Technical Report 1249

Team Composition Optimization: The Team Optimal Profile System (TOPS)

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14. ABSTRACT *(Maximum 200 words)*:

Teams have become strategic features in organizations. Research and practice suggest team effectiveness is driven considerably by the mix of team member attributes. Given the impact a team's composition has on its objectives, private industry and military leaders place a premium on making optimal team staffing decisions. Nonetheless, the challenges associated with achieving optimal team composition are significant and indicate a need for a tool/system to help commanders optimize personnel allocation. Accordingly, this report lays the foundation for a system that incorporates the elements required to help leaders optimize team composition. For our first task, leaders with extensive team staffing experience were interviewed to uncover the implicit decision models used by team staffing experts. Supplementing extant research, the interviews contributed to our second task: the development of a team composition decision taxonomy. The taxonomy defines and organizes elements of the team staffing decision domain. The interviews and taxonomy culminated in the development of a generic, customizable team composition optimization algorithm that models team composition-effectiveness relationships. Finally, we designed a framework/methodology for a Team Optimal Profiling System (TOPS) and demonstrated its use for making an optimal team composition decision.

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Personnel Performance and Training Technology

TEAM COMPOSITION OPTIMIZATION: THE TEAM OPTIMAL PROFILE SYSTEM (TOPS)

EXECUTIVE SUMMARY

Research Requirement:

As reflected in the Quadrennial Defense Review Report (2006), our military is facing continually changing conditions which requires greater agility, flexibility, and partnering. These conditions only magnify the importance of being able to rapidly form and re-form teams to optimize our force capability. Whether the question is who, from an available pool of Soldiers, is the best replacement member for a given combat team, or how a pool of personnel are best allocated to several teams, or whether units should be rotated intact or in pieces, team staffing is a critical issue facing today's military forces. Nonetheless, the challenges associated with achieving optimal team composition are significant and indicate a need for a tool/system to help commanders optimize personnel allocation. Accordingly, this work lays the foundation for a system that incorporates the elements required to help leaders optimize team composition.

Procedure:

Military and private sector leaders with extensive team staffing experience were interviewed to uncover the implicit decision models used by team staffing experts. Supplementing extant research, the interviews contributed to the development of a team composition decision taxonomy that defines and organizes elements of the team staffing decision domain. The interviews and taxonomy culminated in the development of a generic, customizable team composition optimization algorithm that models relationships of team composition with team effectiveness. Finally, a framework/methodology for a Team Optimal Profiling System (TOPS) was developed and its use for making an optimal team composition decision was demonstrated.

Findings:

Interviews with team staffing experts from a variety of industries and jobs suggest most leaders find team composition decisions to be complex. The interviews identified decision factors and constraints that appear to represent the broad spectrum of factors/constraints relevant to team staffing decision scenarios across most team types. Although the specific factors a leader considers in his team composition decision depends in part on the team's function, structure, and environment, most team staffing decision makers try to consider multiple factors and face a variety of situational constraints when staffing teams. The interviews also indicted that most leaders are not equipped with the tools, support, time, or processes needed to effectively manage the information relevant to making effective team staffing decisions.

Along with the team staffing decision types, the major types of factors and constraints identified during the interviews were organized into a team staffing decision taxonomy. The taxonomy, which is grounded in team composition research and theory, highlights elements that should be considered when making team staffing decisions and captured within a team composition optimization tool. These elements include: 1) types of team staffing decisions, 2) factors decision

makers consider when staffing teams, 3) factors that define the team staffing process, 4) factors that define the candidate pool, and 5) constraints placed on team staffing decisions.

The interview results and the taxonomy influenced the foundation of a TOPS algorithm and framework. The TOPS algorithm simultaneously models individuals' knowledge, skills, abilities, and other characteristics (KSAOs) as related to both their job or role performances and the accomplishment of joint team tasks. Moreover, the algorithm drives a methodology for determining "ideal mixes" or "profiles" of team composition and offers an index of team composition which overcomes the weaknesses of traditional team composition approaches.

A conceptual framework that specifies the functional characteristics of the TOPS system was also developed. The generic TOPs framework consists of several interlinking modules, which together with the algorithm will provide a user-friendly software application that accomplishes several objectives. The TOPS algorithm and framework are generic in that they will be applicable for aiding a wide variety of staffing decisions, from identifying an individual team member's replacement, to optimizing large scale force deployment. Although the algorithm and system framework are generic, the specific elements are customizable to fit specific applications.

An illustration of how TOPS can be used for making a specific team composition decision within a specific domain was also developed. Specifically, a storyboard prototype illustrates how a decision maker could use TOPS for making an optimal single team member replacement decision. The illustration demonstrates how the candidate with the best fit for the individual position, who would be selected for the team under a traditional HR selection approach, might not result in the most effective team. This illustrates the algorithm's ability to help a decision maker balance the competing demands of the individual position and the team, thereby offering the greatest combined value of the replacement.

Utilization and Dissemination of Findings:

The interview results suggest there is clearly a need for tools to help leaders make effective team staffing decisions. An important contribution of the interviews and taxonomic work is it began to bridge a gap between team composition optimization theory and the current state of team staffing practices and needs. An immediate benefit of the taxonomy is it can guide leaders as they make decisions that impact the composition of their teams. As a more long-term benefit, researchers can draw from the taxonomy to ensure the future team composition decision making algorithms and tools are grounded in actual team staffing experiences.

The TOPS algorithm forwards the application of team composition research since it represents a more flexible method to index and study the influences of members' KSAOs to the collective competencies of teams. The algorithm has potential to provide valuable insights if it is customized for particular domains and situations. The TOPS framework and methodology articulates how a team optimization system might work in practice to help commanders work through real team staffing scenarios. With an enhanced understanding of how a team composition algorithm can be applied, researchers can now move onto: 1) refining and validating the elements of algorithms that model relationships of team composition with team effectiveness, and 2) building prototype team optimization decision support tools.

TEAM COMPOSITION OPTIMIZATION: THE TEAM OPTIMAL PROFILE SYSTEM (TOPS)

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Introduction

> *"If you don't have the right mix of people, the team is dead from the start."* – CEO and Chairman of CNA

To enable more rapid and adaptive reactions to change and to maximize performance, organizations are reconfiguring their workforce and restructuring their work around teams (Ilgen, Hollenbeck, Johnson, & Jundt, 2005; Kozlowski & Ilgen, 2006; Salas, Bowers, & Cannon-Bowers, 1995). Although team effectiveness is dependent upon a variety of factors, research and practice suggests the best teams are well designed up-front. Specifically, the mix of knowledge, skills, abilities, and other characteristics (KSAOs) of team members contributes significantly to the amount of effort team members apply to a task, their coordination, and ultimately to team task performance (Bell, 2007; Ilgen, 1999). Given the powerful impact a team's composition has on its processes and objectives, team leaders and organizational decision makers place a premium on making optimal team staffing decisions.

The team literature, as well as our own interviews with multiple team staffing subject matter experts (see quotes embedded throughout this report), indicate the need to optimize team composition is pervasive among a variety of industries, including the armed forces. As reflected in the Quadrennial Defense Review Report (2006), our military is facing continually changing conditions which requires greater agility, flexibility, and partnering. These conditions only magnify the importance of being able to rapidly form and re-form teams to optimize our force capability. Whether the question is who, from an available pool of Soldiers, is the best replacement member for a given combat team, or how a pool of personnel are best allocated to several teams, or whether units should be rotated intact or in pieces, team staffing is a critical issue facing today's military forces.

Researchers and practitioners have shown great interest in team composition as a means for increasing team performance because team composition can be manipulated through placement and selection. However, the challenges associated with achieving optimal team composition are non-trivial. Given the numerous constraints commanders face, and the multitude of factors they must consider when making team staffing decisions, optimizing the composition of teams poses a particularly arduous challenge to today's military commanders.

> *"I first consider the mission complexity and visibility. I start by filling the flight lead and the critical positions. I first ask: Who is available? What kind of experience do they have? Time dictates the extent to which we can consider other factors in our (team staffing) decisions. If we have time, we definitely think about things like whether guys can work together, or if they should be doing something else."* – Lieutenant Colonel, United States Air Force.

> *"I often didn't get my top picks because the person's commander wouldn't let them go, or the personnel system wouldn't let me have them."* – Retired Commander of the F-16 Division, United States Air Force Weapons School

This challenge, spread throughout the military system, indicates a call for a tool/system to help commanders make more rapid and optimal team staffing decisions, and ultimately maximize the effectiveness of force deployment overall. Such a system could also allow team leaders to fully explore multiple team staffing options, adjusting the fit if necessary.

The key to such a system is to employ a sophisticated algorithm that considers individuals' position specific KSAOs, as well as the members' interdependencies and team-level composition profiles. Specifically, this system must simultaneously incorporate a variety of considerations including, how one: 1) best aligns members' KSAOs with job/role demands; 2) optimizes the mix of members' KSAOs that are critical for team functioning; 3) incorporates the fact that candidate pools, members, teams, pre-requisites, and situations change over time; and 4) accounts for membership movement in and out of teams. The engine of this system must be an algorithm that accommodates all of these drivers. Such an algorithm must be generic enough to be applicable to a wide variety of staffing decisions such as choosing a given member's replacement, to optimizing large scale force allocations. At the same time, however, the algorithm must be readily customizable so it is specific enough to provide valuable insights in particular circumstances.

The vision for this line of research is the development of a fully functional, user friendly system, which is driven by an algorithm that incorporates all of the elements required for making optimal team composition decisions. Accordingly, we constructed a framework for a team composition system, the Team Optimal Profiling System (TOPS). The elements of the TOPS framework are based on the extant team composition research and grounded by interviews with team staffing subject matter experts. In the section that follows, a brief overview of the research is provided that supports a need for a team optimization system. We then describe the results of our work, including the subject matter expert interviews and the development of a team staffing decision taxonomy, which culminated in the full scale TOPS framework and the vision for a "TOPS Lite." Finally, the anticipated benefits of TOPS for optimizing the composition of teams are described for the private and government sectors.

Team Composition: Background

Team composition research indicates that team processes and effectiveness are impacted by aspects of group composition such as members' skills, job and organizational experiences, values and group heterogeneity (e.g., Bell, 2007; Gladstein, 1984). Yet, challenges concerning how to best operationalize and index team composition, and how to model its influences, continue to plague the field (Arrow & McGrath, 1995; Ilgen, 1999; Ilgen *et al.*, 2005; Kozlowski & Bell, 2003; Morgan & Lassiter, 1992).

Historically, work on team composition has essentially progressed along two lines: 1) an individual-based approach; and 2) a team-based approach. The first approach derives from the application of traditional individual-focused personnel psychology or Human Resource (HR) frameworks. This approach seeks to optimize the fit between individuals' KSAO profiles and the positions or roles they occupy. Based on a thorough job analysis, the relative importance of various dimensions or tasks that must be accomplished in any given position are identified, and the individual KSAOs that are important for performing those tasks are specified and used for staffing decisions (e.g., McCormick, 1979; Stevens & Campion, 1994). With the advent of team based organizations, KSAOs have been extended to address team-relevant competencies (e.g., Hirschfeld, Jordan, Field, Giles, & Armenakis, 2006; Stevens & Campion, 1994). Nevertheless, this approach remains an individually-oriented design and assumes team effectiveness will be optimized to the extent members are well suited for the positions or roles they occupy.

Several disciplines have operationalized team composition in terms of summary indices of members' characteristics. This team-based approach indexes composition in terms of descriptive statistics of members' KSAOs. The key feature of these approaches is that team members' KSAOs are considered collectively rather than in terms of individuals' position/role fit. For example, researchers have employed indices of central tendency, such as average member tenure, task related knowledge, and agreeableness (Barrick, Stewart, Neubert, & Mount, 1998; Devine & Philips, 2001) as predictors of team effectiveness. Other researchers have focused on the diversity of member attributes, such as functional backgrounds, demographics, or personalities (Jackson, 1992; Jackson, Brett, Sessa, Cooper, Julin, & Peyronnin, 1991). Implicitly, both the central tendency and diversity approaches weigh the relevant attributes of all members equally. In other words, no members or positions individuals occupy are viewed as any more (or less) important than others.

Another variation of the team-based approach employs a relative or selected score approach which focuses upon the attributes of one, or a subset, of members' KSAOs. Based mostly on the work of Steiner (1972), these studies have considered attributes such as the competencies of the weakest or strongest member (Halfhill, Nielsen, Sundstrom, & Weilbaecher, 2005; LePine, Hollenbeck, Ilgen, & Hedlund, 1997). More recently, Ellis, Bell, Ployhart, Hollenbeck and Ilgen (2005) argued that the knowledge levels of members who occupy more critical team roles would exhibit higher correlations with team outcomes than would the knowledge levels of members who occupy less critical roles. In this approach, the relative standing of individuals implies that some members' KSAOs are more important to success than are others. Depending on the situation, such focal attributes could be anything from the physical fitness of the weakest member, to the capabilities of the member with the greatest leadership qualities. In effect, this most recent approach is advocating a network style approach to the study of team composition. In concert with such an approach, rather than focusing on individuals as though they are purely independent entities, or treating the entire team only as a unified whole, *we are advocating that team composition be viewed as a set of interlocking dyadic relationships along the lines of network theory and analyses.* In this fashion, one can detail the relative interdependencies among roles within a team (and perhaps across teams) and the extent to which they are symmetrical, and thereby better represent the nature of the relationships within the team. Moreover, employing a network style approach should allow for more appropriate team-level operationalization of the target dimensions, which has been shown to provide greater validity for predicting team performance (Arthur, Bell, & Edwards, 2007; Bell, 2007).

In summary, the extant literature provides us with many insights. From the individual-level approach, team effectiveness is likely to be enhanced to the extent that members' possess profiles of KSAOs that are well aligned with the demands of the roles they occupy. From the team-based approach, team effectiveness is enhanced to the extent some overall combination of member attributes is optimized, whether that is in terms of some index of central tendency, variance, or a relative score. However, the literature is silent in terms of the relative priority of maximizing individual member position/role fits vs. establishing an ideal team mix. Moreover, the literature to date tends to treat individual members as though they were unique contributors – or as equal contributors to a unified whole team composite. In contrast, our approach adopts more of a network approach and details the nature of the interdependencies among different members. For example, consider an instance where a communications officer for a given team needs to be replaced. Consider further that the incumbent's background contributed greatly to the demographic and functional diversity of the team, and the person has been the primary "peacekeeper" when other members were in conflict. What factor(s) should be given priority when choosing a replacement? Is it better to get the "best communications officer" at the expense of team diversity and the peacekeeper role? Is it better to select a qualified communications officer who might contribute more to the team attributes but is not the most skilled communications officer available? What is needed, therefore, is an algorithm that will help a decision maker balance these competing demands and make a selection that will optimize the combined profile of individual and team characteristics that offer the greatest combined value of the replacement.

Objectives

The ultimate objective for this project was to develop and illustrate the use of a prototype algorithm and TOPS decision-aid tool for the placement of personnel onto teams. As proximal goals, we set out to clarify the domain of team optimization decisions and develop a prototype algorithm to assist in the best allocation of personnel to teams. The underlying purpose was to bridge the gap between team composition optimization theory and the current state of personnel allocation procedures. Accordingly, the technical objectives were as follows:

Define the team staffing/optimization decision making domain

This incorporates the types of decisions commanders face when staffing teams, the types of factors they consider (i.e., in terms of both individual role and team attributes) and constraints they deal with during such decisions, and how they balance filling individual positions with existing team characteristics and dynamics.

Develop a first-generation, generic, customizable team composition optimization algorithm that models relationships of team composition with team effectiveness

The plan for the algorithm was that it would be designed to fill a vacant position on an existing team. The objective was to develop a generic algorithm composed of parameters that could be customized and weighted to fit specific target domains. The algorithm was intended to be the engine of the first-generation TOPS decision-aid tool. As part of this effort, a conceptual framework for modifying team composition algorithms has been articulated.

Demonstrate the use of the generic optimization algorithm with a specific occupational domain

The purpose of this objective was to showcase how a customized, SME-driven, prototype decision aid could be used to enable a commander to make quick, informed team staffing decisions for filling vacant positions within a particular domain (e.g., Special Forces). The objective was to illustrate how a TOPS decision-aid tool could help optimize a team's composition for a realistic team composition decision.

To meet these objectives, three primary tasks as well as a demonstration were completed. These tasks are illustrated in Figure 1 and the procedures and results of each task are discussed in detail below.

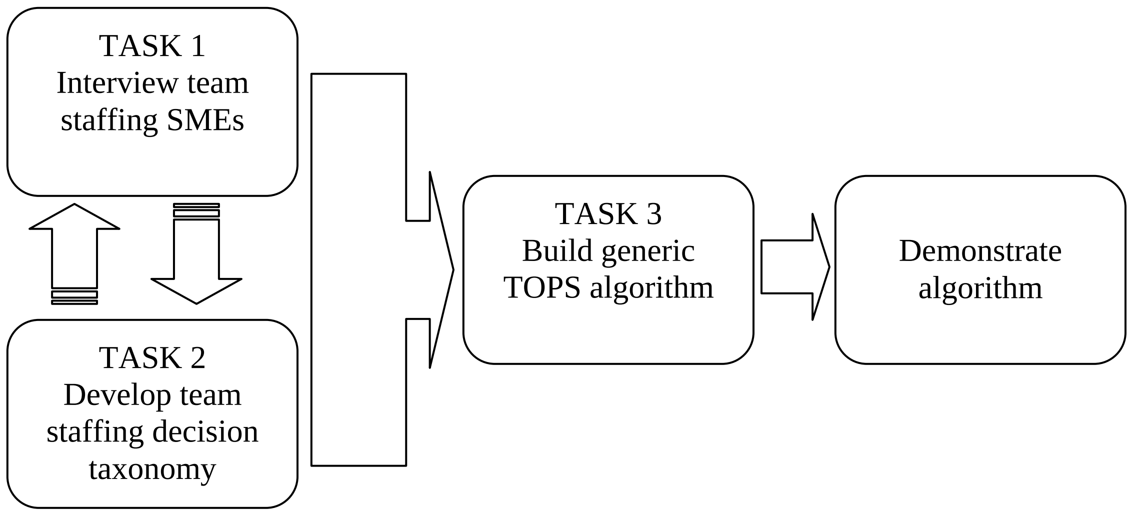

Figure 1. Overview of Phase 1 Work Plan

Project Task Procedures and Results

Task 1: Conduct Structured Interviews with Team Staffing Subject Matter Experts

During Task 1, team leaders with extensive experience making team staffing decisions were interviewed. The purpose of the interviews was to uncover and understand the implicit decision models used by individuals who are experts at making decisions that impact the composition of their team(s). For example, what kinds of team staffing decisions do team leaders or commanders need to make; what individual, team, and situational factors do they consider; what processes do they use to make team staffing decisions (e.g., how do they balance or weigh individual vs. team factors); and what kinds of constraints place limitations on their decisions. The primary purpose of this task was to ensure the decision making algorithms and tools developed in later tasks and phases are grounded in actual team staffing needs and experiences.

Interview participant sample. Participants in the team staffing interviews were individuals who were considered team staffing experts in their respective organizations. Participants were identified based on their extensive experience and expertise in making decisions that influence the composition of teams. Our interview sample consisted of 21 team staffing subject matter experts (SMEs) from 17 well-respected organizations, representing a cross-section of industries and the military. Represented organizations included: United States Air Force, United States Marine Corps, United States Geological Survey, Boeing, BP, The Walt Disney Company, Johnson & Johnson, Crayola, and Merck. While all interview participants were in leadership roles, they held a variety of ranks and job titles, such as Lieutenant Colonel, Major, Captain, Chair and CEO, Vice President of Human Resources, Fire Department Chief, Senior Vice President of Distribution and Operations, and Director of Organization and Talent. On average, the team staffing SMEs had over 15 years experience staffing teams. The teams staffed by the SMEs were representative of all the categories in Sundstrom's team typology (i.e., production, service, management, project, action, advisory/parallel) (Sundstrom et al., 1990; 2000). Representation of various team types is beneficial for this investigation given recent team research, which suggests the influence of some team composition variables on team effectiveness may be dependent upon the type of work the team performs (Bell, 2007).

Knowledge elicitation process and procedures. Appendix A provides a structured interview protocol that was developed to elicit information from the SMEs about their team staffing decisions. The first section of the interview asked the interview participants about the types of staffing decisions faced. For example, do they need to: a) choose replacements for individual positions on teams, b) staff entire teams, and/or c) optimize the mix of individuals on one or more teams? The interviews also prompted the SMEs to describe specific team staffing situations they have encountered, and to "think aloud" and explain the processes they used for making the decision (e.g., amount and source of information considered; temporal dynamics of the process). When describing specific team staffing experiences, the SMEs were also prompted to discuss the individual and team factors they considered, as well as the relative importance of these factors. The SMEs also described the kinds of constraints placed on staffing decisions in a natural/operational environment. Additionally, SMEs were asked to describe experiences in which they needed to balance filling individual positions and roles with team needs or dynamics.

Interview results. As illustrated in Figure 1, the interview and taxonomy development processes were conducted in concert and informed one another. Therefore, in addition to the interview results described here, much of the insight gained from the interviews is reflected in the discussion of the taxonomy in the following section.

The open-ended interview responses were content coded and analyzed. During an early portion of the interview, interview respondents were asked to describe a specific situation in which they needed to make a decision that influenced the composition of a team or teams. Interview respondents were instructed to describe the situation of their choice, regardless of the function of the team, whether it involved existing teams or new teams, filling one or multiple team positions, or composing one or multiple teams. As shown in Table 1, the majority of specific team staffing decisions discussed by the interview participants represented five major types of team staffing decisions. The two most frequently cited team staffing decisions required filling multiple positions on a single team, but differed in terms of whether the team was new or existing. The most frequently cited (48%) type of team staffing experience was a single team formation decision and involved assigning multiple people to a *new* team. In contrast, the second most cited (22%) decision, a multiple member replacement decision, involved assigning more than one person to an *existing* team. A decision that involved assigning a single individual to an existing team, a team member replacement decision, was discussed in 13% of the scenarios discussed. The next most frequently discussed decision type was multiple team formation. Discussed within 8% of the responses, this decision involved assigning people to multiple new teams. Just 4% of the respondents described scenarios where new talent was distributed across multiple existing teams. These results suggest team leaders are faced with making a variety of team staffing decisions, more frequently with a single team, but at times involving multiple teams.

Table 1. Types of Team Staffing Decisions Discussed in SME Interviews

Team Staffing Decision Type	Percentage
Single team formation	48%
Multiple member replacement	22%
Team member replacement	13%
Multiple team formation	9%
New talent distribution	4%
Other	4%

While the interviews with the team staffing experts revealed a certain level of savvy and sophistication in the strategies used to make team staffing decisions, it also suggested that even the most experienced team leaders find these decisions to be cognitively complex and challenging. One reason for this is the number of factors the leaders want or need to consider. Some of these are individual factors (e.g., individual KSAOs), others are at the team level (e.g., fit with existing team members), and a third portion are mission or task-based factors (e.g., criticality of the mission). Table 2 displays the categories of factors SMEs considered during their team staffing scenarios, and the number of times each factor was mentioned across the 20 interviews.

Table 2. Factors which Influenced SME Team Staffing Decisions

Factor	Frequency
Individual	
Availability	2
Individual KSAOs	15
Amount/Type of experience	8
Previous performance record	2
Team	
Fit with the existing team	9
Enhanced team diversity	7
Fill team gaps	5
Plan for future team needs	2
Provide back-up for others on team	3
Features of the task/mission	2
Other	6

These results suggest leaders need or try to weigh a number of factors when making team staffing decisions. It is also clear team staffing experts often consider team needs and dynamics when making staffing decisions.

The important role of team needs, and the need to balance these with individual factors, is also evident in the interview participants' responses to three other experience-based questions. The first of these three questions asked, "Have you ever had an experience where each team member was good at their individual job, but the team as a whole struggled? Why do you think the team struggled?" Several of the 14 team staffing experts who responded to this question indicated that, in their experience, multiple factors contributed to this situation. Each factor mentioned was counted separately and categorized. As shown in Figure 2, it seems there are a variety of reasons why a team of strong individuals can struggle as a team. The reason most frequently cited (30%) by the team staffing interview participants was that strong individual performers are often not team oriented. For example, they are more concerned with their personal performance and outcomes than they are with working well as a team. Also, multiple team staffing experts mentioned they have seen teams of strong individuals struggle because of poor leadership (20%), individual or interpersonal differences between team members (15%), or role clarity issues (10%).

> *"Yes, I see this happen more often than not. People are trained to be individual contributors. They receive no training in or see no value of working in teams, so they are not playing for the team."* - Manager, Organizational Capability, BP
>
> *"In one situation, team members, who were experts in their specialty, were not on the same page because they could not identify with the team."* - Senior Director, Medtronic

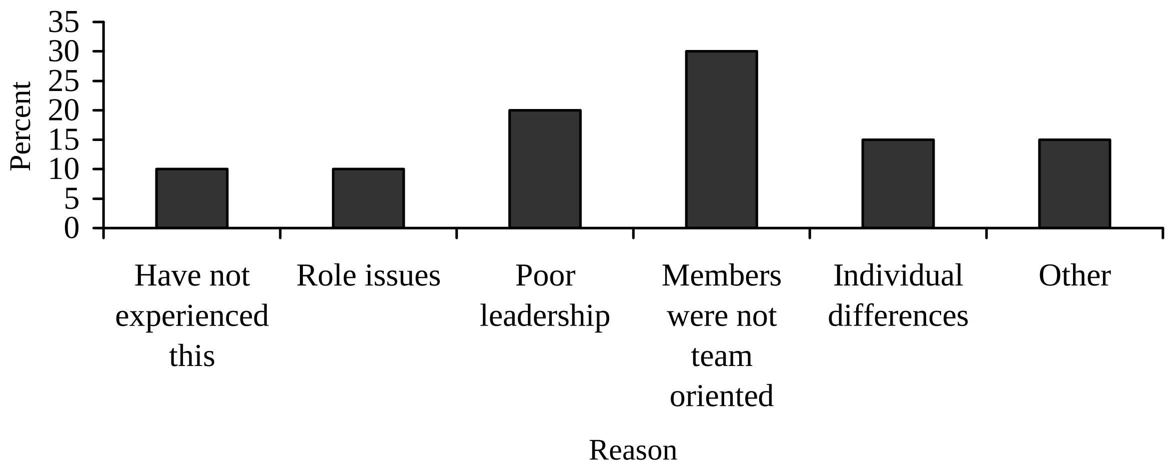

Figure 2. Reasons why a Team of Strong Individual Performers can Struggle

The importance of balancing team needs with individual role needs was also demonstrated through the responses to a question which asked, "Have you ever had an experience where more than one person was highly qualified for a single position? If so, what was the deciding factor?" As illustrated in Figure 3, four themes, or deciding factors, emerged from the results. Of the 18 respondents to this question, 45% indicated that when more than two candidates were equally qualified for a single position, they picked the candidate who was a better fit with the team.

Another 17% of the respondents said they picked the candidate who brought more functional or demographic diversity to the team, and 11% indicated they considered which candidate would get a better developmental experience from the position. Finally, 6% stated they picked the candidate that would fill a team competency gap.

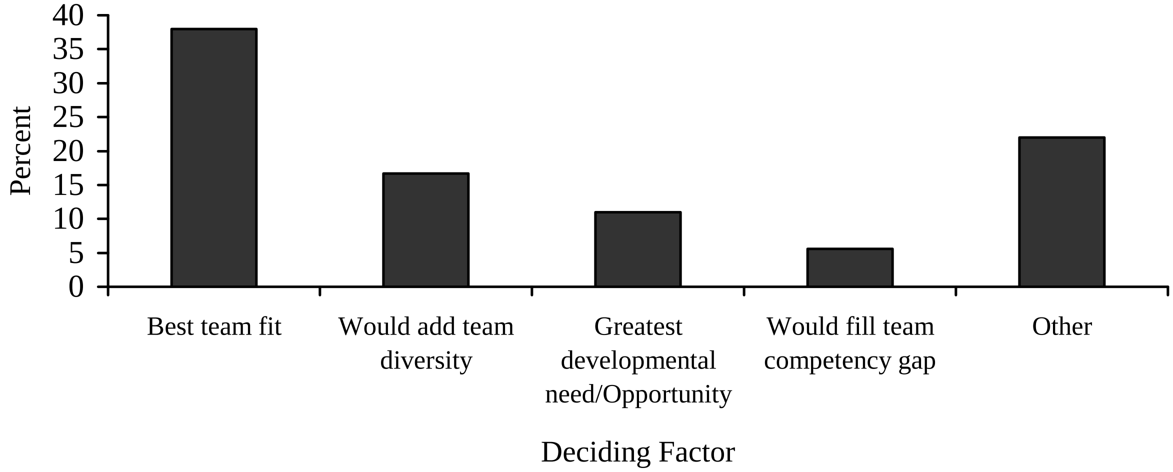

Figure 3. Deciding Factor for Choosing Between Equally Qualified Candidates

The responses to another experience-based question further suggest leaders weigh team needs along with individual and logistical needs when staffing individual positions. Specifically, this question asked, “Have you ever had an experience where you decided not to pick the most qualified person to fill a position. Why?” Figure 4 shows that 45% of the 20 people who responded to this question indicated they have passed over someone who was most qualified for a position because they were not a good fit for the team. Highlighting a more logistical factor, 15% indicated they did not pick the most qualified because that person was unavailable, or of greater value filling some other role. Finally, 10% of respondents indicated they passed over the most qualified to give someone else a developmental opportunity, and another 10% said rather than picking the most qualified candidate, they decided to pick someone who brought greater diversity to the team.

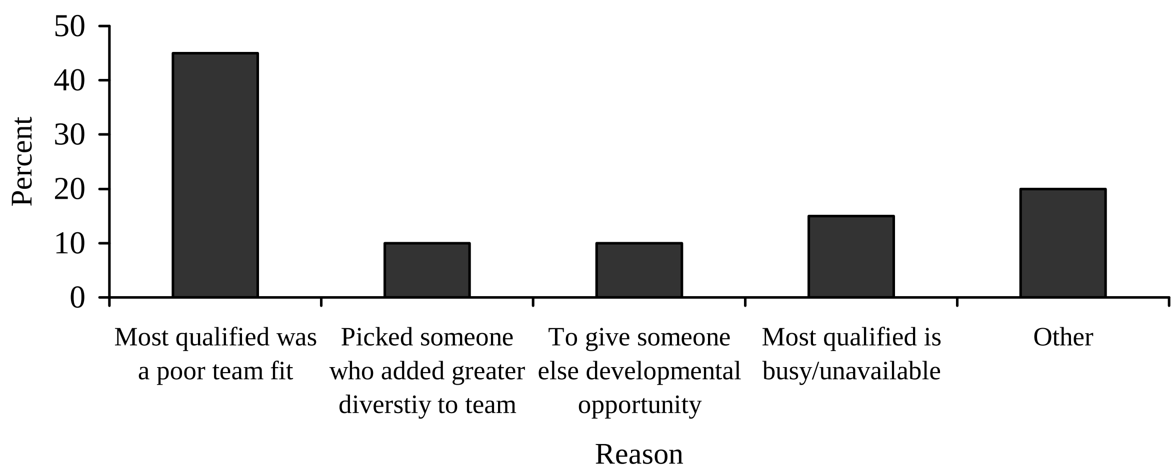

Figure 4. Reasons for Not Choosing the Most Qualified Candidate

Team staffing experts were also asked about their experiences with evaluating their team staffing decisions. First, team staffing SMEs were asked to indicate whether they used formal evaluation criteria (e.g., performance metrics), informal criteria (e.g., general feeling about the team's cohesion or performance), or some combination of formal and informal criteria to evaluate their team staffing decisions. The participants' responses to this question are categorized in Figure 5. All of the 13 team staffing subject matter experts who responded to this question indicated they rely on some informal criteria when evaluating their team staffing decisions. The majority (62%) reported evaluating their team staffing decisions on informal criteria alone.

> *I don't use formal metrics to evaluate my team staffing decisions. I'm more of a process/results person. I look at how effective the team is."* – Lieutenant Colonel, United States Air Force

The other 39% of the experts who answered this question reported employing some combination of formal and informal evaluation criteria to evaluate their team staffing decisions.

> *"We have a lot of formal metrics that measures team productivity (e.g., the number of jobs filled), customer satisfaction. We also, more informally, gauge how much the team members like each other and talk to each other."* – Client Manager for IT Staffing, The Hartford

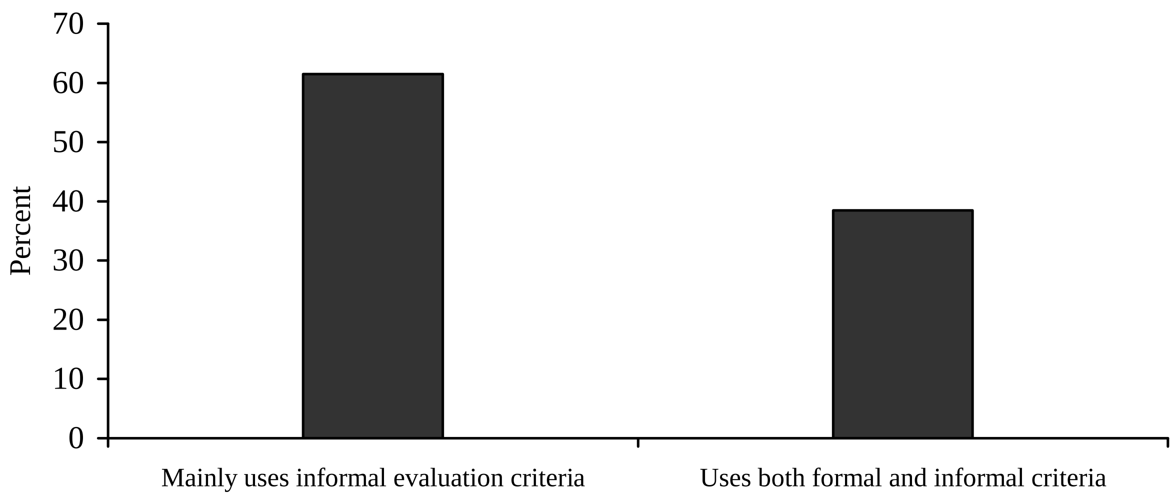

Figure 5. Type of Criteria Used; Formal vs. Informal

In addition to asking about the formal or informal nature of the criteria used, the team staffing experts were asked to describe the factors they consider and the signs they look for to help them determine whether they have put together a good team. Each factor mentioned by a given participant was counted separately. Therefore, the total number of factors mentioned (N = 32) is greater than the number of responses to this question (N = 16). As shown in Figure 6, the factors mentioned generally fell into two major categories. Specifically, within their responses, half of the team staffing experts stated they considered the team's performance or whether the team met their objectives. Ten of the experts indicated they examine whether the team members get along well with one another. Other factors considered by team staffing experts included team member turnover, whether the teams needed to be reconfigured, whether the teams learned from their errors, and whether the rest of the organization reacts positively to the team composition decision.

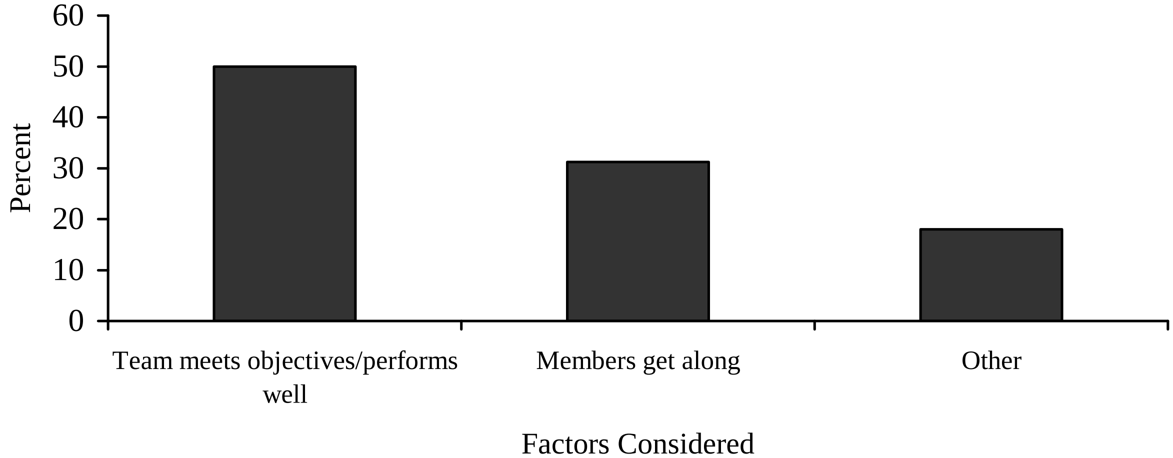

Figure 6. Factors Considered when Evaluating Team Staffing Decisions

In sum, the results of the interviews with team staffing experts suggest leaders across industries and jobs find team composition decisions to be complex. Although the specific factors a leader considers in his team composition decision depends in part on the team's function, structure, and environment, most team staffing decision makers try to consider multiple factors and face a variety of situational constraints when staffing teams.

Based on previous research in the area of team composition, it is not entirely surprising to learn leaders find team composition decisions to be challenging and the factors and constraints considered depend greatly on the team and situation (Bell, 2007; Ilgen, 1999). However, it was somewhat surprising to discover that although many of the experts recognized a need to consider and balance multiple factors in their team staffing decision process, they often could not consider all of the information they would like to include because they did not have the tools, support, time, or a process needed to effectively manage and analyze all of the relevant information.

The interview results identified decision factors and constraints that appear to be representative of the broad spectrum of factors/constraints relevant to team staffing decision scenarios across most team types. Although the domain of decision factors and constraints is likely to be infinite, we believe a system which can incorporate and adjust for the ones uncovered during the interviews will be flexible enough to handle most factors that drive team effectiveness. Along with the team staffing decision types, the major types of factors and constraints identified during the expert interviews were organized into a team staffing decision taxonomy (Task 2), which is described in the following section.

Task 2: Develop a Taxonomy of the Team Staffing Decision Domain

The second task was to develop a taxonomy of the team staffing/optimization decision domain. The taxonomy draws upon findings from team composition research and theory (e.g., Cannon-Bowers, Tannenbaum, Salas, & Volpe, 1995; Mathieu, Gilson & Ruddy, 2006) and was grounded by the results of the team staffing expert interviews. The taxonomy highlights elements that should be considered when making team staffing decisions. These elements include: 1) types of team staffing decisions, 2) factors decision makers consider when staffing teams, 3) factors that define the team staffing process, 4) factors that define the candidate pool, and 5) constraints placed on team staffing decisions. The results of this task have influenced the foundation of the TOPS algorithm and framework, and should continue to inform future TOPS generations as we test and refine the algorithm.

Team staffing decision types. As shown in Table 3, the team staffing decision domain can be organized into six major types of decisions. The first three types are decisions relevant to existing teams. The first type, Team Member Replacement, represents a fairly common scenario, wherein a decision maker must place a single person onto a single existing team (e.g., hiring someone to fill a vacant position on a work team). Multiple Member Replacement scenarios also target a single existing team, but involve assigning *multiple* people to this team, as a leader might decide to do in a situation where she is growing a team or refilling multiple vacant spots concurrently. When making New Talent Distribution decisions, decision makers must place multiple people on multiple existing teams (e.g., when members of a recent class of recruits are allocated to multiple existing teams). In contrast to the first three types, the fourth and fifth types of decisions represent situations where the decision maker forms new teams. Specifically, when decision makers build a single new team from scratch they are making a Single Team Formation decision. A Multiple Team Formation decision is similar, but requires the decision maker to allocate people to multiple new teams, as often takes place when teams within a new organization are formed. The final decision type, Reconfiguration, is one which represents a type of highly complex team staffing decision and is relevant to an entire organization or unit (e.g., a reorganization/restructure that involves the elimination of entire divisions and the redistribution of the former staff within these divisions to other existing divisions. The ultimate objective is to develop a TOPS system that can be utilized for making each of the existing and new team decisions (numbers 1-5 in Table 3).

Table 3. Types of Team Staffing Decisions

Decision Type	Decision Description	Example
Existing Team Decisions		
1. Team member replacement	Assigning a person to an existing team	Replacing a person who left a team *"I had to replace a leader on a single off-shore oil rig. The previous leader was promoted."*
2. Multiple member replacement	Assigning people to multiple positions on an existing team	Replacing several people when their tour of duty ends *"I had to reorganize a team after I had promoted a number of people. I had to back-fill their positions and reorganize."*
3. New talent distribution	Assigning new people to several existing teams	Assigning a new group of graduates to existing teams *"We partnered with a local university, and filled the additional plant positions with the group of new graduates."*
New Team Decisions		
4. Single team formation	Assigning multiple people to a new team	Forming a project or mission team *"I had to build a new helo crew."*
5. Multiple team formation	Assigning people to several new teams	Forming several teams at once *"I was tasked with filling hundreds of positions within multiple departments of a new store."*
Organizational Decisions		
6. Reconfiguration	Assigning or re-assigning multiple people within the organization to multiple existing or new teams	Restructuring a business unit post-merger

Factors that influence team staffing decisions. The taxonomy also classifies factors that influence team staffing decisions. As shown in Table 2, factors associated with the individual candidates (e.g., individual KSAOs, interests, availability), the team (e.g., functional diversity among the team, balance of experienced and new members, personality or work style fit between the leader and members), or the task/mission (e.g., criticality of the mission, potential risks involved) can all influence team composition decisions. While situational constraints may prevent decision makers from being able to consider the full scope of factors they wish to evaluate, it seems experienced decision makers try to consider multiple factors in their decisions.

> *"I typically look for how the person will fit with the team, someone who is flexible (can fill other roles when needed), someone with certain skills (e.g., interpersonal) and experience, and whether they can fill existing skill gaps on the team… I also look for people to be able to back-up one another."* – Director of Workforce Development, SEFCU

Ultimately, the TOPS user will be able to specify the factors that are relevant for their particular domain and decision. The intent for future TOPS research and development is to use computational modeling to assess the fidelity of the TOPS algorithm when considering different factors and combinations of factors.

Factors that define the team staffing decision process. The taxonomy also includes factors that define the processes people use to make team staffing decisions. As indicated by the team staffing experts interviewed, the processes used for making team staffing decisions can vary on several dimensions. First, the centrality of decision making can differ. For example, some team leaders may staff an entire team on their own without input or help from others (central decision making), while others divide the team staffing responsibility among several parties (distributed decision making), as is sometimes done when staffing cross functional teams. Many use a negotiated or coordinated process, which falls between central and distributed approaches (e.g., regional managers nominate team members and then negotiate with central decision makers to ensure the team is staffed appropriately).

> *"I first identify the core team lead. I then work with the management team - those that represent Medtronic's seven functional disciplines (e.g., design, clinical, marketing) - to select the other team members. Generally, the managers of each functional discipline decide who to assign from their function, but I give some input."* - Senior Director for the Core Development Program Management Office, Medtronic

Second, the amount, source, and formality of information considered is another factor that defines the decision making process. For example, some decision makers have access to data on all of the variables they would like to consider (full data). In most operational settings, team staffing decisions are based on partial data (e.g., data on several key factors), or in some cases, no quantitative data at all. Also, decisions could be based on existing sources of information about candidates, newly gathered information, or some combination of the two. Finally, the source of the information (e.g., self vs. other) or the type tool used to collect the data (e.g., objective tests vs. performance ratings) can differ.

> *"Candidates were interviewed by team members and completed an inventory that assessed their fit with the team."* - Head of Organizational Effectiveness, Boeing

Third, the temporal dynamics associated with the process can also influence the team staffing decision. For example, when faced with multiple openings, some team leaders focus on filling targeted positions before filling other positions, while others work on filling all positions at one time. A second temporal issue is whether a multiple hurdle evaluation approach is used (e.g., candidates must demonstrate a minimum level of technical skill before they can move onto an interview process), or all factors are considered in a single hurdle.

> "*Three strong candidates met my initial hurdle (leadership style) and were then interviewed*." –Manager, Organizational Capability, BP

Factors that define the candidate pool. When making team staffing decisions, the candidate pool can act as a limitation or a facilitating feature, depending on the status of the factors that define the candidate pool. Accordingly, the taxonomy also captures factors that define the candidate pool. In some instances, the decision maker can control aspects of the candidate pool. For example, someone might choose to select from the external market rather than the internal pool. Or, they might choose to recruit world-wide when looking to build a global team. However, other candidate pool characteristics are not as easily controlled. For example, in a tight labor market, the list of candidates could be smaller than desired.

> *"I often look for people internally, because they can come in and back people up in other positions sooner than someone from outside."* - Director of Workforce Development, SEFCU

Constraints. Team commanders and leaders frequently are faced with obstacles or constraints when making team composition decisions. Despite these constraints, they must still be able to make effective team staffing decisions. Given this, an effective team composition optimization algorithm must account for the constraints placed on the decision maker. Therefore, the taxonomy captures many of the common constraints placed on team staffing decisions. Although it is expected TOPS users will ultimately be able to customize the system to incorporate unique situational constraints, identifying common types of constraints enables us to develop a "usable" TOPS system. Some common constraints placed on team staffing decisions include:

- Candidate availability (e.g., candidates unavailable/busy/not local)
- Missing information (e.g., about the candidate/team; about the task/mission)
- Costs (e.g., recruiting, candidate compensation requirements)
- Lack of time (e.g., deadlines for putting a team in place)
- Timing of the decision (e.g., right person, wrong time)

> "*The biggest constraint for me is availability of personnel."* – Major, US Marine Corps

> "*Cost considerations were a major factor. They wanted a team with global experience. However, it is expensive to move candidates to New Jersey from other parts of the world."* – Senior Director, Merck

In sum, the team staffing taxonomy, based on the team composition literature and our interviews with team staffing subject matter experts, highlights features that should be captured when developing a team composition optimization tool. As such, these factors influenced the components of the initial TOPS algorithm and framework (described below), and should continue to contribute to future evolutions of the TOPS system.

Task 3: Build a Generic TOPS Composition Optimization Algorithm

The first and second tasks identified: 1) types of situations in which managers/officers confront decisions about team composition; 2) a better understanding of how managers currently deal with team composition situations; 3) types of logistical constraints they face that limit their options; and 4) the need to make such decisions in a better way. This resulted in the development of a team composition taxonomy and highlighted features that should be incorporated in TOPS.

The third task leveraged information from Tasks 1 and 2 to build a generic team composition optimization algorithm. Specifically, this algorithm simultaneously models individuals' knowledge, skills, abilities, and other characteristics (KSAOs) as related to both their job or role performances and the accomplishment of joint team tasks. This resulted in a methodology for determining “ideal mixes” or “profiles” of team composition. Moreover, the TOPS algorithm offers an index of team composition which overcomes the weaknesses of the traditional HR, diversity, central tendency, and selected score approaches previously reviewed. Specifically, the algorithm’s profiling approach models team competencies as a joint function of: 1) members’ competencies related to performing their individual jobs; 2) the interdependence or relationships between members’ jobs; 3) members’ competencies related to performing team tasks; and 4) the interrelationships among members relevant to performing those team tasks. In other words, team performance is a joint function of individual members’ job performances and their combined efforts on team tasks. This approach represents a more flexible method to index and study the influences of members’ KSAOs to the collective competencies of teams.

TOPS Framework. A conceptual framework for a full scale TOPS system was also developed. In this framework, the functional characteristics of this team decision making system, including the algorithm, are specified. The generic TOPs framework consists of several interlinking modules, which together with the algorithm, will provide a user-friendly software application that accomplishes several objectives, as depicted in Figure 7.

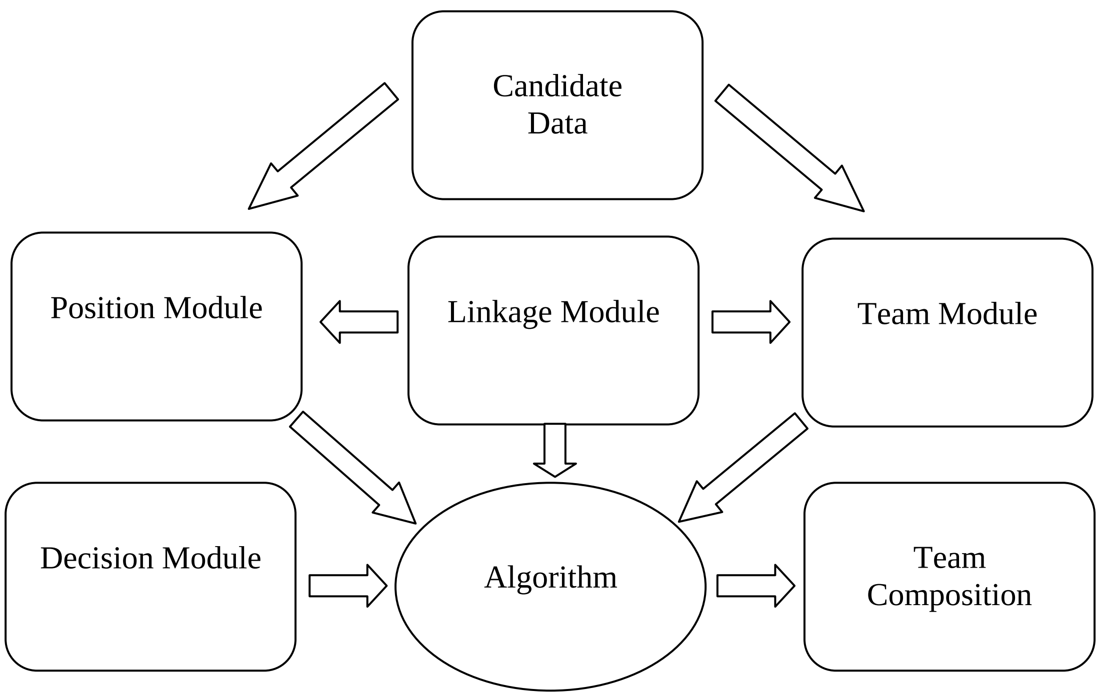

Figure 7: Interaction among Modules in TOPS

Foundational Modules. The four TOPS modules are referred to as “foundational” modules (*Position, Team, and Candidate Data, and Linkage Modules*) because they must be pre-populated in order to produce team composition recommendations. For example, information about the position and team requirements as well as the team members is stored in these modules.

Decision and Team Composition Results Modules. In addition to the foundational modules, the decision maker (e.g., team leader, commander) will work with the TOPS *Decision Module* to confirm or modify underlying assumptions and establish certain boundary conditions for their current staffing decision. The algorithm, which drives the TOPS system, incorporates the assumptions and constraints introduced in the foundational and decision modules to index and examine team composition. Finally, the team composition output (e.g., proposed team composition solutions) is presented for the user in the *Team Composition Results Module*.

To arrive at a fully functional TOPS that can be employed within a specific domain, the foundation modules need to be customized and populated by the decision maker in order to ground the generic TOPS algorithm and system in a given community.

TOPS customization process. The customization process is what makes TOPS scalable across situations and applications. This step, carried out by the decision maker, provides a number of valuable pieces of information. First, it specifies the information that is captured in the *Position*, *Team*, and *Linkage Modules*. For both the *Position* and *Team Modules*, the customization process identifies the "attributes" that will be considered. Moreover, it specifies which of these attributes are prerequisites associated with minimum requirements, and which of these are attributes to be considered in the algorithm. Each attribute that will be considered in the algorithm is assigned a weight that represents its relative importance for performance in the position or team. These weights come from a weighting procedure that can be conducted through various means (e.g., team tasks analyses, observations, using judgments from SMEs). For the *Linkage Module*, the customization process derives interdependency weights, which reflect the relative contribution or influence that a particular position has on the performance of other positions on the team.

TOPS population process. A population process is also completed by the decision maker. This process could be completed in concert with, or subsequent to, the customization process. During the population process, the decision maker enters candidate and team member data (e.g., attribute scores) into the *Candidate Data Module*.

In sum, the customization and population process is an "upfront" decision maker activity that grounds TOPS in a target population. It specifies and populates the foundational modules in TOPS (i.e., *Position, Team, Candidate Data, and Linkage Modules*). While existing position and team task analyses can be leveraged for this effort, a general customization process will be developed that could be followed even if no existing background information is available for a target population.

TOPS algorithm. The information stored in the foundational modules is extracted and manipulated by the TOPS algorithm to ultimately generate team composition solutions. It is helpful to envision the TOPS algorithm's operation in a "fully unconstrained environment." Theoretically, the algorithm will generate every conceivable combination of members in positions within teams. Whereas this would never be the case in real life, this theoretical baseline is important for understanding the system. The theoretical potential number of solutions is a finite number determined by: 1) the number of candidates in the pool; 2) the number of team positions; 3) and the number of teams under consideration. This assumes that anyone can occupy any position in any team, at any time, and members can be arranged in any combination. Again, this is merely a fully unconstrained theoretical baseline. It is general in the sense that it can accommodate any number of candidates, positions, teams, and elements to be considered at the individual and team levels, as related to any sort of arrangement. What TOPS then does is successively overlay "constraints" that preclude certain combinations (for various reasons noted below). These constraints are introduced by the decision maker in the *Position, Team, and Decision Modules*. The position prerequisites stored in the *Position Module* work as constraints that eliminate some of the solutions from the fully unconstrained possibilities, because a potential team member may fail to possess a prerequisite for the position to which he or she is assigned.

Further constraints are introduced in the *Team Module*. The *Team Module* features team summary indices and relative scores at the team-level of analysis as derived from individual team members' attributes. The module includes aggregate prerequisites that are not associated with any specific position (e.g., the team must have a representative from each of "X" countries or functional units, or two or more members must possess fluency in a particular language). In other words, of the viable solutions that surpass the position prerequisites, some will be eliminated because they fail to surpass the team level prerequisites. Therefore, from the theoretical baseline, a limited number of potential solutions will surpass the constraints that are imposed at the position and team levels.

After the candidate data are compared against the position and team prerequisites to determine all feasible member combinations (i.e., solutions), the algorithm calculates relative fit indices, or a Predicted Effectiveness Index (PEI), based on position- and team-level attributes. A separate Team PEI is calculated based on the team attributes. Each of these indices represents a weighted composite of the relevant attributes. The TOPS algorithm combines weighted Position PEI and Team PEI scores to yield an overall TOPS PEI for each potential team composition solution. This PEI, then, represents the predicted effectiveness of each combination of members and is presented to decision makers in a *Team Composition Solution Module*.

Notably, after the TOPS system is customized and populated for a particular domain and decision type, the decision maker (e.g., team leader, commander) will work with the TOPS *Decision Module* first to confirm or modify underlying assumptions and establish certain boundary conditions for their current staffing decision. For example, the decision maker might specify that certain candidates should not be placed on a team together. The boundary conditions and assumptions introduced by the decision maker act as constraints over the fully unconstrained potential solutions. The least constrained *Decision Module* would be a full-scale organization reconfiguration solution (see the Team Staffing Taxonomy) where all candidates could be potential members of any team. Therefore, few combinations would be precluded from the onset. On the other extreme, the most highly constrained situation is the case of looking to replace a single position in a single team. In this instance, the only viable solutions from the fully unconstrained environment that are maintained for consideration, are those that depict the remaining members of the specific given team in their respective positions. In short, this reduces to a traditional selection decision, but now with the additional weightings and considerations that are depicted in the team and linkage modules.

In practice, the generic fully unconstrained TOPS algorithm will be built in and function as the underlying engine to the TOPS system. For a given team composition decision application, a set of constraints is introduced to the system by the decision maker via the position and team modules. The algorithm compares the candidate data against the position and team prerequisites (specified in their respective modules) to determine all potential member combinations (i.e., solutions) for the decision that the user specified. Each of these potential solutions is then weighted by the parameters of the position, team, and linking modules to yield the TOPS PEI for each combination. These TOPS PEI values, which represent the primary team composition solution results, are presented for the user in the *Team Composition Solution Module*. This module will include additional features and summary information, such as the ability to rank order composition solutions, bracket comparable solutions, and drill down to highlight the details of each solution.

The *Team Composition Solution Module* will work in conjunction with the *Decision Module* such that users could return to the *Decision Module* and change their specified conditions and constraints to explore alternative scenarios (e.g., Jim should not be on the same team as Jeff, locking Sue into a specific position). For example, it is possible the initially specified constraints eliminated all potential solutions. It is also possible the decision maker could receive new information about one or more candidates that was not initially considered by the system (e.g., candidates suggested as part of the optimal team within the *Team Composition Solution Module* are not available). Or, the decision maker may want to examine the PEI of a team that did not include candidates or combinations of candidates listed in the initially generated team solutions. Accordingly, the decision maker will be able to examine and modify any initial assumptions or conditions in the *Decision Module* and produce new TOPS PEI results. By relaxing or adding such constraints and re-executing TOPS, the decision maker can explore alternative solutions to the team composition decision.

TOPS Demonstration. Following the development of the TOPS conceptual framework and algorithm, we developed a simple TOPS demonstration for making a single member replacement decision within a specific domain. Specifically, the demonstration, based on fictitious data, depicted how a decision maker within the Special Forces community could use TOPS to guide him in filling a vacant Commander position on an existing Special Forces team. This illustrated how a decision maker could use TOPS within a specific team staffing scenario as well as the technical feasibility of the TOPS concept for a realistic staffing decision. The TOPS demonstration also showed how the candidate with the best fit for the individual position (i.e., the candidate with the highest Position PEI), who would be selected for the team under a traditional HR selection approach, might not result in the most effective team (as depicted by the TOPS PEI). This illustrates the algorithm's ability to help a decision maker balance the competing demands of the individual position and the team, thereby offering the greatest combined value of the replacement.

In sum, the TOPS algorithm and framework are generic in that they will be applicable for aiding a wide variety of staffing decisions from identifying a single team member's replacement, to forming multiple new teams. Although the algorithm and system framework are generic, the specific attributes, weights, and linking function are customizable to fit a specific application. The scalability of these elements also allows users within complex and dynamic environments, such as those within the military, to easily adjust the system to reflect fluctuations in the team composition situation (e.g., changes in candidate pools, team members, pre-requisites, situational changes over time). In operation, each TOPS application will consist of a number of interdependent modules, which together provide a user-friendly software application that accomplishes several objectives as depicted in Figure 5. Four of these modules must be pre-populated with foundational information before the system is ready for use by the decision maker. This customized information will then guide the application of the underlying elements of the algorithm as the decision maker interacts with TOPS to examine potential team staffing (composition) options.

The Future of TOPS: TOPS Lite

The aforementioned TOPS framework represents a “full scale” version of TOPS that features customization to the specific team composition user domain. While this full scale version of TOPS accounts for a great deal of the decision space in optimizing team composition, it requires the user to access and input a substantial amount of data specific to the composition decision and candidates. In the future, it is possible that a scaled down version of TOPS (“TOPS Lite”) will be developed. TOPS Lite would require less user data and customization to set up and run. It would meet usability requirements of many organizations that do not have access to or the resources to generate the domain or candidate specific data that would be required to customize the full version of TOPS. TOPS Lite would still include a small set of required data fields (e.g., number of roles on the team, number of people needed in each role) to run. However, many other data fields (e.g., attribute weights) would be optional for the user. While TOPS Light might include the same modules as a full TOPS system, it would have more boundaries than a full TOPS. For example, there might be limits on the number of roles or candidates and it might be a system that is programmed to solve only one type of team composition decision (e.g., single team formation). These boundaries would enhance the efficiency of the TOPS algorithm and system.

In practice, a leader (or some other decision maker) faced with a specific team composition scenario (e.g., “I need to form a new team composed of 9 people from a pool of 45 candidates) would open TOPS Lite and arrive at a main page. The main page would hold a short list of menu options (Describe Team Roles, Confirm/Modify Requirements, List Potential Team Members/Candidates, Enter Candidate Information, Run Analysis/Review Results) which correspond with many of the modules described previously. The leader would use this menu to navigate through the various steps of customizing and populating the system. At each step, the leader would enter the required information and decide whether to enter any “optional” information. Once the leader has entered all of the required information and any optional information relevant to the decision requirements, team, and candidates, the leader will run the analysis and review the results. It is expected after all data are entered and assumptions are set (or changed), it should take about 60 seconds or less to run the analysis.

The results would present one or more team composition solutions, which would represent the most optimal teams in terms of team effectiveness. If the leader is not satisfied with the suggested solution, the leader would have the option to adjust the requirements or assumptions he entered into the system initially. For example, the leader could lock certain individuals into specific roles and/or reduce the number of people who need a specific qualification. After making these adjustments the leader could then re-run the program to generate a new set of team composition solutions. The system would also incorporate embedded tips and help that would provide the user with instructions, tips, and examples.

In sum, relative to the full version of TOPS, TOPS Lite would be a more manageable tool with greater likelihood of use. It would work much like a full TOPS system, but would be programmed for working a specific type of team composition decision and would require less data from the user. Whether the full TOPS system or TOPS Lite would be best for a given organization would depend on its team composition needs (e.g., Does it need to make multiple types of team composition decisions or does it primarily make one type of decision?) and its willingness and ability to gather and input team and candidate data.

Anticipated Applications and Benefits for Government and/or Private Sector

The interviews with leaders in the private and government sectors indicated that organizations increasingly rely both on permanent teams with regularly changing personnel, as well as temporary teams that must be staffed quickly to meet mission objectives. Virtually all of the 17 organizations interviewed face team staffing challenges similar to those that would be addressed by the TOPS system. Leaders in these organizations need to juggle individual competencies and team needs, and make quick, effective team staffing decisions. They often do this based on instinct or by selecting the person they think has the best individual competencies to fill a position, with little or no consideration of team needs, interdependencies, or dynamics. While some leaders appear to staff their teams effectively, many struggle with this task. Hence, there is clearly a need for tools or decision aids to help leaders make informed and effective team staffing decisions.

Although the team composition literature has recently begun to explore the characteristics team staffing decision makers consider, and has discussed potential methods for indexing team composition, a gap between the team composition theory and an understanding of real team composition scenarios has limited the application of team composition optimization strategies in organizations. An important contribution of the team staffing SME interviews and taxonomic work is that it began to bridge the gap between team composition optimization theory and the current state of team staffing practices and needs. For example, the team staffing interviews revealed the team composition decision models and strategies used by those who are regarded as experts in making team staffing decisions. The majority of the team staffing experts interviewed identified factors they consider when making team staffing decisions and processes or techniques they employ to help them balance individual position requirements with the needs of the team. The information gathered during these interviews grounded the team composition decision taxonomy, which highlights elements leaders should consider when making team staffing decisions. Therefore, an immediate benefit of this taxonomy is that it can guide leaders as they make decisions that impact the composition of their teams. As a more long-term benefit, researchers can draw from the taxonomy to ensure the future team composition decision making algorithms and tools (those developed for TOPS or other team composition applications) are grounded in actual team staffing needs and experiences.

This work also resulted in a generic team composition algorithm designed to assist commanders in filling a vacant position on an intact team. The design of this algorithm advances the application of team composition research in that it represents a more flexible method to index and study the influences of members' KSAOs to the collective competencies of teams. The particular strengths of this approach are: 1) a recognition that team performance is a joint function of members' individual job performances and their contributions to combined team activities; 2) incorporation of the relative interdependencies of members' individual job performances in a network fashion; and 3) a differentiation of members' job versus team related KSAOs. Although the structure of this algorithm is generic, it is applicable for aiding a wide variety of staffing decisions from identifying an individual team member's replacement (as shown in the prototype illustration), to optimizing large scale force deployment. Specifically, the specific attributes, weights, and linking function would be customizable to fit a specific application. Therefore, the algorithm has potential to provide valuable insights if it is customized for particular domains and situations.

A final contribution of this work is the TOPS system framework and user methodology. Outlining how a team optimization system, including the information captured within the interlinking TOPS modules, might work in practice is beneficial in that it articulates how a team optimization algorithm could be applied to help commanders work through real team staffing scenarios. With an enhanced understanding of how a team composition algorithm can be applied, the stage has been set for researchers to move onto: 1) refining and validating the elements of algorithms that model relationships of team composition with team effectiveness, and 2) building prototype team optimization decision support tools.

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Appendix A

Team Staffing Expert Interview Protocol

Interview and Demographic Information

Interviewer Name: ______________________________ Date: ______________________________

SME Name: __________________________________ Organization: _________________________________

Position/Title: _____________________________ Years in Position: ________ Years staffing teams: ________

Type of team(s) staffed (pull from answer to question #1): ____

Opening Comments

- Introduce yourself

- I am talking with you today because you were recommended as a team staffing expert. As part of a research and development effort supported by the US Army Research Institute, The Group for Organizational Effectiveness, Inc. is conducting interviews with team staffing experts. The purpose of the interviews is to gather insights from experts in team staffing. In other words, we would like to uncover what you, as a team staffing expert, think about and the decision processes you go through when you staff a team.

- During the next 30 minutes or so, I will ask you questions about your own experiences staffing teams. For example, we'll focus on:

  - The types of decisions you make
  - Previous experiences you've had in staffing teams
  - Some of your reasoning in staffing teams the way you do

.

- I will be taking notes throughout the interview. It would be helpful if we were able to use some of your comments or quotes in our report. If at any time, you mention something you'd rather not be attributed to you, just let me know and I'll make note that it is "off the record." Our summarized results will be reported to the Army Research Institute, and will be used to influence future team composition research and development.
- Before we begin, do you have any questions?

Demographic Verification

I'd like to begin by collecting some basic background information from you. *[Go through items in the Interview and Demographic Information section, verify any information you already have, and fill in any blanks]*.

Definition of Team Staffing

I'd like to begin by clarifying what we mean by "team staffing." Team staffing involves placing one or more people into a team of individuals who perform interdependent tasks. As you know, it is a decision that influences the composition of the team and potential team performance.

Interview Questions

1. Teams can be categorized into different types, based mainly on the kind of work they perform. I'd like to get a general idea about the types of teams you typically staff. It seems like you normally staff teams that _______________ [*describe a team type using the Sundstrom descriptions*]. Is this correct? If not, what kinds of teams do you usually staff? *[May need to describe other types]*

2. What type(s) of staffing decisions have you had to make in your career? *[Use the probes below if needed]*
    - Filling one position on a team?
    - Staffing a team from scratch?
    - Picking individuals for a team from a pool of individuals? Making subgroups from a larger pool?
    - No flexibility with who is placed on a team, but some control over role/task assignment?

3. Think about a particular situation where you needed to make a decision that influenced a team's composition (e.g., you needed to fill in a single position, multiple positions). *[cycle through two situations if possible...try to get two different kinds of decisions, if possible]*
    - Please describe the situation.
    - What process did you use in making your decision(s)? Did you make the decision yourself or were others involved (e.g., current team members)? Is this how you typically make staffing decisions?
    - What factors influenced, or were important to, your decision? What were the three most influential factors you considered? Could you rank order these factors according to importance?
    - What information about the individual(s) (e.g., performance info, career preferences, location), if any, did you consider? Does your organization track or otherwise make such information available to you?
    - Did you consider existing characteristics of the team (e.g., composition/capabilities of current team, ability to cover/back-up, function/demographic diversity) when making such decisions?
    - Looking back, what information do you wish you had that was unavailable at the time?
    - Were there any obstacles or challenges (within or outside of your control) in making your decision(s)? If so, what were they? How did you overcome them?

4. How do you know when you've put together a good team? What are the signs?
    - Do you follow-up on your staffing decisions? Formally? Informally?

5. Have you ever had an experience where:

    A. Each team member was good at their individual job but the team as a whole struggled? Why do you think the team struggled?

    B. More than one candidate was highly qualified for a single position on a team? What was the deciding factor in choosing a particular candidate?

    C. You decided ***not*** to pursue or choose a person who might have had the best individual qualifications for an opening on the team? If so, why? (e.g., wanted to provide the person with a developmental opportunity; highly qualified for position, but not a team player; neurotic; diversity needs; best qualified person can't work with someone else on the team)

6. If you had a magic wand (e.g., limitless resources/information, no constraints) and could form a team from scratch, what three specific factors would you focus on to guide you in your decision? [get them to be specific – so if they say "individual information" – ask *what* individual information]

Conclusion

Thank you for your participation in this interview. Would you like us to send you a copy of the summarized interview results that will be developed at the conclusion of all interviews? If so, where should we send this report?

Contact information: ____

Thank you for participating in this interview!