained that those techniques can be divided into two groups: (1) "engineered" work measurement methods, including time study and predetermined time study systems and work sampling, and (2) "non-engineered" work measurement methods, including the use of a timing device to measure cycle time, the use of historical records, and estimates of technicians' time, which involve interviews with subject-matter experts. Crance emphasized that the engineered techniques provide the most accurate data and recommended that organizations attempting to develop staffing standards should try to use engineered techniques as much as possible.

To illustrate several of the points made in his answers to the committee's questions, Crance described a study performed in 1998, in which Wilford Hall Medical Center (WHMC) agreed to partner with the Air Force Management Engineering Agency to provide "proof of concept" that discrete event simulation modeling could be used to model its new TRICARE primary care clinic. For this project, Crance's manpower study team first process-mapped primary care, which involved defining the processes, the employees needed to perform those processes, the inputs and outputs, and the business regulations governing those processes. Crance warned that process mapping is an involved technique and is not the same as simple flowcharting.

In terms of data collection, Crance's team time-studied routine processes and used technicians' estimates for those processes that rarely occurred. They also gathered a facility layout diagram to determine whether the layout and age of the facilities affected the staffing requirements. In analyzing the data, Crance explained, they determined the process mean, data dispersion, and shape of the distribution. Simulation models were built using the data to determine what the requirements should be. He noted that activity-based costing models were also part of the deliverable. He also noted that the time to complete the first pilot study at a single location was 125 days, which he described as "about average, probably, for a lot of single-point studies out there."

Crance summarized the results of implementation of the study's findings for the primary care clinic: (1) a savings of $100,000 annually through reduction in unnecessary nursing staff; (2) a reduction in congressional inquiries from patient complaints, from one per week to less than one per quarter; and (3) increased patient throughput by 30 percent, by using doctors more efficiently and decreasing their idle time. WHMC leadership was so impressed with the study that they asked Crance and his team to expand the study to the obstetrics-gynecology clinic, internal medicine, and the pharmacy. He noted that the obstetrics-gynecology and internal medicine studies took approximately 75 and 42 days to complete, respectively, and he did not know about the length of the pharmacy study.

Paullin asked Crance how modeling methods can be used to deal with similar functions across many different facilities. Crance explained that if a discrete event simulation model is used, data obtained from that model can be used to create a correlation-regression model that is run multiple times against different patient workloads to generate the necessary data points, allowing the model to be applied across the rest of the organization. He noted that individual locations will have variances that need to be considered, and he acknowledged that assessing these variances and making the appropriate adjustments to the model take time. Crance suggested starting with a simple, functional model, with the intent to get a more accurate model over time by adjusting it on the basis of workload differences at individual locations.

Steven Broskey (VHA) asked how work order backlogs in VHA engineering departments can be addressed using staffing models. Crance pointed out that for maintenance-based functions, it is desirable to have a certain amount of backlog because the nature of the work is such that it cannot always be performed on a set schedule, perhaps due to competing priorities for a given piece of equipment. He suggested that models be used to assess staffing needs only if the severity of the backlog becomes such that equipment breaks down because maintenance has been deferred. Broskey explained that sometimes backlogs occur when there is employee turnover, and Crance cautioned that he would not inflate the staffing requirement to account for turnover, but instead suggested that a contingency plan be developed, such as having an additional electrician from the private sector on retainer to fill in until a permanent replacement is found.

Crance summarized his presentation with four points: (1) Creating and implementing labor standards in a medical setting has been done before. (2) The desired levels of service should be established first and should then inform staffing requirements, which then are used for budget submissions. (3) There are many methods to forecast workload requirements; they all require accurate measurement of workload content. (4) Workload requirements modeling is an involved process, but it can reap huge benefits in mission accomplishment for the right cost.

4

Outsourcing Options and Marketplace Tools

This chapter covers four presentations on outsourced options for facilities management and marketplace tools that could aid in the workforce modeling process for the Veterans Health Administration (VHA). The speakers represented three private-sector companies in facilities management—CBRE, JLL, Plan4 Healthcare—and the RSMeans costing tool.

WORKFORCE PLANNING

This workshop session described work undertaken by CBRE Group, Inc. (CBRE), to bring consistency and best practices to health care clients across the United States. For this workshop session, the committee had asked the speaker to address the following questions, which he touched on throughout the course of his presentation:

> How does your approach calculate workload requirements for different jobs? Does the approach consider as-is and desired productivity levels? Can the approach adjust staffing requirements to account for location-specific conditions? How does the approach account for anticipated changes in skill and workload requirements? And, are individual jobs largely considered interchangeable or are they ever staffed at the team level?

John Poulos (senior managing director, CBRE) began by explaining that part of his role as vice chairman of CBRE's health care sector involves an attempt to bring consistency and best practices to all of CBRE's health care accounts nationwide. He then described a number of factors that are key to accomplishing this goal.

To calculate workload requirements and assess productivity, Poulos emphasized the importance of the implementation and effective management of an appropriate work order system. He noted that there are many work order systems in existence, most of which can track the metrics necessary for effective workforce planning if properly managed. The work order system should encompass all of an organization's facilities and assets, and it should contain accurate preventive maintenance schedules and estimated completion times for both preventive maintenance and regular work orders. He noted that work orders can be tagged with "service levels" that are tied to the appropriate response time, depending on the urgency of the task. This tagging also provides those who place work orders with an idea of when the work will be completed. Poulos noted that customer satisfaction surveys can be used to assess the effectiveness of a work order system and that many of CBRE's accounts average 99 percent customer satisfaction.

Appropriate use of a work order system allows the tracking of various metrics, Poulos noted, with such tools as Tableau[1] providing easy access to that information. Important metrics to monitor include execution of preventive maintenance to assure 100 percent completion each month, overtime, and the utilization rate for technicians' time. In terms of tech utilization, Poulos went on to explain that tech utilization data can be used to determine whether employees are over- or underworked and can also be applied to identify and upscale efficient employees. Those effective individuals can be trained to perform tasks currently performed by vendors, ultimately decreasing vendor costs. However, Poulos acknowledged, the usefulness of a work order system to track these metrics ultimately requires that employees enter information accurately and consistently.

To address the issue of adjusting staffing requirements to account for location-specific conditions, Poulos said that gearing ratios—such as 41,000 square feet per full-time-equivalent staff person (FTE) for hospitals or 100,000 square feet per FTE for outpatient centers—are good guidelines, but in order to staff appropriately, each facility has to be examined individually to determine the function of the facility and the services it provides. The age of the facility is also a factor affecting the gearing ratio. Poulos stressed that there is no simple formula for adjusting staffing between locations: "You do need to look at the function of the facility, the service that it provides and, again, considering the safety of the patient as being primary, you staff accordingly."

Throughout his presentation, Poulos touched on other factors relevant to effective workforce planning. He noted that, in his experience, centralization was a consistent theme. Poulos used the example of the Cleveland Clinic, in which CBRE was involved, to illustrate this point. Originally, every medical center in the Cleveland Clinic had its own administrator and its own maintenance crew, and signed its own leases. Procedures differed from location to location. CBRE brought everything under a single management group, with a director of operations and regional directors of engineering. To make the sweeping changes required for centralization, Poulos emphasized the importance of communication at all levels, clear alignment of individual goals with the overall goals of the organization, and building of a "caretaker mentality" among the entire workforce.

Following Poulos's presentation, the first questions and discussion focused on centralization. Kim O'Keefe (committee member) asked about the procedure CBRE uses for centralization. Poulos explained that CBRE first works with an organization to establish buy-in at the local level, so that each facility agrees to turn over control. CBRE brings in the leadership, technology, and best practices, and the current workforce is hired and reorganized to place workers in appropriate positions. Employee satisfaction surveys are implemented to assess employee reaction to the process. In response to a question from a participant, Poulos stated that voluntary employee loss in the first year following centralization trends around 10–14 percent.

James Smith (committee cochair) asked whether pushback was experienced from center executives in response to the centralization of Northwestern Medicine (also a CBRE project). Poulos replied: "They were all for it. They didn't want to deal with it." Smith further asked how much time it took to show that the centralization method was more cost-effective and responsive. Poulos replied more expansively: "It took about 18 months. It takes time. A lot of people look for results immediately. They think that an outsource agreement is a magic wand, and it really isn't. It takes time. We needed people to engage with each employee and help them understand what it is we were trying to accomplish. And we needed to put our systems in place. Tagging assets alone is monumental. So, with all these things in place, we are seeing the successes and recording them, but it takes at least 18 months, in some cases 24, if the portfolio is very dispersed."

Several questions focused on methods of staffing specific trades and on the way variations between different facilities in an organization affect their staffing methodologies. Smith asked, "As you look at the individual facilities, how do you take into account and how do you resource based on the age of buildings and the number of buildings at a facility?" Poulos replied that the process takes time because even if the age and number of buildings is known, the maintenance status of the equipment within those buildings is often unknown at the outset. As this information is acquired, the appropriate staffing can be performed to align with the need. Poulos explained that staffing for specific trades is often based on historical workload rather than algorithms because new buildings need different trades than older buildings.

[1]Tableau is a data visualization tool created by Tableau Software. The company creates interactive data visualization products focused on business intelligence.

David Alvarez (VHA) asked Poulos to delineate some of the factors that should be considered when staffing facilities of different ages. For a quick determination of whether current staffing is appropriate, Poulos suggested that basic gearing ratios be used while also looking into the function of each facility to account for such factors as procedure rooms that would alter the gearing ratio. When these numbers are compared with actual staffing numbers, an assessment of over- or understaffing can be made. Furthermore, he said, if a work order system is in place and the information is reliable, staffing assessments can be further refined on the basis of the number and type of work orders. He noted that the condition of buildings should also be factored in. However, he noted, although facility condition assessments are very useful for understanding the day-to-day maintenance and staffing needs of specific facilities, these assessments are often not performed due to high cost.

Robert Anselmi (committee member) asked Poulos to describe the scope of the services CBRE provides for clients. Poulos explained that, as a global real estate company, CBRE can do everything from full facilities management, in which it is responsible for every piece of infrastructure (as at the Cleveland Clinic), to project management tasks, such as expanding an office or building out a suite. Additional functions undertaken by CBRE include administration of leases; compliance with applicable state and federal laws; market studies to verify that rents are appropriate; energy management; real estate tax management; quality control management of vendor contracts, such as cleaning services; and building infrastructure replacement plans, based on facility condition assessments and risk. In summary, Poulos said: "So it really is full service. Anything that has anything to do with a facility is within our ability to perform. But each organization wants something different, and we customize the solution to meet that need."

FACILITY BENCHMARKING

For this workshop session on procedures and best practices for facilities management functions in the health care industry, the committee had asked the speaker to address the following questions, which he touched on throughout the course of his presentation:

> What are the most critical factors to include in a staffing model? How do you determine when a heuristic model is good enough? Can you have several models with different structures, even bases, for different groups of staff? And, how well have your models covered the diversity of elements of an organization?

Ed Ricard (JLL) described JLL as a global organization that performs real estate and facility management, with approximately 7 years of involvement in the health care industry. JLL has 90,000 employees and manages over 5 billion square feet of facilities worldwide. It currently partners with approximately 230 hospitals and has also performed consulting for more than 600 additional hospitals, using a team of industry professionals who help those hospitals look for opportunities to improve in the areas of finance, risk, and patient satisfaction.

Ricard explained that an integrated facilities management function, in which the facilities team works in concert with the clinical team to improve the patient experience, is an important goal for every health care organization. He described several interdependent initiatives that can be implemented to achieve an integrated facilities management function. One such initiative is a "center of excellence," consisting of a team of experts in health care, emergency management, sourcing, energy, and sustainability, that creates standards and processes to help facility directors and engineers improve their performance. Another initiative involves implementing an integrated facilities model to begin to standardize operational compliance among independent medical facilities. Another initiative that could be implemented to achieve integration is the application of a standardized computerized maintenance management system to improve employee productivity and responsiveness. Using technology for such a system, said Ricard, ultimately influences the environment of care in a facility. Employee development is yet another initiative that can be undertaken, he explained, because training is the key to the effective utilization of technology.

Ricard expanded on the center of excellence concept, explaining that its goal is to provide best practices, and these must be evidence based. Ricard noted that JLL shares its best practices not only across life sciences and health care, but across all business units so that information about effective practices is available to all, to aid in continuous development and to define the business process. One critical best practice provided by the

center of excellence involves standardization. For example, Ricard explained, every location should use the same general ledger codes, and pieces of equipment should have standardized barcoding and definitions. This type of standardization not only helps with understanding where the money is being spent, but also helps to drive maintenance strategy, and it allows for comparisons between facilities. He said that the data obtained through standardization of facilities maintenance procedures and equipment may eventually enable a comparison with clinical outcomes.

Ricard noted that hospitals share enough similarities with other types of properties, such as class A office buildings and hotels, that it is possible to run hospitals similarly to such other properties. He stated that JLL aims to help the facilities management and clinical functions of hospitals work together, as they do in the hotel industry, for example, "so that everybody knows and understands that the ultimate goal is the patient experience." In order for integration to occur, Ricard stressed, close collaboration between the facilities management team and the clinical team is needed so that the facilities staff can fully understand the needs of the clinicians. Both the clinical staff and the facilities staff must understand that the physical environment of the health care facility is a priority, because the clinical needs of the organization cannot be met if the physical environment fails.

Ricard asked the workshop participants to imagine an ideal facilities management function: mechanical equipment that runs as designed and provides reliable outcomes, standardized engineering practices that are widely established, data-driven decisions to drive improvements, and drawings that reflect the actual conditions of the building. He explained that this vision can be achieved by partnering with a team responsive in building requests and service work, working collaboratively with the clinical side, maintaining all systems, and training employees appropriately. Ricard stated his belief that development and training are critical components of success in building an ideal facilities team, as it is in furthering the careers of individuals, but he acknowledged that many hospitals spend their training dollars on clinicians, not on facilities staff. He noted that JLL has developed certifications for a number of technical specialties, 20 percent of which are very specific to the health care environment. Skills assessments are done for new employees, and programs are designed to help them learn skills, become more efficient, and understand the importance of their role in the organization.

Ricard stressed that JLL understands the importance of data, and he detailed various forms of data collected by JLL and how they are used. For example, data on financials, employee productivity, uptime, and response times can be used to create key performance indicators that can help an organization improve in those areas of facilities management. Customer satisfaction surveys can provide data that will ultimately improve the experience of doctors, nurses, and patients. JLL also gathers data from all of its hospital partners, ranging from the size and location of each facility to the number of open work orders that are work-safety related, in order to monitor facilities, set priorities, and make business decisions.

The majority of the questions and discussion in the session focused on various aspects of JLL's facilities management function. Anselmi asked Ricard several questions related to this process. First, he asked Ricard to elaborate on the kinds of staff JLL uses to perform successful facilities management. Ricard explained that in areas where JLL has multiple hospital clients, each hospital will have a generalist on-site, but the hospital clients will share specialists, such as HVAC [heating, ventilation, and air conditioning] specialists, that are employed by JLL. Ricard noted that JLL also has an engineering group consisting of seven full-time individuals dedicated to compliance, operational excellence, and assistance with issues in facilities. A group of performance managers collect and analyze data, using those data to help facility directors understand their priorities. Ricard noted that JLL also has staff dedicated to finance, sourcing, energy, and sustainability.

Anselmi next asked how work orders are created in JLL's system. Ricard replied that this can happen in a variety of ways, depending on the client. He noted that JLL has a maintenance call center, completely dedicated to health care, that operates around the clock. He also explained that JLL's goal is for 80 percent of work orders to be proactive, generated directly by the facilities department. The circulating generalist in each hospital should also have a relationship with the clinical staff, particularly the nurses, so that any work that needs to be done can be directly relayed to that generalist, who will then either do the work immediately or put in a work order.

Anselmi's third question about facilities management processes was whether JLL performs capital asset management or oversight of construction projects. Ricard replied "yes": last year, JLL did $1.1 billion worth of project management in hospitals alone, ranging from building entire hospitals to small projects. He explained

that for most of the company's clients, JLL is responsible for all nonstrategic capital. Anselmi then asked about the staff JLL has on-site during construction projects, and Ricard responded by stressing that facilities functions and projects must always be coordinated so that projects do not disrupt hospital operations. Some clients will be assigned a full-time project manager who works collaboratively with the facilities team. Also, JLL has project management teams in 85 offices across the United States, and these staff can be brought into hospitals to assist with large projects.

A participant asked about the employee loss rate generally seen by clients after they partner with JLL. Ricard replied that JLL hires approximately 94 percent of a client's employees, and, after 1 year, retention is 92 percent of that initial 94 percent.

Another major topic of discussion concerned the way facilities management is viewed within an organization and the implications of that view. Smith asked Ricard his observations on hospitals where facilities maintenance and engineering are viewed as part of the core mission, in comparison with other hospitals where these functions are viewed only as a cost or support. Ricard said that he can easily tell whether facilities management is considered part of the team simply by observing the way the facilities director is treated by the rest of the hospital staff. In Ricard's opinion, bridging the gap between the facilities and clinical functions is very important, and the facilities staff bears some of the responsibility for working collaboratively with clinicians to recognize and solve problems.

In response to a related question from Alvarez, Ricard noted that hospital leaders also have to understand that maintaining the environment of a hospital is critical. When hospital leaders do not work collaboratively with facilities management, the hospital environment begins to suffer, which can result in greater infection rates and higher staff turnover. However, in Ricard's view, as more people with business experience come into hospital management, the environment is beginning to change because these business people are financially trained and can understand how budgets and clinical care outcomes are affected by facilities issues. He explained that when JLL partners with an organization, it gives the facilities group a voice at the executive level. When an older piece of equipment needs to be replaced, for example, JLL works to provide hospital leaders with hard data to make the case for replacement, including the cost of recent repairs, the amount of downtime and the resulting lost revenue, and the energy savings from new equipment, all of which help to illustrate the return on investment.

Several questions revolved around the methods used by JLL to perform staffing modeling and benchmarking. Cheryl Paullin (committee member) asked Ricard which factors JLL considers when creating staffing models for facilities management. Ricard replied that the creation of staffing models is a complex journey that takes about 3 years to complete. Differences in the sizes, ages, and locations of facilities necessitate employees with varying skill sets in each location. Ricard explained that JLL's first tasks with a partner client are to assess the skills of existing employees and determine the type of equipment in the facility. JLL also uses technology to understand how productive employees are by tracking their hours through work orders. These data, he said, can illuminate opportunities for training in order to improve employee efficiency. Ricard noted that JLL also tries to assess the true need for specialists, for example, by determining how much of an electrician's time is spent doing electrical work in comparison with work that could be performed by a generalist. In general, Ricard said, the modeling process first involves gaining an understanding of the right skill sets and people needed to staff a facility.

Paullin also asked about JLL's procedure for benchmarking. Ricard replied that when JLL works with a client, the client is first provided with a data request, asking for information about facilities, finances, and employees. JLL staff also walk the facility to directly observe certain procedures, and they also look at the facility's computerized maintenance management system. All of the data collected from these activities are formatted to allow comparison with a facility run by JLL, and the client is then provided with a report containing categorized results, opportunities for improvement, and an outline of the steps that could be taken to reach the client's objectives. Colin Drury (committee cochair) asked whether JLL performs benchmarking across much larger organizations, like the VHA, rather than just single hospitals. Ricard replied that JLL has undertaken large benchmarking studies with several organizations, including Tenet, with 64 hospitals, and Kindred, with 128 hospitals. He noted that the challenge in benchmarking larger organizations is standardizing the data collected among facilities. It is critical, Ricard said, for the benchmarking staff to be trained to look for the same things and gather the same data, and JLL has a site audit tool to help with that data collection.

In concluding, Ricard said that successful change can be challenging, and he cited evidence that 70 percent of change programs fail to achieve their goals, largely due to employee resistance and lack of management support.[2] "If we're going to make change, make sure we're all buying in, and that we know where we're going, and that we're all behind it, and that we have a clear vision and plan of how we're going to change."

BUSINESS PLANNING FOR INCREASING OPERATIONAL EFFICIENCY

For this workshop session on the best practices and tools used by Plan4 Healthcare, the committee had asked the speaker to address the following questions, which he touched on throughout his presentation:

> How does your approach calculate workload requirements for each job? Does the approach take into account as-is and desired productivity levels of the workforce? Can the approach adjust staffing requirements for location-specific conditions? And who are the key participants in the development process?

Seth Sinclair (Plan4 Healthcare) explained that Plan4 Healthcare was founded in 2015 with a mission of "enabling smarter planning for better outcomes" for health care facilities, particularly for the VHA. Sinclair noted that he had personally worked in various capacities with approximately 50 hospitals in the VA system. Plan4 Healthcare currently has a team of approximately 20 subject-matter experts, including former directors and chief financial officers of the Veteran's Integrated Service Network and a health care economist. The team is currently working with 22 VA medical centers (VAMCs), which represent approximately 15 percent of the VA health care system, to assist the VHA with implementing best practices for business planning.

Sinclair outlined the core planning challenge shared by all VAMCs, which involves first determining the goals, objectives, and priorities of the local leadership. Second, each facility has to understand its operational needs and the resources required to meet those needs. Third, each facility has to have a clear picture of its budget and the resources it can afford. He explained that bringing these three factors into balance helps an organization achieve its operational priorities while remaining financially responsible.

Sinclair listed several challenges and variables at play at each VAMC that can interfere with the development of effective core planning. These challenges include, but are not limited to, lack of standardized processes or tools for facility-level planning; differing philosophies on how such planning should be conducted; and leadership turnover, which results in the loss of any progress made in establishing planning processes. Plan4 Healthcare, Sinclair explained, aims to provide solutions to the difficulties posed by these challenges and other variables among VHA facilities in order to aid the organization in business planning and implementation.

Sinclair went on to explain that the concept of Plan4 Healthcare was first tested in 2011 on a single mid-sized VHA facility that was operating with a significant budget deficit. In 1 year, Sinclair's team was able to use the basic concepts of what eventually became a model to bring the facility back to a balanced budget. That model, SCORE, contains five elements—strategy, collaboration, operations, results, and excellence—that work together systematically to promote data-driven decision making and to foster consistent use of planning tools and practices. He noted that the SCORE model has evolved to support *all* organizations in planning best practices, not only those organizations in financial distress. These tools and practices allow medical centers to prioritize operations and operate effectively and sustainably within their budgetary constraints. The SCORE model contains a web-based technology platform, called 4Cast, created by Sinclair's team and tailored for the way VAMCs plan and operate.

To further explain the SCORE model, Sinclair first outlined the process of business planning. Sinclair defined business planning as a bottom-up process in which every department or service in a hospital develops a plan that includes tactical objectives and data-driven resource needs for the coming year. These plans should support the overall goals of the facility. Plans should also be briefed regularly to leaders, with key players from other departments also present, so that the implications of individual plans on other services can be assessed. Sinclair asserted that, if every service in a medical center develops a well-supported business plan, leaders can use these plans to

[2]Ewenstein, B., Smith, W., and Sologar, A. (2015). Changing Change Management. Washington, DC: McKinsey & Company. Available at https://www.mckinsey.com/featured-insights/leadership/changing-change-management.

understand the needs of the entire facility and to prioritize resource requests. Sinclair advocated for this decision-making process even in the face of acknowledged budgetary restraints that make the process difficult: "It's better than going into the year without having that decision making, without having that transparency, and facilities who don't do that will get in trouble with their resources as the year progresses."

Sinclair then provided a practical example of 4Cast in action—a facilities management service business plan created using the 4Cast tool—and explained the various components of the tool that can assist with each stage of the business planning process. As a preliminary step, 4Cast can assist each service with a strength, weakness, opportunity, and challenge analysis, capturing this information so that it can inform the service's tactical objectives for the year. 4Cast can also capture workload, which is a key component of business planning. Sinclair acknowledged that workload data from VHA facilities are extremely variable, with different metrics used to capture workload, such as the ratio of FTEs per square foot, the numbers of projects, or the number of work orders. He explained that at this phase of the tool's development, 4Cast allows users to determine their own workload metrics, which the Plan4 Healthcare team eventually plans to aggregate and standardize. Another component of 4Cast that can assist with the business planning process is a make-or-buy analysis tool, which helps organizations determine which services should be done in-house and which should be contracted out. Service-level tactical objectives can also be tracked in 4Cast, and Sinclair asserted that these proposed priorities should be the cornerstone of a service's business plan. He restated that each objective should support one or more of the facility's overall priorities in order to keep the service's business plan grounded and aligned. 4Cast also includes the capability to build action plans in support of each tactical objective.

Sinclair explained that 4Cast can also assist with the resource side of business planning. The tool contains contracts and fund control points element, which compares historical resource data with projections for the coming year, allowing for justification of any significant differences. Regarding FTE resources, Sinclair underscored the importance of this aspect of an organization's business plan, explaining that in most VA hospitals, FTEs account for 65–70 percent of the budget. He explained that 4Cast contains a module that allows services to look at FTE needs by position and to project the total cost of FTE resources for the year. This projection involves numerous gain and loss considerations, including historical turnover, retirements, transfers, the timing for filling open positions, and the timing of new hires, to name just a few. Equipment is another resource element traced by 4Cast, and this module can help services to consider all aspects of equipment purchase, including service contracts, additional FTEs required, and space considerations. Sinclair noted that the equipment module pulls data from a system called SEPG [Strategic Equipment Planning Guide], which is used by the VA to manage equipment requests and approvals.

Lastly, Sinclair summarized modules of 4Cast that aid leaders, such as a medical facilities director, in monitoring and analyzing all the data collected by the tool in order to assist with decision making, staffing, and budgeting. Once these decisions are made using the tool, services receive a passed-back budget, detailing, for example, the overall FTE budget, overtime budget, or any other budgets established for that service. Once budgets have been established, 4Cast also has tools that allow service managers to monitor their use of budgeted resources and to project use for the remainder of the year.

Following Sinclair's presentation, several questions addressed the sources of data used for the SCORE model. Paullin asked how workload data for projected workload requirements were obtained. Sinclair replied that the source depends on the data that are available. He noted that there is a good deal of data available for clinical services, but fewer data are available for administrative services, and Sinclair's team still relies on the service teams to provide historical workload data. He explained that his team is working diligently to establish a direct connection with all of the back-end data systems in GovCloud.

Brian Norman (Compass Manpower Experts, LLC) asked about the source of data on human capital, and Sinclair explained that the VA has a database called PAID [personnel and accounting integrated data] that lists all current FTEs and their salaries. The PAID database has a mapping system, organized by service, that assigns each FTE a code. He noted that the system can be complicated by several factors, of which the most significant is that each VA medical center has the discretion to create service alignments differently, making comparisons between facilities difficult. However, Sinclair noted, within a single medical center, PAID can be used to capture FTE data in a way that supports the model.

In another data-related question, Steven Broskey (VHA) asked whether Sinclair has seen any correlations between the number of work orders projected and the staffing necessary to complete that work in a timely and thorough manner. Sinclair replied that once enough data have been entered into the 4Cast platform by service chiefs, analytics are used to determine ratios between work orders and staffing requirements. These ratios could then be used for comparing similar facilities. Paullin asked whether tasks related to Joint Commission[3] standards have already been populated into the model, since these tasks are required. Sinclair replied that this has not been done, but that these tasks could easily be incorporated as tactical objectives that need to be addressed in a business plan.

Anselmi asked if it has been Sinclair's experience that the clinical side of VHA facilities takes priority over the facilities management function, resulting in less funding for those support services. Sinclair agreed that the clinical functions are usually first in line for resources, but he also believes that center directors are beginning to understand the ultimate necessity of facilities management in terms of the provision of patient care functions.

To conclude, Sinclair stated his belief that the VHA would benefit from a consistent approach to business planning. In Sinclair's words, "The return on investment can be 100 times of what it cost in just one year to put that model in place."

MARKETPLACE TOOLS FOR MODELING

For this workshop session on the RSMeans costing tool, the committee had asked the speaker to address the following questions, which he touched on throughout the course of his presentation:

> Are there any reasonable standard models, or model structures, that have seen broad validation and acceptance by customers? How do you know what level of aggregation is "best" for a model: individual departments, groups of departments, or whole organizations? What factors do you consider in the selection of the appropriate tool? How do you weigh these factors, and what kind of trade-offs require more consideration?

Steve Plotner (Gordian) described the RSMeans tool, which provides asset-driven cost data for construction and maintenance functions. He then listed four major areas in which RSMeans could help the VHA with the development of facilities staffing models: (1) RSMeans data could assist with benchmarking of staffing efficiency against industry norms. (2) If facilities staffing is outsourced, RSMeans could serve as a contractual unit price basis or provide independent pricing validation. (3) RSMeans could be used to inform the organization's programs and budgets, reducing the gap between budgeted and execution costs for facilities maintenance. (4) RSMeans could forecast costs over the entire life cycle of a facility, from planning and design through construction and commissioning, and into the operations phase, when preventive maintenance, repairs, replacements, and asset renewals are needed.

Plotner detailed the history and contents of RSMeans, which evolved from a handwritten book in 1943 to three formats that are available today: printed cost books, the CD-based Costworks software program, and the web-based RSMeans Online. RSMeans now has 20 different cost titles, including electrical, plumbing, mechanical, concrete and masonry, building construction, and facilities maintenance and repair. The RSMeans team has 12 full-time researchers and 10 full-time engineers, and the team spends about 22,000 hours each year researching construction costs.

The RSMeans database is fueled by actively monitored data points in several areas: material pricing, trade wage rates, equipment rental rates, productivity, and location factors. The database contains 55,000 unique material IDs, with material pricing determined by selected materials that serve as material price drivers. These drivers are researched in up to nine regions of the country to develop a national average material price. To obtain data on trade wage rates, the team tracks 35 trades in 314 locations in the United States. They also research up to 638 pieces of construction equipment across the country to come up with average rental costs. Plotner referred to productivity factors as "that secret sauce," which takes into account how many people are needed to do a job and how long that job takes.

[3]See fn. 4 in Chapter 2.

Plotner provided a detailed explanation of location factors, which help organizations calculate their location-specific cost from the national average cost. A team of four individuals works year-round to develop these factors. They start by shopping a subset of labor rates, materials costs, and equipment rentals in 96 locations across the country. These data are used to create the national average, and each location is then compared with the national average to obtain a ratio, representing the location factor. Algorithms in the database can interpolate between nearby locations using ZIP codes, ultimately resulting in more than 970 specific location factors for different areas of the country.

RSMeans also has cost data specific for facilities maintenance and repair, Plotner explained. These data include three different types of costs: preventative maintenance costs, maintenance and repair costs, and general maintenance costs, which include custodial services. He noted that some of the salient features of the maintenance and repair data include the use of the UNIFORMAT II alphanumeric numbering hierarchy,[4] the approximate frequency of maintenance, the types of workers and equipment needed for each task, and labor hours. Preventive maintenance data, which are also based on the UNIFORMAT II numbering system, include specific tasks, labor hours, frequency, and annual/annualized rollups for each piece of equipment. Costs for maintenance tasks, such as landscape and custodial maintenance, can also be calculated with RSMeans, and these costs are calculated per unit of measure, per occurrence. Plotner provided data on lawn renovation as an example of landscape maintenance.

Plotner described a feature of RSMeans Online called the square foot estimator. Using this tool, the cost of an entire construction project can be estimated, based on location, footprint size and perimeter, structural frame, and façade, among other factors. This estimator also feeds into the RSMeans life-cycle cost estimator, which can then provide life-cycle costs for any desired term, illustrating the data in the form of a summary table or charts by the year. Data details include which equipment will need to be replaced and when, as well as costs for preventive maintenance, replacement, and repair over the chosen term.

Plotner provided an example of how RSMeans data can be used in an Excel-based preventive maintenance model (see Figure 4-1). For each facility, maintenance tasks, including quantity and unit of measure, are compiled. Data from RSMeans can be used to determine the annualized labor hours per unit, which will allow a calculation of the number of staff needed to complete the required tasks. RSMeans can also be used to determine both bare materials costs and the in-house costs that include procurement costs and labor-associated costs, including workers' compensation and payroll taxes. For comparison, subcontractor costs for the same tasks can also be obtained from RSMeans. Plotner concluded by stressing that, as others have noted, data integrity is an essential part of any trustworthy model, and he reminded the workshop participants that models do not stay static but have to be constantly reviewed and improved.

Anselmi said that in his past experience with RSMeans, he found that the maintenance data did not go to the depth that was needed. He asked whether the RSMeans database currently contains information that addresses maintenance of advanced HVAC systems, medical gas systems, and other systems that are necessary in a health care setting. Plotner replied that the current database "probably will not go into depth in the health care arena. It will cover maybe 80 percent of it, but that missing 20, which is what you really need, we would have to develop in conjunction with you." He provided the example of the Bureau of Indian Affairs, for which the RSMeans team developed new data, almost doubling the agency's preventive maintenance database.

Paullin asked Plotner whether RSMeans contains data specific to health care facilities. Plotner replied that one of their 75 models is an outpatient surgery center, and Tony Edwards (Gordian), a colleague of Plotner, said that custom data also exist for other health facilities, including the Cleveland Clinic. Edwards explained: "There is an emergent health care practice where we are actually doing a lot of custom health care data. I think also from a builder standpoint, because of our engagements with many hospitals as well, some of that data exists to support health care." Plotner concluded the discussion on the availability of health care data in RSMeans by explaining that if the VHA decided to contract with RSMeans, the team would develop new data for the VHA, as the company has done for other federal clients.

[4]UNIFORMAT II is a standard for classifying building specifications, cost estimating, and cost analysis in the United States and Canada, maintained and published by the Construction Specifications Institute and Construction Specifications Canada.

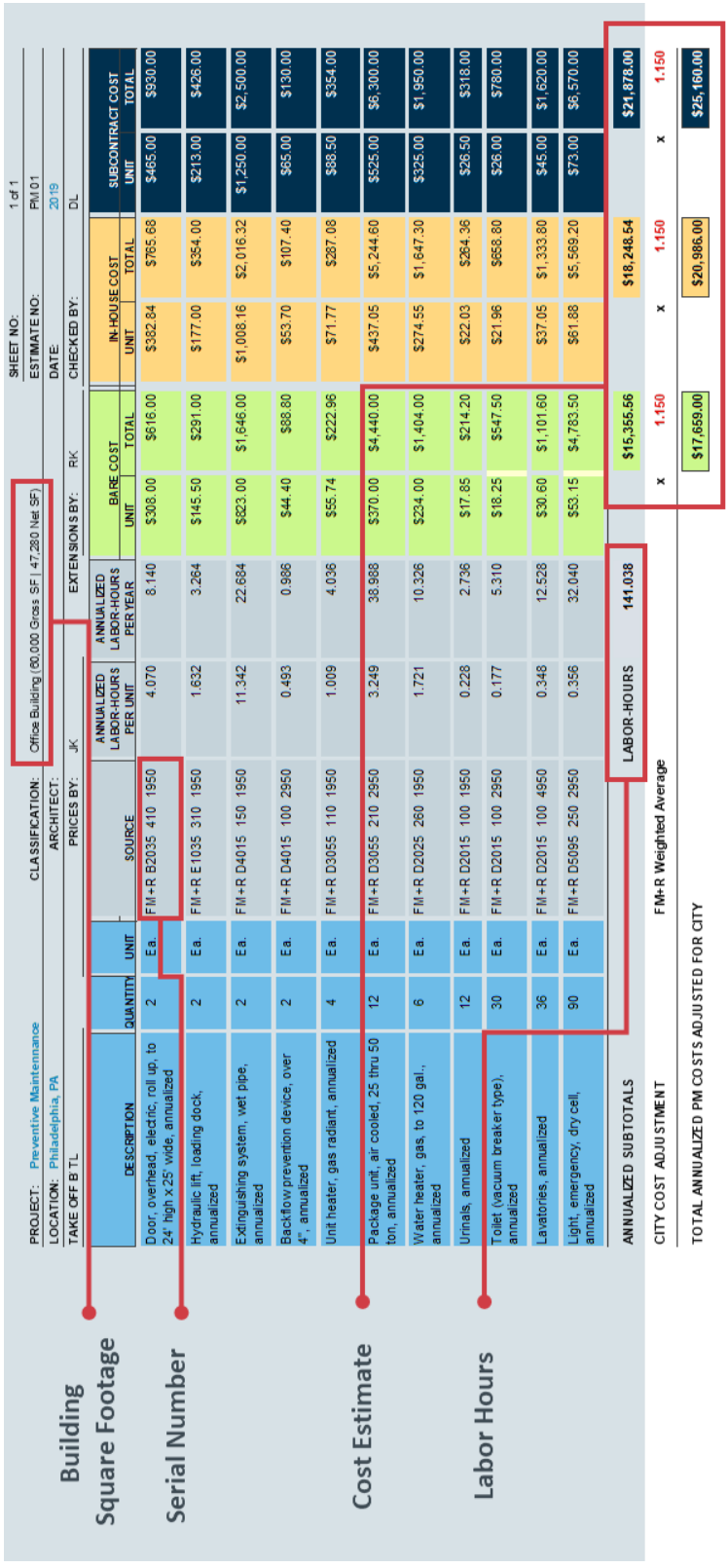

FIGURE 4-1 RSMeans data used in an Excel-based preventive maintenance model.
SOURCE: Plotner, S. (2019). *Marketplace Tools for Modeling Panel*. Presentation for the Workshop on Resourcing, Workforce Modeling, and Staffing (slide #20). Reprinted with permission.

5

Modeling Considerations

This chapter covers two presentations discussing additional considerations for facilities staffing modeling. The first presentation highlighted the role that artificial intelligence (AI) could play in human resources modeling and the business implications of AI use. The second one considered the importance of incorporating change management practices into the implementation of workforce planning initiatives.

ARTIFICIAL INTELLIGENCE IN MODELING

This workshop session focused on the increasing role of AI in the workplace, its effects on employees, and its potential implications on business outcomes. For this session, the committee had asked the speaker to address the following questions, which he touched on throughout the course of his presentation:

> What kind of data would be of particular use when using an AI approach to staffing modeling? What are the applications and limitations of AI in forecasting human resources needs? What are examples of workforce planning problems that are best solved using an AI system? And how can AI build a system that evaluates thousands of possible forecasting models and chooses not only the method that is best, but which subset of the thousands can be best combined in an ensemble of models to increase forecasting accuracy?

Anshul Sheopuri (IBM) provided background on AI and discussed IBM's journey as an organization that has attempted to implement AI within the company. He asserted that when AI is adopted within an enterprise, it results in improved business results, which are often reflected in better margins, better revenue, and better business metrics. However, he said, the biggest challenge of adopting AI lies in the organization's ability to integrate AI solutions into existing processes and systems. In order to be effective, AI tools must fit into the existing workflow, incentives must exist to use the tools, and the tools must drive business solutions.

Artificial intelligence, explained Sheopuri, isn't new—the term was first coined in 1956. After a long "AI winter," there has been a resurgence of interest in AI due to such factors as the decreased cost of the technology, the explosion of available data, and the increased sophistication of AI algorithms. As a result of this resurgence, he said, in certain narrow domains AI solutions now are equal to humans in decision quality. He noted, however, that most experts predict that it will be 30 to 50 more years before general AI, across domains, will be at this same high level of decision quality.

Along with the recent resurgence of AI, Sheopuri explained, the marketplace is concurrently experiencing significant disruptions in standard business models. As a result of these global changes in the marketplace, the talent makeup of even such "old school" industries as oil and gas is drastically changing to include employees with diverse skill sets, such as design experts, product managers, and data scientists. Along with this change is a rapid decline in the half-life of skills, requiring more frequent retraining of employees. In addition, the marketplace changes have led employees to have higher expectations for their workplace experiences: "The way they experience movies or the way they buy goods at home, those experiences are now the new North Star. It is no longer okay to have clunky experiences within the workplace and exceptional experiences at home while you're watching a movie or buying diapers on a webpage."

These disruptions in the marketplace, noted Sheopuri, are occurring simultaneously with an explosion in the number of AI tools and technologies that can be used to manage various aspects of human resources, including recruiting, hiring, staffing, recognition, performance management, and leadership and development. Enterprises will have to determine how to navigate this new technological complexity in order to transform their practices and achieve positive business outcomes in this new environment.

As AI tools and technologies are implemented in an organization, Sheopuri emphasized, validated user research needs to be performed to understand their effects on employees, managers, and business leaders. He explained that IBM has implemented such user research over the past 5 years, which has helped the company to successfully adopt various AI tools, reducing failure rates or helping them to "fail fast" in a few months' time instead of after 12 or 18 months of investment, or to scale up the use of the tools quickly if they are successful.

Sheopuri next turned to how IBM has successfully embedded AI into its human resources function, using these tools across an employee's life cycle, from onboarding to development to operations. In this process, information from an employee's resume and from training and performance is collected into an aggregate view that shows that employee's level of expertise along specific skills. These skills data are available to everyone, including the employee, who can update the data. Sheopuri explained that these data provide IBM with a way of understanding the skills of its employees and the progression of those skills across the entire workforce. The data also allow employees to engage in their own improvement and help business leaders to make better decisions. This integration of AI into human resources processes, and the use of other AI technologies such as digital assistants, have improved the employee experience, which ultimately can lead to better business outcomes. Sheopuri stated: "The notion that you can really make an employee's life better, make them more productive, help them be more effective in making decisions, and that could drive client experience, is something that we have learned over the past few years can be very productive and powerful in driving business outcomes as well."

As IBM began to embed AI tools and technologies into its processes, Sheopuri said, the company discovered that its employees' skill sets did not have the capacity and depth needed to help them most effectively leverage the new technologies. In response, IBM incorporated new, relatively inexpensive ways of upskilling, with self-serve content that is directly embedded in each employee's workflow. Sheopuri noted that the upskilling effort has begun to show results and that employees are self-motivated and self-directed when they have these learning opportunities. These motivated employees tend to seek out collaborative, self-directed ways of working that provide them with regular feedback, and self-motivated, short-segmented methods of working have translated into reduced failure rates for some of IBM's products.

Along with implementing AI tools in the human resources setting, Sheopuri said, IBM has also undergone process transformation, in which the organization has transitioned from thinking about processes like the recruiting and onboarding of employees in terms of silos and begun to focus on the overall employee experience. He noted that the recruiting and onboarding processes, and other processes that involve mundane, process-centered work, can be enabled with chatbots. Chatbots both improve the employee experience by allowing new employees to engage with the enterprise up front, and free up human resources employees to perform higher-value work. He noted that these process transformations have led to faster process speeds and better business outcomes.

Cheryl Paullin (committee member) asked Sheopuri whether AI approaches have been used to determine how many of certain types of employees are needed to effectively manage workload. Sheopuri replied that IBM uses technology to understand the extremely diverse skill sets of its 350,000 employees. He explained that in the past IBM determined staffing by identifying business objectives related to revenue, profit, and associated costs

and mapping those factors to the headcount needed to deliver the desired outcomes. According to Sheopuri, this method resulted in inaccurate projections because it was not taking skills into account. Today, he continued, IBM tracks 5,000 skills at a high level of granularity, using a skills management tool called Employee 360. This approach allows IBM to assess not only the skills, but the depth of each skill that is necessary to achieve desired business outcomes.

Paullin also asked Sheopuri to expand on the creation of chatbots. He responded that the technology has evolved so that bots are fairly easy to create, even by those who are not software engineers. Domain experts in the organization, who understand the types of questions the bot might be asked, can "train" the bots in 2 to 3 weeks. The technology can then figure out alternative ways that same question might be asked. Sheopuri encouraged the use of bots, stating that in his opinion bots "can drive massive productivity gains and employee experience gains in many settings."

To conclude, Sheopuri shared what he sees as the main takeaway from IBM's use of AI: the technology is only a building block, and it will not drive business outcomes in the absence of a more holistic transformation of an organization. He concluded: "What we have found is that, when you only focus on the tools and technology without these other building blocks, without upskilling the teams, without new ways of working, without clarity on the offering strategy, without having a data platform that is fit for purpose, what ends up happening is you have a good shiny object, but that doesn't necessarily translate into business outcomes."

CHANGE MANAGEMENT

This workshop session covered change management practices to drive successful workforce planning. For this session, the committee had asked the speaker to address the following questions, which he touched on throughout the course of his presentation:

> What change management principles and techniques should be considered to ensure decision makers are willing to buy into the workforce planning premise and act on their findings? What are common roadblocks and strategies to overcome them? And, what are some lessons learned from the implementation of a workforce planning initiative?

Robert Motion (Raytheon Company) said that change management has been a common thread through the three positions he has held over the past 10 years of his employment with Raytheon Company. As a defense contractor with 65,000 employees, 40,000 of whom are engineers, Raytheon's workforce planning primarily involves the needs of the company's technical talent.

Motion noted that change management is a very large part of successful strategic workforce planning, and he posited four common change management challenges: creating an aligned understanding of what workforce planning will look like; demonstrating the business value of workforce planning; proving the impossible, in terms of providing a vision for what the future will look like with workforce planning; and building an army to manage change through an understanding of all the stakeholders involved in the change process.

In terms of the first challenge, Motion noted an organization's leaders often do not share the same understanding of what workforce planning is and why it is needed. An aligned understanding has to be reached regarding the specific purpose of workforce planning in the organization, and he stressed that a clear definition of what workforce planning involves helps to align stakeholders. Motion explained workforce planning as a human capital story that involves "having the right people in the right place at the right time and at the right cost." An organization has to understand and be in alignment on its human capital needs, in terms of capabilities, location, and timing, and those factors need to be rooted in analytics and data science, not simply based on gut feeling. The plan developed to achieve the desired workforce must be strategic and deliberate, and the effort must be collaborative and cross-functional, he said.

Motion then discussed four key considerations for meeting the second common change management challenge of demonstrating the business value of workforce planning: executive championship, a strong business case, benchmarking, and scoping. Executive championship is critical for the success of this process, he said: strong backing of a workforce plan drives commitment and follow-on. For a strong business case, metrics that tie the impact of

the workforce planning initiative to revenue and cost are essential. Benchmarking against peer organizations in the industry is another way to demonstrate business value, Motion said, because benchmarks help an organization to understand the standards and best practices to which it should be adhering. In terms of scoping, he noted that trying to do everything at once is not a good solution. Instead, he suggested using an incremental approach that will help long-term initiatives not run the risk of losing momentum. Raytheon prefers an incremental change approach to workforce planning, which provides "quick wins" that establish credibility.

By proving the impossible, the third change management challenge, Motion said he means telling people what the future will look like with workforce planning in place. Through benchmarking, a proof of concept can be created that will enable stakeholders to see what success in workforce planning could look like, in terms of strategy and business implications, the roles and competencies making up the workforce, and current costs compared with future costs.

At Raytheon, Motion's team built a workforce planning toolkit to help with implementation, which included a workforce planning "playbook" to assist with training on workforce planning; interview protocols to enable proper workforce segmentation; decision analytics on the roles of interest, including data on such aspects of the workforce as voluntary turnover rate and retirement rate vulnerability; and forecasting templates to relate financials with roles, head counts, and staffing needs. Also, in terms of predicting the future, Motion stressed using the organization's inherent strengths. In the case of Raytheon, where the strengths are analytic, this meant leveraging data to "talk the language of the leaders" and help the workforce understand and engage with the workforce planning initiative.

Turning to the final common change management challenge, building an army to manage change, he reminded the workshop participants that people fear change and recommended a book by John Kotter and Holger Rathgeber[1] that uses the format of a fable to illustrate the fact that stakeholders will have different wants, needs, and attitudes in a change situation. He highlighted the importance of crafting both the workforce planning solution and the communication with stakeholders around the wants and needs of stakeholders.

Motion described the types of stakeholders—the army—needed in a workforce planning initiative, who he called bankers, customers, consumers, and teammates. "Bankers" are the people who fund the work, and Motion noted that the banker is often the executive champion of the project. The banker needs to understand how the change will add value to the organization. "Customers" are the business leaders who will "buy" the product, which, in the case of workforce planning, are the people who will spend time on the activity. Customers need to understand how the change will both mitigate risk and add value, based on hard data. "Consumers" are the human resources staff, the people who will use the product. At Raytheon, Motion noted, education of the consumers was very important, particularly in the areas of data, statistics, and models. Since human resources staff are the conduit to the leaders of the organization, Motion stressed that they need to be fully on board. "Teammates" are the individuals helping to implement workforce planning. Teammates, Motion said, need to be educated like consumers, but they must also understand the vision for the organization and help to drive alignment. Successful workforce planning has to integrate the various perspectives of stakeholders to create an aligned plan that will "build an army" in support of the proposed changes. In Motion's words: "The idea here is, by putting this together as a collaborative cross-functional team, we end up with one voice across the organization."

Motion listed four key capabilities needed in order for human resources to support workforce planning effectively: data acumen, general business acumen, partnering skills, and change management skills. Motion's team performed a self-assessment of the human resources workforce in terms of these capabilities and then instituted immersion learning to upskill them on data analytics and business acumen, areas in which they showed less capability than other areas.

Fred Switzer (committee member) asked Motion how the labor market intelligence included in Raytheon's workplace planning toolkit was obtained. Motion explained that some of the data were obtained through location-specific analysis of Raytheon's primary business across the United States. As a long-term strategy, location-specific analysis of such factors as cost of living, availability and cost of skills, and competitive presence can be used to determine the best locations to expand a business. With shorter-term decisions, such as whether to "make" or

[1]Kotter, J., and Rathgeber, H. (2016). *Our Iceberg Is Melting: Changing and Succeeding Under Any Condition*. New York: Penguin Random House.

"buy" employees, these data help the organization know where pockets of talent are located. Motion noted that such tools as LinkedIn, labor market analysis tools such as Burning Glass and TalentNeuron, and publicly available information are also used to create that part of the toolkit.

Paullin asked how Motion's human resources team developed its expertise in change management. Motion explained that Raytheon has an organizational effectiveness department, that, at the time of the described workforce planning initiative, had recently developed a very robust change management curriculum specific to the company. So his human resources team "essentially attended a crash course in change management." He noted that Raytheon also worked with an external consultant to get an outside perspective and that she was a very provocative voice in helping to drive the change. Stakeholder risk assessments were also implemented to determine who was on board with the initiative and who still needed information. Motion said, "It was a combined effort. It was, in retrospect, a really powerful combination."

Alberto Galué (committee member) asked about validation of the workforce planning model. Motion outlined two different approaches undertaken over the years by his team. First, a revenue forecast was built, which was historically accurate, but it fell apart in terms of staffing needs and they had to learn to account for the shifts. They did so by introducing a Monte Carlo simulation, which provided a best-case estimation in terms of staffing needs at the skill-set level. This output was used for their recommended plan line. Motion added that historical staffing data were also studied, and a shift in the mix was incorporated into the overall model, based on the skills needed for the particular types of business projected.

In summarizing, Motion reiterated that change management was ultimately more important than the technical workforce planning solution. He stressed that workforce planning is a journey, that alignment across the organization is absolutely critical, and that starting small and generating initial wins are key to credibility. He again emphasized the importance of a continued focus on business value throughout the process, as well as of leveraging the strengths of the organization and building an army of advocates to support a workforce planning initiative.

6

Wrap-Up: Workshop Themes

This chapter provides highlights of the final workshop session, which Cheryl Paullin (committee member) began by recapping some of the key points from the earlier sessions. As an aid to the final discussion, Paullin presented a list of potential themes on which she encouraged participants to comment. The recap and discussion resulted in the identification of six themes of the workshop: accurate and reliable data, model simplicity and practicality, continual updating, understanding implications and risk, unique characteristics, and change management. Workshop participants then offered their views on the various topics related to the development of budgeting and staffing methodologies for the Veterans Health Administration (VHA) facilities management function.

THEME 1: ACCURATE AND RELIABLE DATA

Several workshop participants discussed the importance of basing a staffing model on solid, credible data about workload requirements. Brian Norman (Compass Manpower Experts, LLC) stressed that clear, consistent labeling of equipment, cost centers, and labor processes is a prerequisite to accurate data collection. Norman also noted that the implementation of a robust, appropriate computerized maintenance management system can drive the effective collection of workload data. John Poulos (CBRE) cautioned, however, that the usefulness of data obtained from a work order system relies on the accurate and consistent entering of data by employees.

In their presentations, Joe Crance (consultant, medical facilities staffing) and Neal Schmeidler (Grant Thornton) had described the various techniques available for collecting work measurement data as a prerequisite for building a manpower model, emphasizing that these techniques have varying levels of accuracy. Crance had noted that engineered work measurement techniques provide the most accurate data; historical record data are less dependable. However, as discussed by Schmeidler, engineered tools are the costliest, and analytic work measurement tools, such as judgment estimating, can often provide good data if performed properly. Both Norman and Bill Strickland (member, Committee on Assessment of Staffing Needs of Systems Specialists in Aviation) cautioned against taking historical data at face value, noting that such data need to be reviewed for accuracy before being used.

Poulos, Ed Ricard (JLL), and Seth Sinclair (Plan4 Healthcare), who had discussed outsourcing options for facilities management, also stressed the importance of quality data. Sinclair noted that current workload data from VHA facilities are extremely variable. Poulos specified that effective workforce planning requires accurate tracking of various metrics, including preventive maintenance, overtime, and tech utilization rate. Ricard noted that JLL regularly collects facilities data on many factors, including employee productivity, uptime, and response times, to

create performance indicators that can improve facilities management functions. Steve Plotner (Gordian) described RSMeans as a powerful marketplace tool that can provide much of the data necessary for workforce modeling.

Fred Switzer (committee member) and several of the presenters noted that accurate, reliable data are costly to obtain, and Schmeidler reiterated that budget constraints need to be considered in the choice of appropriate data collection techniques. However, Oleh Kowalskyj (VHA) responded, there is also a cost associated with the absence of data, and a balance must be struck between the two. The VHA, according to Switzer and Kowalskyj, needs to be aware of the costs involved in either choice. Norman said that he thinks that data collection is worth the up-front investment, explaining that, in addition to providing a basis for workforce planning, collection of accurate data is also a powerful business practice that can aid in day-to-day task management, execution, and planning. Accurate workload data can also help to create a business case to bring to leaders when changes are needed, he argued.

THEME 2: MODEL SIMPLICITY AND PRACTICALITY

Crance and Norman had each noted in their presentations that the data collection techniques applied as part of workforce planning need to be practical and straightforward so that they can be easily followed by all users. In his description of the study performed for the Federal Aviation Administration (FAA), Strickland had acknowledged that data collection can be time intensive, and if the data collection process has a negative impact on employees, data might not be collected appropriately, if at all. Therefore, the committee that wrote the earlier report recommended that the FAA's chosen model not place an unacceptable burden on data providers.

Anshul Sheopuri (IBM) emphasized that validated user research should be performed to assess the effects of new tools and technologies on employees, managers, and business leaders. He noted that such research helped IBM to successfully implement various artificial intelligence tools. Sheopuri also explained that employees may not initially have the skills necessary to use new technologies, so an upskilling effort may be necessary. Ricard also emphasized that employee training is key to the effective utilization of newly implemented technology.

On the issues of simplicity and practicality, Steven Broskey (VHA) discussed the risk of beginning with a complicated model that cannot be supported by the kinds of data currently being collected by the VHA. David Alvarez (VHA) stressed that to avoid any model becoming "shelf-ware," beginning with rough benchmarks rather than a more complex, theoretical model will likely provide the best chance of success.

Robert Anselmi (committee member) noted that although the focus of much of the discussions and presentations was centered on the maintenance aspect of facilities management, other aspects of facilities staffing, such as project and construction work and engineering administration, are also important. He cautioned that, since each aspect involves different types of work, to be of practical use different models, rather than one overarching model, might be needed.

THEME 3: CONTINUAL UPDATING

In his presentation, Alex Manganaris (consultant, public-sector human capital) had stressed that effective workforce planning models rely on a strategic business plan that takes into account any foreseeable changes in technology, business practices, systems, and legislative policies. In presenting an example of work performed for the Internal Revenue Service, he had described how workforce models can be used to help organizations transition through various kinds of changes.

In response to Strickland's presentation on the FAA modeling study, Colin Drury (committee chair) had noted that the situations of the FAA and VHA are similar in that both organizations were attempting to develop models in the face of major high-level changes in their respective industries—the transition to NextGen technology in the case of the FAA and the transition from inpatient to outpatient care in the case of the VHA. Strickland had explained in his presentation that workforce planning models are not static. Even appropriate models should be reviewed and updated regularly to enhance their accuracy.

THEME 4: UNDERSTANDING IMPLICATIONS AND RISK

Paullin said that an important point made in the earlier presentations could be summarized rather simply: "There should be a way, through the modeling process, to explain to decision makers the implications and risks of not meeting the recommended staffing standards." As Crance had outlined in his presentation, when the budget received does not meet 100 percent of the staffing requirements, corporate decisions should be made to reduce the levels of service provided and decrease workload in order to mitigate risk. He had further noted that unfunded requirements should be defined and kept in view because they are a key aspect of risk. Robert Anselmi (committee member) stressed that even in the presence of accurate data about the work being performed, the risk of failure is not mitigated if the model does not account for work that should be, but is not being, done.

Strickland noted that the ability to predict risk was also one of the recommendations for the FAA's staffing model. He explained that a model that can account for risk can also provide justification for budgeting requests related to staffing. Norman reiterated that some organizations object to investing in facilities management because this function is seen as a cost instead of a part of the organization's mission. He explained that this view in itself is a risk because the cost of inadequate staffing of facilities management work centers—investing in useful models to properly estimate the FTE requirement and then stepping up to properly fund and fill these requirements—is essential to the overall VHA mission. VHA facilities management is a true "mission partner" with the medical professionals taking care of the patients.

THEME 5: UNIQUE CHARACTERISTICS

In its statement of task, the committee was asked to identify and address the unique characteristics of the VHA that might influence the development of budget and staffing methodologies for the agency's facilities management. While presenters acknowledged the challenge that some of these variables bring, some also noted that although the VHA has some unique characteristics, the same is true of many other organizations, and several of the methods commonly used in staffing modeling are also applicable to the VHA. In his presentation, Crance had explained that the creation and implementation of labor standards in medical settings have been done successfully in the past, and Ricard had noted that hospitals share enough similarities with other types of properties, such as Class A office buildings and hotels, that JLL believes it is possible to use a similar approach for hospitals. Ricard reiterated that the important point is "that everybody knows and understands that the ultimate goal is the patient experience." Drury had also pointed out several similarities between the FAA's situation and the situation at the VHA, including the stochastic nature of the work, the specialized training required, the variability between worksites, and the development of staffing models in the face of major changes in the industry.

In terms of handling these unique characteristics in a model, Norman noted that it is common practice to begin the modeling process using simple techniques, like ratios of full-time-equivalent staff per square foot. Even though it is known that these figures will not be accurate in every setting throughout an organization as diverse, decentralized, and nonlinear as the VHA, Norman said they provide a starting point from which benchmarking can be performed. A more refined model can then be built incrementally on the basis of the specifics of each facility, such as whether snow removal is needed or whether historical preservation is required. Poulos and other presenters acknowledged that it can take a significant amount of time to build a highly robust model for diverse organizations like the VHA, but they reiterated that ratios and other simple techniques can be used as a baseline while a more accurate model is being researched and constructed. One participant noted that one of the risks of staffing deficiently or ineffectively is the cost burden, and thus the VHA may not be saving the money it thinks it is saving when understaffing a facility or understaffing overall.

THEME 6: CHANGE MANAGEMENT

In his presentation, Robert Motion (Raytheon) had stressed that change management is a very large part of successful workforce planning, potentially more important than the technical workforce planning solution itself. Employees have to be educated on the reasons for the planned changes so that they are motivated to accept them.

Ricard had also emphasized that successful change can be challenging, and he reminded participants of the study that found that 70 percent of change programs fail, largely due to employee resistance and lack of management support (see Chapter 4).

In their presentations, Crance and Schmeidler had emphasized incrementalism as a useful change management approach, noting that the implementation of small, discrete steps can reduce resistance and aid with the successful implementation of standardized data collection processes and subsequent workforce modeling. Norman summarized this approach: "Rather than go for some cosmic model, realize there are steps in between that run parallel or at least on converging tracks." He emphasized that such incremental steps are, in themselves, healthy management practices.

Motion had discussed the concept of "building an army" to manage change through an understanding of all the stakeholders involved in the change process. Schmeidler and Ricard had also emphasized the importance of stakeholder support, including strong backing by management. In Ricard's words: "If we're going to make a change, make sure we're all buying in, and that we know where we're going, and that we're all behind it, and that we have a clear vision and plan of how we're going to change."

One point repeatedly stressed throughout the presentations and in the final discussion was the need for standardization within and across VHA sites, to allow for the data collection and subsequent comparison across facilities necessary to drive successful modeling. In his presentation, Poulos had noted that, in his experience, centralization plays a large role in CBRE's success in effective workforce planning. Norman had emphasized that prior to developing a model, common systems for functions that are shared across facilities should be implemented by the VHA, such as standardized labeling and barcoding of equipment, common labeling of cost centers and centers associated with different types of labor, and a common computerized maintenance management system to collect and process work orders.

Norman also noted that implementation of standard labeling across facilities will enable future data collection and the continued success of a model beyond just the work measurement phase, and he stressed that if data are not continually available to maintain the model, it could easily become "a one-shot deal." Ricard had explained that one of the best practices promoted by JLL involves standardization of general ledger codes and equipment definitions, which allows accurate comparisons among facilities. James Smith (committee cochair) noted that the need for a standardized business model at the VHA is beyond the current task of the committee. He suggested that the VHA ultimately needs to decide how much of the workforce modeling process will be centralized and how much will be decentralized.

To conclude the workshop, the committee cochairs thanked all of the presenters and other attendees for their participation, and they noted that other workshops related to the committee's statement of task (see Appendix C) will be held over the next few months and are detailed on the project's website.

Appendixes

A

Workshop Agenda

COMMITTEE ON FACILITIES STAFFING REQUIREMENTS FOR VETERANS HEALTH ADMINISTRATION

Workshop on Resourcing, Workforce Modeling, and Staffing
January 29–30, 2019
The National Academies
2101 Constitution Ave., NW
Washington, DC

MEETING OBJECTIVE

Obtain data-gathering briefings and discussions in support of the committee's task

Tuesday, January 29, 2019

8:00 a.m. **Welcome and Introductions**
- **Cheryl Paullin,** *Committee Member*

8:30 a.m. **Committee Update**
- **Colin Drury,** *Cochair*

8:45 a.m. **Perspectives on Strategic Workforce Planning in the Federal Government**
- **Alex Manganaris,** *Senior Consultant*

9:45 a.m. Break

10:00 a.m. **Workforce Planning Panel**
- **John Poulos,** *Senior Managing Director,* CBRE

11:15 a.m. **Modeling Best Practices for the Future**
- **Brian Norman,** *CEO,* Compass Manpower Experts, LLC

12:15 p.m. *Lunch*

1:00 p.m. **FAA Staffing Model Case Study**
- **Bill Strickland,** *Member,* Committee on Assessment of Staffing Needs of Systems Specialists in Aviation

2:00 p.m. **On Modeling Medical Manpower Requirements**
- **Joe Crance,** *Consultant*

3:00 p.m. Break

3:15 p.m. **Marketplace Tools for Modeling**
- **Steve Plotner,** *Senior Cost Engineer,* Gordian

4:15 p.m. **Ask the Modeler Discussion**
- **Brian Norman,** *CEO,* Compass Manpower Experts, LLC

5:15 pm End of Session

Wednesday, January 30, 2019

8:00 a.m. **Business Planning for Increasing Operational Efficiency**
- **Seth Sinclair,** *President and COO,* Plan4 Healthcare

9:15 a.m. **AI in Modeling**
- **Anshul Sheopuri,** *Vice President, AI and Offering Strategy, HR IBM Distinguished Engineer,* IBM

10:00 a.m. Break

10:15 a.m. **Facility Benchmarking**
- **Ed Ricard,** *Managing Director,* JLL

11:15 a.m. **Change Management in the Context of Implementation**
- **Robert D. Motion,** *Director, Workforce Planning & Strategy, Intelligence, Information and Services*, Raytheon Company

12:15 p.m. *Lunch*

1:00 p.m. **Work Measurement Operations Research**
- **Neal Schmeidler,** *Public Sector Manager,* Grant Thornton

2:00 p.m. **Wrap-up Discussion**
- **Cheryl Paullin,** *Committee Member*

3:00 p.m. Adjourn

B

Workshop Participants

NOTE: In addition to the in-person participants listed here, many other people listened via a live webcast.

David Alvarez, Compliance Engineer, Office of Capital Asset Management Engineering and Support, Veterans Health Administration
Robert Anselmi, VA Hospital Engineer (retired)
Kevin Brathwaite, Grant Thornton
Steven Broskey, Compliance Engineer, OCAMES and COR for Engineering Resourcing Study, Veterans Health Administration
Joe Crance, Consultant, medical facilities staffing
Colin G. Drury, SUNY Distinguished Professor Emeritus, University at Buffalo
Michael Dunlop, Veterans Health Administration
Dennis Duren, NAVFAC HQ PW
Tony Edwards, Gordian
Ana Ferreras, Senior Program Officer, National Academies of Sciences, Engineering, and Medicine
Kurt Finke, Veterans Health Administration
Michael Fundator, *Journal of Theoretical and Applied Statistics*
Alberto J. Galué, Assistant Vice President, Talent Acquisition and Development, Dallas/Fort Worth International Airport
Robert Goodman, Principal, The Innova Group
Wesley L. Harris, Charles Stark Draper Professor of Aeronautics and Astronautics, Massachusetts Institute of Technology
Nicole Katikos, Veterans Health Administration
David Klein, Veterans Health Administration
Heather Kreidler, Associate Program Officer, Board on Environmental Change and Society, Division of Behavioral and Social Sciences and Education
Oleh Kowalskyj, Veterans Health Administration
Libby Lipscomb, Veterans Health Administration
Ed Litvin, Deputy to the Assistant Deputy Under Secretary for Health Administrative Operations, Veterans Health Administration

Alex Manganaris, Senior Consultant (retired)
William S. Marras, Honda Chair Professor and Director, Integrated Systems Engineering Department, Ohio State University
Chan Math, Veterans Health Administration
Brian Melewski, Acting Director, Office of Capital Asset Management Engineering and Support, Veterans Health Administration
Eileen Moran, Veterans Health Administration
Drew Morgan, Grant Thornton
Robert D. Motion, Director, Workforce Planning & Strategy, Intelligence, Information and Services, Raytheon Company
Brian Norman, Founder and CEO, Compass Manpower Experts, LLC
Kimberly O'Keefe, Former Director for Resources, Office of the Assistant Chief of Staff for Installation Management, Department of the Army
Cameron C. Oskvig, Director, Board on Infrastructure and the Constructed Environment, Division on Engineering and Physical Sciences, National Academies of Sciences, Engineering, and Medicine
Cheryl Paullin, Vice President, Talent Management & Analytics Division, HumRRO
Douglas Peterson, Veterans Health Administration
Steve Plotner, Senior Cost Engineer, Gordian (retired)
John Poulos, Senior Managing Director, CBRE
Isolde Opphile, Supervisory Administrative Officer**,** Washington Headquarters Services/Federal Services Directorate
Mike Reed, Center for Engineering & Occupational Safety and Health, Veterans Health Administration
Ed Ricard, Managing Director, JLL
Vincent Rizzo, Veterans Health Administration
Neal Schmeidler, Public Sector Manager, Grant Thornton
Richard Sertoa, Grant Thornton
Anshul Sheopuri, Vice President, AI and Offering Strategy, HR IBM Distinguished Engineer, IBM
Seth Sinclair, President and COO, Plan4 Healthcare
James B. Smith, U.S. Ambassador (retired)
William Strickland, Member, Committee on Assessment of Staffing Needs of Systems Specialists in Aviation
Fred S. Switzer III, Professor, Clemson University
Daniel Talmage, Program Officer, Board on Human-Systems Integration, Division of Behavioral and Social Sciences and Education, National Academies of Sciences, Engineering, and Medicine
Laura Tucker, Grant Thornton
Toby Warden, Director, Board on Human-Systems Integration, Division of Behavioral and Social Sciences and Education, National Academies of Sciences, Engineering, and Medicine

C

Statement of Task for the Committee on Facilities Staffing Requirements for Veterans Health Administration

An ad hoc committee will be appointed to prepare a comprehensive resource planning and staffing methodology guidebook for VHA Facility Management (Engineering) Programs. The resource and staffing methodology must take into account all significant parameters and variables involved in the VHA Engineering Programs. The methodology should yield customized outputs based on site specific input data, to enable specification of the optimal budget and staffing levels for each site.

The study committee will review relevant available information on: (A) the knowledge, skills, and abilities of staff and the tasks they perform; (B) the present-day staffing strategies employed by the VHA; (C) any materials already produced by the VHA, including a recent consulting report on staffing strategies; (D) current overall and agency-relevant research concerning best staffing models that contribute most effectively to the broad system of effective operations, patient safety, and performance; and (E) any labor categorization or relevant labor union considerations. Additionally, the VHA will assist in the committee's efforts by identifying stakeholder organizations and agencies and facilitating communication with them.

Based on its analysis of the available information, the study committee will develop the following:

- A description and evaluation of current VHA facilities staffing strategies, models and standards;
- Identification of factors that differentiate VHA Facilities Management (Engineering) from facilities engineering in the private sector;
- A comprehensive inventory of program requirements that fall under the purview of Healthcare Facilities Management (Engineering) Departments in VHA. For each program, the committee will identify the key variables that must be factored into the resourcing methodology. Examples of variables include the program scope, complexity, magnitude, and performance requirements.
- A methodology for estimating the resources required to fulfill each of the program requirements, factoring in key variables and unique aspects. This task may include guidance on:

    - objective staffing standards
    - measures for determining staffing based on workload, taking into account various constraints and clients served
    - consideration and evaluation of methods for determining workload
    - guidelines to assess and evaluate competencies for key positions.

- Recommendations for staffing models
- A budgeting and staffing methodology that is adjustable based on site specific program characteristics and inputs. The methodology will provide a tool that VHA Facilities can utilize across the system for establishing Healthcare Facilities Management (Engineering) Departments budgets and staffing levels.
- Recommendations for the steps needed to transition from the current staffing strategies and approaches used by the VHA to the plans for staffing recommended by the committee.

D

Biographical Sketches of Committee Members and Workshop Presenters

Robert Anselmi (*Committee Member*) is a retired hospital engineer for the U.S. Department of Veterans Affairs (VA). As chief engineer at VA Cheyenne, he chaired the Veterans Integrated Service Network 19 (Regional) Chief Engineer Committee that determined fund distribution, and he was also responsible for setting up energy programs at all eight major medical centers in the region. He is a certified facility manager by the International Facility Management Association, a certified health care facility manager by the American Society for Health Care Engineering of the American Hospital Association, and a certified energy manager by the Association of Energy Engineers, as well as a state-registered professional engineer. He has a B.S. and an M.S. in electrical engineering from Carnegie Mellon University and an M.B.A. from Wilmington College.

Joseph G. Crance (*Presenter)* is a consultant in facilities staffing, with a particular focus on medical settings. He previously held positions with the U.S. Air Force (USAF), the U.S. Army, in private industry, and in academia, determining manpower requirements, carrying out cost modeling, and conducting process improvement studies. He had led or participated in more than 70 manpower studies, ranging from single-point locations to USAF-wide functions. At Southern Illinois University and for the USAF, he has taught motion and time study, quality control, quality management, data analysis, work measurement, development of labor standards, computer-aided process mapping, discrete event simulation modeling, and activity-based costing modeling. He has a bachelor's degree in industrial technology from Southern Illinois University and an M.B.A. from Wright State University. He also has a Six Sigma Black Belt, with a certification in quality engineering, through the American Society for Quality.

Colin G. Drury (*Committee Co-Chair*) is SUNY distinguished professor emeritus of industrial and systems engineering at the University at Buffalo of the State University of New York. He is also president of Applied Ergonomics Group, Inc., and director of the Research Institute for Safety and Security in Transportation. His work has concentrated on the application of human factors techniques for error reduction to manufacturing, quality, maintenance processes, and security services. He is a fellow of the Institute of Industrial Engineers, the Chartered Institute for Ergonomics and Human Factors, the International Ergonomics Association, and the Human Factors & Ergonomics Society. He is a recipient of the Bartlett medal of the Ergonomics Society and both the Fitts and Lauer Awards of the Human Factors Ergonomics Society. He has a B.Sc. in physics from the University of Sheffield and a Ph.D. in engineering production from the University of Birmingham, England.

Alberto J. Galué (*Committee Member)* is assistant vice president of talent acquisition and development at Dallas/Fort Worth International Airport. He provides day-to-day oversight of all strategic and operational aspects of talent acquisition, onboarding, new employee orientation, talent assessment, leadership development and learning, succession management, and performance management. Previously, he was system director of talent management at Baylor Scott & White Health. He is a member of the Society of Industrial and Organizational Psychology and the American Psychological Association. He has a B.A. in psychology from Boston University and an M.S. and a Ph.D. in industrial/organizational psychology from Tulane University.

Robert Goodman (*Committee Member)* is a principal with the Innova Group in Austin, Texas. Previously, he held a variety of positions with the U.S. Army, including chief of staff for the U.S. Army Medical Command in Falls Church, Virginia. In that position, his responsibilities included management of roughly 3,200 headquarters personnel working in Virginia, Maryland, and Texas running 19 hospitals with 1.3 million enrollees. His career has entailed leadership in hospitals and clinics, often serving as the chief financial officer, building staffing modeling, and programming for construction and sustainment of health care facilities. He has a master's degree in education from Boston University, a master's degree in health care administration from U.S. Army-Baylor University, and a master's degree in strategic studies from the U.S. Army War College.

Wesley L. Harris (*Committee Member*) is the Charles Stark Draper professor and head of the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology. His research focuses on theoretical and experimental unsteady aerodynamics and aeroacoustics, computational fluid dynamics, and the government policy impact on procurement of high-technology systems. Previously, he served as the associate administrator for aeronautics at the National Aeronautics and Space Administration and as the vice president and chief administrative officer of the University of Tennessee Space Institute. He is a member of the National Academy of Engineering and an elected fellow of the American Institute of Aeronautics and Astronautics. He is also an elected fellow of the American Helicopter Society for personal engineering achievements, engineering education, management, and advancing cultural diversity. He has a B.S. in aerospace engineering from the University of Virginia and an M.S. and a Ph.D. in aerospace and mechanical sciences from Princeton University.

Gene Hubbard (*Committee Member*) is the senior vice president for human capital at RiVidium, Inc., a recognized service-disabled veteran-owned small business that provides human resources, logistics, information technology, and other services to client federal agencies. Previously, he held a wide range of positions in military and civilian service, including the Naval Facilities Engineering Command, the National Oceanic and Atmospheric Administration, and the National Aeronautics and Space Administration. His work has covered the life cycle of facilities management, including design and construction, operations and maintenance, public works, and real estate programs, as well as human resources, financial management, information technology, and administrative services. He is a member of several professional societies, including the Society for Human Resource Management and the American Society for Public Administration. He has a B.S. from the U.S. Naval Academy, an M.P.A. from Troy University, and a master of engineering degree (civil engineering) from the University of Florida.

Alex G. Manganaris (*Presenter*) is a consultant in public-sector human capital with a focus on strategic workforce planning, workforce analytics, and quantitative analysis. Currently, he is part of a team developing the Cyber Talent Management System (CTMS) for the U.S. Department of Homeland Security. Previously, he served as the senior strategic adviser to the assistant director of national intelligence for human capital for the intelligence community and as the chief of workforce planning and competencies in the Office of the Director of National Intelligence. He also previously worked as a senior manager in the office of the chief financial officer of the Internal Revenue Service, at the Congressional Budget Office, at the Army Research Institute, and in the Office of the Secretary of Defense. He is a long-time member of the Institute for Operations Research and Management Sciences. He has a B.A. in sociology from Stony Brook University and an M.S. from the W. Averill Harriman College for Policy Analysis and Public Management at Stony Brook University.

William S. Marras (*Committee Member*) is the Honda chair professor in the Department of Integrated Systems Engineering at Ohio State University, executive director and scientific director of the Spine Research Institute, and executive director of both the Center for Occupational Health in Automotive Manufacturing and the Institute for Ergonomics. His research focuses on understanding the role biomechanics plays in causing spine disorders and their prevention, evaluation, and treatment. He is a two-time recipient of the Swedish Volvo Award for Low Back Pain Research, Austria's Vienna Award for Physical Medicine, and the Liberty Mutual Prize for Injury Prevention Research. He is a member of the National Academy of Engineering and an elected fellow of the American Association for the Advancement of Science, the American Institute of Medical and Biological Engineers, the American Industrial Hygiene Association, the Human Factors and Ergonomics Society, the Ergonomics Society (UK), and the International Ergonomics Association. He has a B.S. in systems engineering from Wright State University and an M.S. in industrial engineering and a Ph.D. in bioengineering and ergonomics from Wayne State University.

Robert D. Motion (*Presenter*) is the director of workforce planning and strategy for Intelligence, Information & Services (IIS), a business within Raytheon Company. In this position, he is responsible for IIS's operational and strategic workforce planning processes, ensuring that the business has an aligned understanding of its workforce needs and has strategies in place to meet those needs and minimize workforce risk. Previously at Raytheon, he established and led a specialty function that provided predictive analytics in strategic workforce planning, competitive intelligence, compliance analytics, employee survey analytics, and integrated human resources analytics. He is a member of the executive board of the Strategic Workforce Planning Council of the Conference Board, and he chairs the Workforce Analytics Working Group of the Aerospace Industries Association. He has a bachelor's degree with special honors and majors in Plan II, government, and history from the University of Texas at Austin and an M.B.A. from the Cox School of Business at Southern Methodist University.

Brian Norman (*Presenter*) is founder and chief executive officer of Compass Manpower Experts, LLC, which is dedicated to assisting organizations to optimize the use of their workers. In this capacity, he has provided coaching, mentoring, executive leadership assistance, and strategic workforce planning solutions around the world, to customers ranging from local entrepreneurs and small businesses to mid-sized and large federal contractors, large federal agencies, national think tanks and committees, the Pentagon, and national governments. Previously, he held a variety of positions in federal service, including command of the U.S. Air Force Manpower Agency. He has also served as a course director and then as an adjunct professor at Ira P. Eaker College for Professional Development, Air University, Maxwell Air Force Base. He has a B.S. in industrial engineering from the University of Missouri, an M.S. in strategic studies from Air University, and an M.S. in systems management from the University of Southern California.

Kimberly O'Keefe (*Committee Member*) is retired from a position as resource director in the Office of the Assistant Chief of Staff for Installation Management in the Department of the Army (OACSIM) in the U.S. Department of Defense. In that position, she was responsible for oversight, management, and execution of $17 billion in requirements for U.S. Army installations. She also managed the modeling for base operations support requirements and the integration of the Army facilities investment strategy, and she oversaw stewardship of the Army's 156 installations worldwide. She also had oversight of OACSIM's business transformation initiatives and the Army's Communities of Excellence Program. She is a graduate of the U.S. Military Academy at West Point and has an M.S. in engineering management from the University of Missouri, Rolla.

Cheryl Paullin (*Committee Member*) is vice president of the Talent Management & Analytics Division of the Human Resources Research Organization in Alexandria, Virginia. In that position, she oversees four programs comprising professionals with advanced training in industrial-organizational psychology or closely related fields and software engineers. She provides technical leadership for development, validation, and implementation of custom assessments and talent management processes. She has directed several projects that involved working within the terms of a consent decree that predated her involvement with the client organization, including an employee development program for more than 80 jobs in the Department of Transportation of Alabama and entry-level fire

service selection processes in the cities of Minneapolis and St. Louis. She is a fellow of the American Psychological Association and of the Society for Industrial and Organizational Psychology. She has a B.A. in psychology from the University of Iowa and a Ph.D. in industrial-organizational psychology from the University of Minnesota.

Stephen C. Plotner (*Presenter*) is a consultant, recently retired from Gordian, where he was the principal cost engineer for RSMeans data. In that position, he served as the senior editor of *Building Construction Costs with RSMeans Data, Facilities Construction Costs with RSMeans Data, Facilities Maintenance & Repair Costs with RSMeans Data*, and *Concrete & Masonry Costs with RSMeans Data*. Previously, his experience included serving as the Northeast regional facilities manager with a national home center/lumberyard retail chain, where he was responsible for annual facility audits, annual capital improvement budgets, remodeling projects, corrective repairs, and preventive maintenance. He also previously worked in the construction industry as a superintendent, project manager, and estimator for commercial building contractors, and he was the owner of a residential remodeling company. He has a B.S. in civil engineering from Northeastern University.

John Poulos (*Presenter*) is senior managing director at CBRE, where he is the health care sector vice chairman. In that position, he oversees all health care accounts and service lines in the delivery of operational excellence and client care. He also leads the Cleveland Clinic account, where CBRE provides facility management, lease administration, real estate tax administration, project management, energy management, development, transaction management, and consulting services for approximately 6 million square feet of medical office, outpatient clinic, surgical, emergency, administrative, and data center space. As East division director, he also manages operational aspect of global workplace solutions health care accounts in the Eastern United States. His responsibilities also include contract negotiations, business plan development, and organizational staffing. He supports business development initiative in the East, and he supports recruiting efforts for all account senior leadership positions. He is a licensed attorney and real estate broker in the state of Ohio. He has a B.S. in accounting and finance from Case Western Reserve University and a J.D. from Cleveland-Marshall College of Law.

Ed Ricard (*Presenter*) is executive vice president and chief operating officer of JLL Healthcare Solutions. In that position, he is responsible for the management and oversight of all client account operations. He also oversees the development and refinement of the facility management platform for health care systems, including business development support, operational efficiency, operational metrics and dashboards, technology delivery, regulatory compliance, energy management, sourcing, plant operations, environmental services, dietary, and clinical engineering. Previously, he was the senior director for national brand management for the national health care facility solutions at Sodexo. He also served as vice president and general manager for facility management at Johnson Controls, Inc., as well as director for North America facility management operations and district manager for health care facility management services. He has a B.S. in business management from Bryan College. He is a member of the American Society for Healthcare Engineering.

Neal F. Schmeidler (*Presenter*) is a manager in the public-sector practice of Grant Thornton, LLP, in Alexandria, Virginia, which is the U.S. member firm of Grant Thornton International Ltd., an independent audit, tax, and advisory firm. His experience covers human capital planning, productivity and work measurement, management and operational analysis, and statistical analysis and modeling. He has worked on a wide range of activities, including air carrier flight line operations and aircraft maintenance, air traffic control, aviation safety inspection, oil spill response system testing, federal services to veterans, medical response to acts of bioterrorism, preventive medicine, electrical power systems acquisition, construction waste recycling, and space shuttle orbiter maintenance. Previously, he founded, owned, and operated an industrial engineering services firm, OMNI Engineering & Technology, Inc. He is a fellow of the Washington Academy of Sciences and the Institute of Industrial and Systems Engineers. He has a B.S. in mathematics from Fort Hays State University and an M.S. in industrial engineering from Kansas State University.

Anshul Sheopuri (*Presenter*) is the director of the people analytics and cognitive offerings team at IBM corporate headquarters. In that capacity, he leads a large analytics team to build, accelerate, and scale the impact of IBM's workforce analytics solutions across the analytics spectrum, from self-serve reporting to next-generation cognitive capabilities. He is also the chief technology officer for cognitive human resources and an IBM distinguished engineer. Previously at IBM, he was a principal research staff member and senior manager for digital research at the Thomas J. Watson Research Center. In that role, he led a team of researchers working on innovative big data digital technologies in such areas as real-time bidding algorithms for paid media optimization, spatiotemporal analytics for mobile personalization, and omni-channel content personalization. He has held teaching positions at New York University's Leonard N. Stern School of Business and the McCombs School of Business at the University of Texas at Austin. He has a B.Tech. in mechanical engineering from the Indian Institute of Technology, Madras, and a Ph.D. from New York University's Leonard N. Stern School of Business.

Seth Sinclair (*Presenter*) is the president and chief operating officer of Plan4 Healthcare, a technology company. The company's goal is to assist clients to implement planning best practices and solutions, including Plan4's SCORE model for health care excellence and the 4Cast platform. His specific area of focus is working with organizations in the Department of Veterans Affairs (VA), particularly the Veterans Health Administration and VA medical centers. Previously, he was a cofounder and partner of Sinclair Advisory Group, a small business providing strategic planning, leadership development, and expert advisory services to federal and private-sector customers. He also served as a consultant and manager for Accenture LLP. He is a member of the American College of Healthcare Executives. He has a B.S. in finance from the University of Maryland and is a credentialed project management professional.

James B. Smith (*Committee Co-Chair*) most recently served as U.S. Ambassador to Saudi Arabia. Previously, he served in a variety of executive positions with Raytheon Company involving corporate strategic planning, aircraft manufacturing, and international business development. Prior to his work in the private sector, he served in the U.S. Air Force, retiring as a brigadier general. He held a variety of operational assignments, including combat missions during Operation Desert Storm. He also held a variety of staff assignments involving coalition partners and served as Air Force chair and professor of military strategy at the National War College. During his final assignment at U.S. Joint Forces Command, he led Millennium Challenge, the largest military transformation experiment in history. He has a B.A. in military history from the U.S. Air Force Academy and an M.A. in history from Indiana University.

William J. Strickland (*Presenter*) is president and chief executive officer of the Human Resources Research Organization (HumRRO) in Alexandria, Virginia. Prior to his current position, he was a HumRRO vice president, directing its Workforce Analysis and Training Systems Division. Previously, he served in the U.S. Air Force, retiring as a colonel. He is a fellow of the American Psychological Association (APA), a past president of its Division of Military Psychology, and the division's representative on APA's Council of Representatives. He currently serves on APA's Policy and Planning Board and as a member-at-large on the APA Board of Directors. He is a graduate of the U.S. Air Force Academy and has a Ph.D. in industrial and organizational psychology from Ohio State University.

Fred Switzer (*Committee Member*) is professor in the College of Behavioral, Social and Health Sciences at Clemson University. His current work focuses on issues in infrastructure resilience and automotive safety. With colleagues, he established the Clemson University Driving Simulator Laboratory to provide a tool for examining issues of human judgment and decision making and risk perception. He also established the Clemson Process Control Simulator laboratory to facilitate studies in the training of industrial operator teams and the interactions of training and supervision with interface design and plant operation and with operator judgment and control. In addition to this area of research, he conducts studies on cognitive and physiological indicators of team performance in industrial and military teams. He has a B.A. in psychology from the University of Texas at Austin, an M.S. in industrial-organizational psychology from Lamar University, and a Ph.D. in industrial-organizational psychology from the University of Illinois at Urbana-Champaign.

Brian Yolitz (*Committee Member*) is associate vice chancellor for facilities at Minnesota State University, a system of public colleges and universities. He is responsible for overseeing facilities policies, planning and programming, design and construction, and operations and maintenance for the system's 54 campuses, with more than 28 million square feet of facility space serving more than 375,000 students across Minnesota. He also oversees policy and guidance for college and university environmental and safety compliance, campus security, and emergency planning and management programs. Previously, he served with the U.S. Air Force. In his final assignment, as director of installations at headquarters, U.S. Air Forces Central, Shaw Air Force Base, South Carolina, his responsibilities included planning and execution of $2.1 billion in construction, service, and commodity contracts for the Air Force. He has a bachelor´s degree in civil engineering from the University of Wisconsin, Platteville, an M.S. in engineering management from the University of Alaska, and a master´s degree in national resource strategy from the National Defense University.