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A Theoretical Manpower Optimization Model for the Air Force Installation Contracting Agency (AFICA)

December 2017

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ABSTRACT

This project examined the potential impact of process savings achieved through strategically sourced contracts on the Air Force Installation Contracting Agency's (AFICA) manpower. The project leveraged AFICA's contract man-hour data to make logical inferences concerning the transaction costs of various strategically sourced contracts. The information derived from the transaction cost analysis was used to construct a theoretical linear program (LP) to optimize manpower with respect to man-hour savings achieved through strategically sourced contracts. The optimized manpower solution provides a theoretical framework to identify manpower savings that may be used to address AFICA mission objectives.

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LIST OF ACRONYMS AND ABBREVIATIONS

5RMS	Fifth Manpower Readiness Squadron
A1C	Airman First Class
A&E	Architecture and Engineering
AFICA	Air Force Installation Contracting Agency
AFIMSC	Air Force Installation Mission and Support Center
AFMS	Air Force Manpower Standard
AFPC	Air Force’s Personnel Center
AFWay	Air Force Way
ASP	Acquisition Strategy Panel
BPA	Blanket Purchase Agreement
Capt	Captain
CLASS	Clinical Acquisition for Support Services
CMLC	Category Management Leadership Council
CMSgt	Chief Master Sergeant
CO	Contracting Officer
CONS	Contracting Squadron
DO	Delivery Order
ESS	Enterprise Sourcing Squadron
FAC	Functional Accounting Code
FAR	Federal Acquisition Regulation
FPDS-NG	Federal Procurement Data System-Next Generation
FSS	Federal Supply Schedule
FSSI	Federal Strategic Sourcing Initiative
FY	Fiscal Year
GAO	Government Accountability Office
GPC	Government Purchase Card
GPO	Group Purchasing Organization
GSA	Government Services Administration
IDIQ	Indefinite-delivery/Indefinite-quantity
LP	Linear Program
Lt	Lieutenant

MAF	Man-hour Availability Factor
Maj	Major
MAJCOM	Major Command
MIRT	Multi-functional Independent Review Team
MSgt	Master Sergeant
OA	Operational Audit
OC	Operational Contracting
OLF	Overload Factor
OMB	Office of Management and Budget
OPM	Office of Personnel Management
PCS	Permanent Change of Station
PO	Purchase Order
PWS	Performance Work Statement
SAT	Simplified Acquisition Threshold
SrA	Senior Airman
SCONS	Specialized Contracting Squadron
SMSgt	Senior Master Sergeant
SSgt	Staff Sergeant
TCO	Total Cost of Ownership
TSgt	Technical Sergeant
TO	Task Order
USAF	United States Air Force
UTC	Unit Type Code

I. INTRODUCTION

The aim of this project is to develop a theoretical framework to explore how process savings generated by strategically sourced contracts may be leveraged by AFICA to optimize manpower at the operational contracting squadron (CONS) level. In the following paragraphs, the project objective is defined, a brief background of process savings in Air Force Installation Contracting Agency (AFICA) is provided, the scope of the research is defined, and the research question is posed.

A. PROJECT OBJECTIVE

The objective of this project is to develop a theoretical model to optimize manpower in order to process savings achieved through strategically sourced contracts. Specifically, this project leveraged AFICA's contract man-hour data to make logical inferences concerning the transaction costs of various strategically sourced contracts. The information derived from the transaction cost analysis was used to construct a linear program (LP) to optimize manpower with respect to process savings achieved through strategically sourced contracts. The optimized manpower solution derived from the LP provides a theoretical framework for AFICA to identify manpower savings that may be used to address other mission objectives.

Although the manpower outputs of the model suggest that AFICA may be able to leverage process savings by reducing manpower, the goal of this project is to provide a theoretical basis for identifying manpower savings that may be used to address other mission objectives. By leveraging manpower savings, this project argues that AFICA may be able to meet more mission needs without adversely affecting the mission of operational CONSs.

B. BACKGROUND

AFICA is responsible for improving operational contracting efficiency by capitalizing on strategic sourcing opportunities "while reducing the resources required for support and execution" (Muir, Keller, & Knight, 2014, p. 15). Strategically sourced contracts help achieve procurement efficiencies by reducing manpower inputs (Anderson & Woolley, 2002 p. 66), streamlining procurement processes, and rationalizing the government's supply base (Lieberman, Collins, Issa, & Cummings, 2012, p. 5). Although the concept of improving efficiency is central to AFICA's core function, there is little guidance concerning actionable steps for managing manpower savings achieved through procurement efficiencies. For example, AFICA (2017) established a means for quantifying process savings; however, it does not appear that AFICA has an established policy for leveraging manpower savings beyond the operational CONS level. AFICA may benefit from internal manpower optimizations that provide a top-down perspective on which units may have excess contracting capacity to accomplish more work.

This project aims to bridge the gap between federal directives to achieve procurement efficiencies and agency-wide efforts to leverage procurement efficiencies to optimize the contracting workforce. The ongoing effort to quantify and leverage procurement efficiencies is a priority for AFICA. This project is a collaborative effort with AFICA to research frameworks to quantify and leverage procurement efficiencies achieved through AFICA's strategically sourced contracts.

C. SCOPE

The findings and the theoretical manpower model proposed by this project are applicable to all AFICA operational CONSs at or below the wing. The findings and the model proposed by this project are not applicable to enterprise sourcing squadrons (ESSs) or specialized contracting squadrons (SCONSs). Although ESSs and SCONSs are manpower-driven organizations, manpower for ESSs and SCONSs is typically dictated by factors such as policy development and enterprise-wide market intelligence. The theoretical manpower model proposed by this project optimizes manpower in respect to contracting production. Consequently, the model cannot assess the manpower needs of an ESS or a SCONS.

Although the results of the model are based on AFICA-specific data, the general optimization framework is externally valid to any federal agency with contracting units using strategically sourced contracts. This project is an extension of the 2014 Operational Contracting (OC) 12A000 Air Force Manpower Standard (AFMS) study (Carter, 2014). The scope of this project conforms to the 2014 OC AFMS study conducted by the Fifth Manpower Readiness Squadron (5MRS; Carter, 2014).

The manpower optimization model proposed by this project is theoretical in nature and is not designed to aid leadership in making strategic manpower decisions. Rather, the model provides a theoretical framework to analyze the potential benefits of process savings on AFICA's manpower.

D. RESEARCH QUESTION

This project is designed to explore one central question: how can AFICA leverage process savings achieved through strategically sourced contracts to identify manpower savings that may be used to address other mission objectives? The objective of the proposed manpower optimization model is to provide a theoretical framework for AFICA to identify manpower savings that may be used to accomplish other mission objectives.

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II. LITERATURE REVIEW

In order to develop a theoretical manpower optimization model that leverages process savings achieved through strategically sourced contracts, this project reviewed scholarly research pertaining to (1) AFICA's definition of procurement efficiency, (2) the implications of category management and strategic sourcing to process savings, (3) how industry leverages process savings, (4) how federal contracting leverages process savings, (5) the implications of learning curve theory to AFICA process savings, (6) the implications of best-in-class acquisition practices to AFICA process savings, (7) the implications of transaction cost theory to process savings, (8) the Air Force's Personnel Center's (AFPC's) policy for manpower determinations, (9) the 2014 OC AFMS, (10) AFICA's preliminary Transaction Cost Schedule, (11) AFICA's preliminary Transaction Cost Comparison Table, and (12) optimizing manpower using a LP. The manpower optimization model coalesces the major concepts in the literature review to develop a theoretical framework for converting process savings into manpower savings.

A. AFICA'S DEFINITION OF CONTRACTING EFFICIENCY

For the purposes of this project, procurement efficiencies refer to any process or demand savings which directly or indirectly reduce the man-hour burden for operational CONSs. Below is a brief explanation of how AFICA analyzes procurement efficiencies, and how these efficiencies are directly or indirectly related to man-hour demand at the operational CONS level.

AFICA measures procurement efficiency through process, demand, and rate savings (Q. M. Hearns, personal communication, August 31, 2017). Process savings "reduce operational redundancy" (Air Force Installation and Mission Support Center [AFIMSC], 2017, p. 8) by improving ordering efficiencies, standardizing requirements, and reducing the number of transactions. Demand savings "maximize the mission return of each AF dollar invested" (AFIMSC, 2017, p. 8) by controlling requirement demand, reducing consumption, and changing the product mix. Rate savings optimize program costs through price reductions, discounts, and rebates (AFIMSC, 2017).

Although AFICA measures procurement efficiencies through process, demand, and rate savings, only process and demand savings provide a clear connection to man-hour savings. For example, streamlined procurement processes should theoretically reduce the contracting man-hours necessary to execute an award. Additionally, the elimination of redundant contracts should also reduce the associated man-hour demand. Lastly, controlling consumption through demand management may result in fewer contract actions and the associated man-hour requirements. Although rate savings may result in lower program costs, reduced prices may not translate to a lower man-hour demand at the operational CONS level. While many procurement efficiencies are achieved by contracting functions (e.g., streamlined ordering processes for strategically sourced contracts), other procurement efficiencies, such as demand savings, are primarily attributable to consumption modifications made by requirement owners.

Many corporations and federal agencies do not categorize procurement efficiencies within the context of process, demand, and rate savings. However, corporations and federal agencies generally ascribe to AFICA's definition of process and demand savings. For example, the Office of Management and Budget (OMB; 2015) describes process savings in terms of acquisition process improvements achieved through best-in-class acquisition practices. Additionally, the OMB (2015) describes contracting efficiency in terms of total contract reductions (demand savings). The Unilever Corporation described procurement efficiency in terms of cost savings achieved by streamlining purchasing functions (process savings), controlling consumption (demand savings), and workforce reductions (Anderson & Woolley, 2002). Regardless of the terminology, all procurement efficiencies described in this project imply a direct or indirect reduction in operational contracting man-hour demand.

B. THE IMPLICATIONS OF CATEGORY MANAGEMENT AND STRATEGIC SOURCING TO PROCESS SAVINGS

Category management and strategic sourcing are the primary business approaches that AFICA uses to promote process savings at the enterprise and operational CONS level. The following paragraphs contain a discussion on (1) the evolution and definition of category management and strategic sourcing and (2) how each approach is used to promote process savings in AFICA.

The OMB (2015) defines strategic sourcing as “the establishment or modification of acquisition vehicles to better address Federal Government procurement needs and/or more effectively leverage spend, market position, market knowledge (e.g., price benchmarks), and capabilities (e.g., IT integration) in contract terms and conditions” (p. 30). In short, strategic sourcing aims to achieve lower total cost of ownership (TCO) by identifying common sources of spend across the enterprise and capturing economies of scale and process savings by establishing contracts with vendors. Although strategic sourcing provides a viable way to reduce TCO, strategic sourcing cannot adequately address non-contractual savings, such as enterprise-wide consumption control and requirement standardization.

To address these deficiencies, federal and agency-level category management teams were developed to maximize TCO savings. The OMB (2015) defines category management as a structured approach aimed at defining common, enterprise-wide products and services in order “to buy smarter and more like a single enterprise” (p. 9). Unlike strategic sourcing, category management also considers “a broader set of strategies to drive performance, like developing common standards in practices and contracts, driving greater transparency in acquisition performance, improving data analysis, and more frequently using private sector (as well as government) best practices” (Rung, 2014, p. 2). In order to holistically address TCO savings, each category is led by an experienced subject matter expert capable of developing enterprise-wide strategies to drive performance and TCO savings (Rung, 2014). Strategic sourcing is one of many tools a category manager may use to achieve TCO savings.

Although category management effectively addresses enterprise-wide process savings, these process savings may be difficult to quantify at the operational CONS level because the process savings are not clearly traceable to a contract action. For example, to augment the market intelligence of category teams, the Government Services Administration (GSA) launched the web-based Acquisition Gateway (OMB, 2015). Although the Acquisition Gateway may be having significant impacts on improving process savings (e.g., expediting market research), these savings are generally not discernable at the operational CONS level.

Conversely, strategically sourced contracts provide a more tangible basis for analyzing process savings because strategically sourced contracts can be compared to the process cost of a comparable open-market contract (i.e., man-hour cost of an open-market contract versus a strategically sourced contract). Additionally, process savings achieved through category management are often manifested in strategically sourced contracts. For example, a category manager's decision to standardize a requirement may be manifested in the performance work statement (PWS) of the strategically sourced contract. For the purposes of the project, only process savings attributable to strategically sourced contracts were analyzed.

C. HOW INDUSTRY LEVERAGES PROCESS SAVINGS

In the procurement and supply management fields, strategic sourcing is one of the most prominent methods used by organizations to achieve process savings (Yagoob & Zuo, 2015). Anderson and Katz (1998) defined strategic sourcing as a systematic framework "to leverage the corporate buy, … minimize linked costs in the supply chain, and maximize the value of goods and services" (p. 1). To achieve these ends, strategic sourcing involves "managing the supply base in an effective manner by identifying and selecting suppliers for strategic long-term partnerships" (Talluri & Narasimhan, 2004, p. 236) that are aligned with a corporation's competitive strategy. In order to execute strategic sourcing, both private and public organizations establish framework agreements with strategic partners and suppliers (Karjalainen, Kemppainen, & van Raaij, 2009). Typically, strategic sourcing is characterized by centralized purchasing and the systematic migration "from numerous individual procurements" to collaborative agreements with strategic suppliers (Government Accountability Office [GAO], 2011, p. 215). As the commercial marketplace continues to become more competitive and dynamic, business leaders are increasingly turning to strategic sourcing to improve efficiencies and reduce costs (Kraljic, 1983).

Business leaders that have led successful strategic sourcing efforts report billions in savings and substantial quality and service improvements (GAO, 2011). Lieberman et al. (2012) reported that companies that used strategic sourcing experienced a 10–20% reduction in total procurement costs and "a more efficient and effective enterprisewide process" (p. 5). Organizations such as the Unilever Corporation leveraged procurement efficiencies achieved through strategic sourcing to save billions of dollars and reduce manpower by approximately 25,000 employees over a five-year period (Anderson & Woolley, 2002, p. 66). The federal government has begun incorporating strategic sourcing principles in hopes of replicating commercial successes (Lieberman et al., 2012).

D. HOW FEDERAL CONTRACTING LEVERAGES PROCESS SAVINGS

Unlike industry, public contracting generally does not leverage process savings to optimize manpower. Although the objective of this project is not to cut contracting manpower (e.g., the Unilever Corporation; Anderson & Woolley, 2002, p. 66), AFICA may be able to leverage process savings achieved through strategically sourced contracts to identify excess manpower that may be used to address other mission objectives. The following paragraphs contain a discussion of federal and AFICA policies pertaining to the importance of achieving procurement efficiencies and the prescribed methods for quantifying and leveraging process savings.

Federal acquisition officials generally agree that achieving procurement efficiencies is important for improving value and reducing costs. The OMB challenged agencies to "make business decisions about acquiring commodities more effectively and efficiently" (Johnson, 2005, p. 1) as part of a commitment to increase value and reduce acquisition costs. Rung (2014) continued the mantra of improving federal procurement efficiency by implementing concepts such as category management to create "a more innovative, efficient, and effective acquisition system" (p. 1). These OMB directives to improve procurement efficiencies resulted in the establishment of the Federal Strategic Sourcing Initiative (FSSI) in 2005 and the Category Management Leadership Council (CMLC) and *Government-Wide Category Management Guidance Document* in 2015 (OMB, 2015). These organizations confront the challenge of improving procurement efficiencies by incorporating practices such as planned demand reduction, strategic sourcing, and best-in-class acquisition practices (OMB, 2015). Additionally, agency-level organizations, such as AFICA, continuously improve efficiencies by capitalizing "on strategic sourcing opportunities at the enterprise and major command levels while reducing the resources required for support and execution" (Muir et al., 2014, p. 15).

Although federal and agency-level policies corroborate the importance of improving procurement efficiencies, there is little guidance for quantifying and leveraging procurement efficiencies to optimize manpower. Federal acquisition officials generally agree that quantifying and leveraging procurement efficiencies is difficult and subjective. Despite appreciable efficiency improvements, the GAO found that agency officials were hesitant to quantify efficiencies achieved through strategic sourcing, such as contract consolidation, administrative savings, and streamlined procurement processes, because the efficiencies were difficult to quantify (Lieberman et al., 2012). The OMB (2015) corroborated the GAO's findings: "While savings is a desired outcome of category management, it is often difficult to quantify. As such, savings data should be focused on areas where specific data is readily available" (p. 33). Due to the difficulties associated with quantifying procurement efficiencies, the OMB (2015) does not appraise contracting efficiencies or administrative savings. The OMB (2015) recognized the shortcomings of the prescribed metrics for contracting efficiency and promised improved reporting and analysis over time.

In addition to the difficulty of quantifying procurement efficiencies, realized procurement efficiencies may have an adverse effect on an organization's budget and manpower. For example, the AFPC may suggest that since AFICA is so efficient, it should require less manpower. However, AFICA may have plans to gainfully employ its excess manpower to meet other mission objectives.

As previously mentioned, AFICA lacks a definitive process for quantifying and leveraging procurement efficiencies to optimize manpower. AFICA (2017) quantifies process savings in terms of (1) man-hour savings achieved by consolidating contracts and (2) man-hour savings achieved through ad-hoc process improvements. AFICA (2017) used the 2014 OC AFMS contract man-hour data as the basis for establishing process savings for consolidating contracts. Although AFICA uniformly quantifies process savings in terms of man-hours, the relative value of a man-hour is unknown. For example, man-hour savings attributable to contract consolidation may be worth more than man-hour savings attributable to process improvements because higher skill-level (and more expensive) labor was previously involved in awarding multiple contracts. Additionally, man-hour savings should be leveraged in some way (e.g., using the excess capacity to address operational CONS or AFICA taskers, training requirements, additional duties, readiness needs, and so forth). A highly efficient CONS may simply have less work to do if wing and readiness requirements are relatively fixed. If AFICA optimized manpower in accordance with achieved process savings, AFICA may be able to use the manpower savings to address other mission objectives.

It is important to note that this project does not presuppose that all operational CONSs are adequately staffed to meet their mission objectives. Anecdotal evidence suggests that some operational CONSs are currently challenged to satisfy wing and readiness requirements given current resourcing. Regardless of the current manning level, internal manpower optimizations that account for potential process savings achieved through strategically sourced contracts provide AFICA with a better assessment of the contracting capacity available at any given operational CONS.

E. THE IMPLICATIONS OF LEARNING CURVE THEORY TO FEDERAL CONTRACTING

Learning curve theory provides a conceptual framework to describe organizational learning within the context of process efficiency. According to Mislick and Nussbaum (2015), empirical research suggests that performance improves with learning achieved through consistent repetition. Quantitatively, learning is expressed by the following relationship: as productivity doubles, the cost of producing a single unit decreases by a constant percentage (Mislick & Nussbaum, 2015). In short, when workers accomplish a task several times, they can complete the same task in a shorter amount of time due to process improvements attributable to learning.

Similarly, contract uniformity achieved by strategic sourcing increases the volume of recurring tasks within a larger process which, in the long-run, reduces the total man-hour demand at the operational CONS level. For a given requirement, strategically sourced contracts bind all operational CONSs, customers, and contractors to a uniform set of contractual terms and conditions. Consequently, contracting officers (COs) and vendors are not perpetually re-learning the contractual intricacies of different contracts across multiple operational CONSs. Government contracting personnel that transition between operational CONSs should presumably be familiar with the form and function of any decentrally executed, strategically sourced contract awarded at any operational CONS. For the purpose of this project, a decentrally executed, strategically sourced contract refers to any operational CONS contract executed against a centrally managed, strategically sourced contract.

Additionally, contractors that previously managed multiple contracts with varying terms and conditions for the same requirement must now only conform to the uniform terms and conditions of the master strategically sourced contract. The implications of AFICA-wide uniformity are reduced complexity and increased learning through repetition and familiarity, which ultimately reduces the man-hour burden of awarding a decentrally executed, strategically sourced contract.

F. THE IMPLICATIONS OF BEST-IN-CLASS ACQUISITION PRACTICES TO FEDERAL CONTRACTING

Best-in-class acquisition practices help achieve contracting efficiencies primarily through data-driven demand management. The OMB (2015) defined demand management as policies that encourage procurement control and compliance through practices such as directing spend through approved acquisition channels in order to eliminate administrative costs associated with unnecessary contracting, business transactions, and logistics costs throughout the supply chain. In practice, the OMB's definition of demand management is closely aligned with AFICA's definition of process savings. For the purposes of establishing a common understanding of the terms, data-driven demand management is henceforth referred to as process savings.

Operationally, best-in-class process savings practices are expressed in strategically sourced contracts through efficient ordering procedures, streamlined PWSs, e-procurement platforms, electronic payment, and so on. This project focused on the potential impact of efficient e-procurement platforms and expanded Government Purchase Card (GPC) purchasing on the process cost of decentrally executed, strategically sourced contracts.

E-procurement generally provides three benefits to an organization's purchasing function: (1) transaction savings (include process savings), (2) increased use of existing strategically sourced contracts, and (3) market transparency (Heywood, Barton, Heywood, 2001). Croom and Brandon-Jones (2005) found that the use of e-procurement platforms in the UK achieved process savings in public contracting (although the process savings were difficult to quantify). Additionally, e-procurement in the UK public sector was an important tool for promoting the use of existing strategically sourced contracts (Croom and Brandon-Jones, 2005). Unlike UK public procurement, many AFICA strategically sourced contracts are not currently leveraging efficient e-procurement platforms (Reese & Pohlman, 2005). GSA's FSSI website suggests that the government is slowly transitioning to streamlined e-procurement sites to facilitate simple and effective decentralized ordering (GSA, n.d.).

GPC use for strategically sourced contracts also provides an efficient purchasing tool for operational CONSs. The GPC Expanded Use Initiative incentivizes warranted COs to make GPC purchases up to $150,000 on pre-priced commodity contracts, Blanket Purchase Agreements (BPAs), and Federal Supply Schedules (FSS; Lyle, 2015). GPC purchases allow COs to circumvent the man-hour intensive contract process for pre-priced commodities. The implication of efficient e-procurement platforms and expanded GPC purchasing on strategically sourced contracts are significant man-hour reductions for operational CONSs. In the long-run, AFICA's strategically sourced services and commodities may be accessible on a centrally managed, e-procurement site that accepts GPC purchases up to (or beyond) the simplified acquisition threshold (SAT). The private sector has employed this practice for many years (Dai & Kauffman, 2000). In the medical community, Group Purchasing Organizations (GPOs) provide simple e-procurement platforms that (in some cases) may eliminate the need for a dedicated CO (Ebert, 2017).

The overarching implication of best-in-class procurement efficiencies is that theoretically, decentrally executed, strategically sourced contracts should incur a lower man-hour cost than an equivalent open-market contract. For example, a decentrally executed, strategically sourced order that leveraged an e-procurement platform and expanded GPC purchasing should require less man-hours than an equivalent open-market order executed against an operational CONS's Indefinite-delivery/Indefinite-quantity (IDIQ) contract. Currently, anecdotal evidence suggests that an open-market order probably shares a similar man-hour cost to an equivalent decentrally executed, strategically sourced order. This may be attributable to a lack of efficient e-procurement platforms and primarily awarding contracts instead of leveraging GPC purchasing. This project assumes that over the long-run, decentrally executed, strategically sourced contracts will achieve appreciable process savings over equivalent open-market contracts.

G. THE IMPLICATIONS OF TRANSACTION COST THEORY IN FEDERAL CONTRACTING

Transaction Cost Theory provides a lens to assess federal contracting efficiencies in terms of costs. Brown and Potoski (2005) defined transaction costs in public contracting as a mechanism to identify "service specific characteristics that affect the efficacy of contracting" by analyzing "the costs of negotiating, implementing, monitoring, and enforcing contracts" (p. 327). Transaction costs in public contracting are dependent on factors such as the labor and time inputs necessary for conducting source selections, contract management, and performance monitoring (Pint & Baldwin, 1997). Contracts with high transaction costs are typically characterized by complexity, requirement ambiguity, and specialized investments (Brown & Potoski, 2005). Conversely, contracts characterized by well-defined requirements typically incur fewer transaction costs (Brown & Potoski, 2005).

Federal policies implicitly corroborate transaction cost theory in federal contracting. The Federal Acquisition Regulations (FAR) and AFICA Mandatory Procedures implicitly demand additional labor and time inputs in the form of research, documentation, and so forth for complex requirements and contract actions that increase the government's risk exposure (e.g., sole source contracts).

Beyond the inherent complexity of a product or service, strategically sourced requirements are more complex because they must account for the needs of the entire enterprise. A strategically sourced contract must adequately address the individual needs of each wing while providing cost, schedule, and performance benefits that exceed what an individual CONS could broker independently. Enterprise-wide complexity is further exacerbated when complexity is primarily driven by regional variables and statutory requirements (e.g., unique wing requirements, small business participation, and so forth). The increased complexity and ambiguity of strategically sourced requirements require more man-hours and higher-level labor inputs which invariably leads to higher transaction costs.

Conversely, decentrally executed, strategically sourced contracts incur substantially lower transaction costs because the master strategically sourced contract defined most of the product, exchange, and governance rules. Consequently, the time and labor inputs and the associated transaction costs for defining the product, exchange, and governance rules for a decentrally executed, strategically sourced contract are significantly lower. Moreover, learning efficiencies and best-in-class process savings reduce the transaction cost of decentrally executed, strategically sourced contracts.

The claim supported by Transaction Cost Theory and federal contracting policies is that factors such as complexity, ambiguity, and risk increase the labor and time inputs necessary to execute a contract. Although contracts are not homogenous products, general transaction cost inferences can be applied to similar requirements (Brown & Potoski, 2005).

H. AFPC'S POLICY FOR MANPOWER DETERMINATION

The following paragraphs contain a discussion of (1) AFPC's manpower policy and (2) the implications of AFPC's manpower policy on operational CONSs.

1. Manpower as a Function of Mission Objectives

AFPC defines a manpower requirement as "the manpower needed to accomplish a job, mission, or program … Manpower is not a program by itself which can be manipulated apart from the program it supports … [manpower] is sized to reflect the minimum essential level to accomplish the required workload" (United States Air Force [USAF], 2014, p. 11). Thus, manpower is strictly a function of an organization's mission. It necessarily follows that manpower that exceeds the minimum requirement for a given mission is slack. Conversely, manpower that does not meet the minimum requirement for a given mission is insufficient.

In order to determine the manpower for an organization, AFPC develops manpower standards. A manpower standard is "the basic tool used to determine the most effective and efficient level of manpower required to support a function. It is a quantitative expression that represents a work center's man-hour requirement in response to varying levels of workload" (USAF, 2014, p. 92). The 2014 OC AFMS contains the manpower standards for an operational CONS (Carter, 2014).

It is important to recognize that a minimum manning requirement does not constitute insufficient manning. Manpower standards include Man-hour Availability Factors (MAFs) and Overload Factors (OLFs) that "account for time away from work center related to leave, medical care, education and training (other than on-the-job training), permanent change of station (PCS), organizational duties, etc." (USAF, 2014, p. 17). Although the manpower standard does not contemplate readiness requirements, other Air Force regulations supplement manpower in accordance to readiness needs (USAF, 2014).

2. Implications of AFPC's Policy

The implication of AFPC's manpower policy is that theoretically, all operational CONSs are appropriately manned in accordance to their mission profile. In actuality, many operational CONSs may be undermanned. This may be due to (1) unfunded manpower requirements or (2) poorly defined manpower standards.

Due to budgetary constraints, AFPC may not allocate the required manpower to an operational CONS. If this is the case, an operational CONS is simply undermanned for its given mission profile. Although operational CONSs often contain unfunded manpower billets, anecdotal evidence suggests that most operational CONS are still capable of meeting mission objectives because (1) wing requirements are being met and (2) personnel working in operational CONSs are generally not working abnormally long hours to satisfy mission requirements. This may not be true for every operational CONS.

It is also possible that manpower standards do not accurately define the labor requirements for a given task. If the manpower standard is inaccurate, an optimized manpower solution will not adequately address the manpower needs of an operational CONS. This project assumes that AFPC's manpower standards are accurate. An empirical study to validate AFPC's manpower standards is beyond the scope of this project.

I. THE 2014 OC AFMS STUDY

In 2014, the 5MRS conducted a manpower study on operational CONSs. The objective of the study was to "develop a manpower standard to be used as a manpower determination and allocation tool" (5MRS, 2014, p. 2) based on historical contracting workloads and labor and time inputs. The study culminated with a manpower workload tool and process flowcharts for AFICA's most common contracts. Absent from the study were process flowcharts and man-hour data for strategically sourced contracts. This omission is particularly notable because AFICA's strategically sourced contracts potentially contain process savings that cannot be leveraged through a manpower allocation tool that does not account for man-hour savings achieved through strategically sourced contracts.

Consequently, the manpower output from the AFMS allocation tool does not leverage process savings achieved through strategically sourced contracts. If AFPC determines manpower in accordance to the minimum manning required to meet mission objectives, it necessarily follows that AFPC's manpower optimization must contain more manpower than an optimized solution that accounts for man-hour reductions for strategically sourced contracts.

J. AFICA'S PRELIMINARY TRANSACTION COST SCHEDULE

AFICA's Transaction Cost Schedule is the agency's preliminary effort to appraise process savings. AFICA's Transaction Cost Schedule used the 2014 OC AFMS to develop a list of common contract categories and their estimated man-hour demand and transaction costs. Refer to Table 1 for AFICA's Transaction Cost Schedule.

Table 1. AFICA's Transaction Cost Schedule. Adapted from C.R. Parson, personal communication (May 22, 2017).

Categories	Man-hours	Rate	Transaction Cost
Commodity	475.1	$ 33.02	$ 15,687.80
Commodity Delivery Order	40.25	$ 33.02	$ 1,329.06
Commodity Purchase Order	35.46	$ 33.02	$ 1,170.89
Service	615.08	$ 33.02	$ 20,309.94
Service Task Order	219.66	$ 33.02	$ 7,253.17
Service Purchase Order (Commercial <$150K)	38.37	$ 33.02	$ 1,266.98
Construction	477.92	$ 33.02	$ 15,780.92
Construction Task Order	86.7	$ 33.02	$ 2,862.83
A&E	449.19	$ 33.02	$ 14,832.25
A&E Task Order	145.42	$ 33.02	$ 4,801.77
Sealed Bid	214.13	$ 33.02	$ 7,070.57
Blanket Purchase Agreement	69.1	$ 33.02	$ 2,281.68
Options	22.34	$ 33.02	$ 737.67

Note. The Transaction Cost Comparison Table (see Appendix A) was developed by C.R. Parson at AFICA. The comparison table is Parson's preliminary effort to appraise procurement efficiencies. This is a draft version.

1. Contract Categories

The 2014 OC AFMS defined the Commodity, Service, Construction, and Architecture and Engineering (A&E) contract categories in accordance to their respective requirement (Carter, 2014). The definition does not presuppose a specific contract type (e.g., firm fixed price), instrument (e.g., IDIQ), or source selection method. These contract categories are representative of large, CONS-level procurement efforts greater than or equal to $150,000 (Carter, 2014, p. 4).

Conversely, the Commodity Delivery Order (DO), Commodity Purchased Order (PO), Service Task Order (TO), Service PO, Construction TO, and A&E TO contract categories are defined by both their requirement and contractual instrument. The Sealed Bid, BPA, and Options contract categories are solely defined by the source selection procedure, agreement type, or special contracting method used.

2. Man-Hours

The 5MRS defined a man-hour as a unit of measuring work that "is equivalent to one person working at a normal pace for 60 minutes, two people working at a normal pace for 30 minutes, or a similar combination of people working at a normal pace for a period of time equal to 60 minutes" (Carter, 2014, p. 13). The 5MRS (2014) determined the man-hours for each contract category by conducting an "operational audit (OA) using historical records and technical estimates" from 17 operational CONS (p. 2).

3. Wage Rate

The wage rate is the weighted average of the fully burdened hourly rate of the personnel mix in Operational Contracting Functional Account Code (FAC) 12A0 (Carter, 2014, p. 15). AFICA determined a wage rate of $33.02 for all contract categories (see Appendix B for AFICA's wage rate calculation).

K. AFICA'S PRELIMINARY TRANSACTION COST COMPARISON TABLE

The Transaction Cost Comparison Table is a simple tool for forecasting appraised transaction cost savings for strategically sourced contracts. The transaction cost of a contract mix is compared to the forecasted transaction cost savings of implementing a new strategically sourced contract. The variance between the two transaction costs represents the estimated appraised transaction cost savings AFICA may achieve if the strategically sourced contract was established and used by operational CONSs (refer to Appendix A for the Transaction Cost Comparison Table). Although AFICA's Transaction Cost Comparison Table generates "cash" outputs, the outputs do not represent real savings. The appraised transaction cost savings are a notional representation of "cash" savings achieved through a strategically sourced contract.

The primary limitations of AFICA's Transaction Cost Comparison Table are (1) a lack of strategically sourced contract categories, (2) inaccurate transaction costs, and (3) nonactionable outputs.

AFICA's Transaction Cost Schedule captures a narrow band of contract categories. The lack of stratification is especially important when analyzing transaction cost differences between contracts executed against a strategically sourced contract category and an open-market contract category. For the purposes of this project, an open-market contract category is a contract category derived directly from the 2014 OC AFMS. All the contract categories listed in AFICA's Transaction Cost Schedule are open-market contract categories. Under the current construct, AFICA is comparing the transaction cost differences between open-market contract categories. Without contract categories capturing the man-hour savings of strategically sourced contracts, AFICA cannot ascertain the true transaction cost savings of its strategically sourced contracts.

The transaction costs listed in AFICA's Transaction Cost Schedule are probably inaccurate due to a misapplication of the wage rate. The wage rate AFICA used is the weighted average of the fully burdened hourly rate of the personnel mix in OC FAC 12A0 (Carter, 2014, p. 15). This weighted average wage rate presupposes that each rank "touches" a contract in proportion to the number of members of their rank in the CONS. However, the AFMS manpower allocation tool allocates manpower on the basis of historical work unit inputs into a given open-market contract category (5MRS, 2014). For example, a complex contract may actually have a higher wage rate because more experienced (and expensive) work units "touch" the contract more than less experienced (and inexpensive) work units.

The 2014 OC AFMS defines a work unit by the individual ranks (e.g., Major [Maj], Senior Airman [SrA]) that comprise a work center (Carter 2014).

Unfortunately, the 2014 OC AFMS does not contain the estimated work unit man-hour demand for each contract category. In the absence of historical work unit data, anecdotal evidence would suggest that large and complex contracts are primarily handled by experienced (and typically more expensive) contracting personnel, while simple contracts are typically executed by less experienced (and less expensive) personnel. This claim is supported by the Operational Contracting Data Questionnaire included in the OC Squadron AFMS Development FAC 12A100: Workload Data Collection Plan (5MRS, 2014). Complex activities such as conducting a Multi-functional Independent Review Team (MIRT) review requires more-experienced work units (e.g., CO and director of business operations), while simpler activities, such as processing an invoice, require less-experienced work units (e.g., contract specialist; 5MRS, 2014). Consequently, the transaction costs of complex contract categories (e.g., service contract) that contain complex activities are likely underestimated, while the transaction costs of presumably simpler categories (e.g., service TO) that contain less complicated activities are overestimated.

Lastly, AFICA's Transaction Cost Comparison Table generates nonactionable outputs. As previously mentioned, the transaction cost savings generated from the Transaction Cost Comparison Table are appraised process savings. Internal manpower optimizations that account for man-hour savings achieved through strategically sourced contracts may reveal manpower savings at the operational CONS level that may be used to meet other mission objectives.

L. OPTIMIZING MANPOWER USING A LP

The following paragraphs contain a discussion on (1) why a LP was used to optimize manpower and (2) the theoretical model's orientation.

1. Why a LP?

A LP is a common mathematical modeling tool used extensively in industry for business optimization. A LP looks at the current state of the system and the overall objective of the system in order to construct "a statement of actions … which will permit the system to move from a given status to a defined objective" (Dantzig, 1963, p. 2). This project used a LP to leverage man-hour savings achieved through AFICA's strategically sourced contracts by optimizing the staffing mix of a typical operational CONS.

2. Model Orientation

The following paragraphs contain a discussion on why a (1) minimization orientation was used and (2) maximization orientation was not used.

a. Minimization Orientation

A minimization objective function minimizes manpower with respect to the mission (i.e., contracting workload). The proposed theoretical model supports this point of view. By definition, "manpower is a limited resource which is sized to reflect the minimum essential level to accomplish the required workload" (USAF, 2014, p. 11). If AFICA believes that manpower is (1) a limited resource and (2) a function of the mission, AFICA should also internally optimize manpower through minimization.

Additionally, a minimization orientation produces outputs in terms of work unit man-hours that can be translated to whole people. An internal minimization objective function that accounts for process savings will reveal manpower savings in terms of man-hours or whole people for each rank. AFICA can clearly identify manpower savings in terms of man-hours or whole people for each rank.

As previously mentioned, AFPC allocates manpower as a function of mission objectives (expressed as contract actions for an operational CONS). If AFICA achieves internal man-hour savings not accounted for by AFPC, internal AFICA optimizations must generate less manpower than AFPC's optimizations. The difference between AFPC's and AFICA's manpower optimizations theoretically provide an opportunity for AFICA to leverage manpower savings to meet other mission objectives. In short, a minimization orientation (1) ensures that mission objectives are met, (2) allows AFICA to leverage internal man-hour savings not accounted for by AFPC, and (3) produces manpower savings in terms of man-hours or whole people. Constraints in a minimization LP must include readiness requirements (as defined by Air Force readiness regulations) and incidental manpower requirements such as breaks, sick days, maternity leave, normal working hours, and so forth.

An operational CONS's mission should also account for its forecasted workload and mission essential slack.

Lastly, a minimization objective function also challenges the organizational tendency to withhold manpower regardless of mission requirements. If an operational CONS is able to meet its mission objectives with its current workforce, simply being able to "produce" more with excess manpower does not necessarily constitute a more effective organization. This is particularly true for operational CONSs because they are support functions that are contingent on wing and readiness requirements. An efficient CONS may simply have less work to do if wing and readiness requirements are relatively fixed. As operational CONSs achieve more process savings, manpower savings at an operational CONS may be used to meet other mission objectives. Operationally, manpower savings may be leveraged by using the excess manpower to accomplish mission related tasks within the CONS, accomplish AFICA taskers, or meet a variety of other mission objectives.

The LP proposed by this project used the framework of the classic production mix problem to optimize manpower (Dantzig, 1963, p. 50). Unlike the classic production mix problem, the proposed LP defines the "production mix" as the manpower mix necessary to execute a given contracting workload. Typically, manpower is expressed as a constraint for optimizing a production mix.

b. Maximization Orientation

An alternative model orientation is to maximize production. A maximization model considers an operational CONS's workforce and maximizes contracting production in terms of contract outputs (i.e., how many commodity contracts, service contracts, etc., can an operational CONS produce?). This orientation decouples mission requirements from manpower. The fundamental question should not be how much contract production can an operational CONS generate but does that production meet wing and readiness requirements? In accordance with AFPC's manpower definition, manpower should be strictly optimized in respect to the wing's requirements, readiness needs, and incidental manpower requirements such as leave and additional duties (USAF, 2014).

A maximization LP may provide a basis to quantify an operational CONS's readiness (e.g., the more a given workforce can produce, the more readiness it may provide). Although contract production may be used as a readiness indicator, "production" (in terms of contract actions) is an abstract way to think about readiness. Air Force readiness requirements are generally described in terms of Unit Type Codes (UTCs) that describe a specific personnel (or asset) capability (USAF, 2001). Combatant commanders do not deploy contract production (i.e., 15 commodity contracts, 20 service contracts, etc.), they deploy UTCs (1 Maj, 3 SSgts, etc.). Contract production must be interpreted to represent things like readiness, quality, etc., to describe the effects on the mission.

Conversely, if readiness is a required mission set of an operational CONS, readiness requirements should be included as a constraint in a minimization model (similar to how AFPC accounts for readiness). This ensures that the right quantity and mix of UTCs are available to meet readiness requirements. Moreover, a minimization model may also buffer against unknown readiness requirements by adding additional constraints to account for deployment surges.

Lastly, a maximization model does not consider slack because it presupposes that personnel is always gainfully employed. It may be the case that an operational CONS with excess capacity is simply less busy. If an operational CONS is capable of exceeding wing and readiness requirements, it may be beneficial for AFICA to consider using the excess capacity to meet other mission objectives (if the excess capacity is not already being used within the CONS).

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III. METHODOLOGY

Chapter III details the methods and processes used to answer the research question posed by the project. Chapter III contains the (1) framework for analysis, (2) the methodology used to develop the Revised Transaction Cost Schedule and theoretical manpower optimization model, and (3) the methodology used to optimize a notional operational CONS.

A. A THEORETICAL FRAMEWORK FOR MANPOWER OPTIMIZATION IN AFICA

The literature review informed the following theoretical framework for manpower optimization in AFICA:

1. AFPC manpower optimizations do not include man-hour savings attributable to strategically sourced contracts. Assume AFICA manpower optimizations include man-hour savings attributable to strategically sourced contracts.

2. If AFPC determines manpower in accordance to the minimum manning required to meet mission objectives, AFPC's optimized manpower level must be more than AFICA's optimized manpower level.

3. If items one and two are true, the implication is that operational CONSs may have excess manpower that may be used to accomplish other mission objectives.

4. As AFICA continues to achieve more man-hour savings through strategically sourced contracts, AFICA may achieve more manpower savings that may be used to accomplish other mission objectives.

To reiterate, this study is interested in exploring one central question: How can AFICA leverage process savings to identify manpower savings that may be used to address other mission objectives?

To achieve this objective, the project segments the research into two distinct phases. Phase I of the project analyzes AFICA's transaction cost data and estimated labor and time inputs to develop a Revised Transaction Cost Schedule and theoretical LP for manpower optimization. Phase I consists of two steps: (1) developing the Revised Transaction Cost Schedule and (2) developing a theoretical LP for manpower optimization.

Phase II of the project used the theoretical LP to demonstrate how AFICA may be able to internally optimize manpower. Phase II consists of three steps: (1) simulating AFPC's manpower optimization for a notional operational CONS, (2) simulating AFICA's internal manpower optimization, and (3) analyzing the manpower variance between the two optimized solutions. The manpower variance between the two optimized solutions is excess manpower that may be used to meet other mission objectives.

B. PHASE I

1. Developing the Revised Transaction Cost Schedule

The Revised Transaction Cost Schedule incorporates the following modifications to AFICA's Transaction Cost Schedule: (1) new strategically sourced contract categories, (2) the corresponding man-hour demand for the new strategically sourced contract categories, and (3) a differentiated wage rate based on contract complexity.

a. Additional Contract Categories

In addition to adding categories for strategically sourced contracts, this project included the "Modification" and "Close-out" Contract Categories contained in the 2014 OC AFMS (Carter, 2014). The inclusion of these categories provides a more holistic analysis of the true transaction costs of executing an operational CONS's workload.

b. Determining the Man-Hour Demand of the Strategically Sourced Contract Categories

To determine the man-hour demand of the new strategically sourced contract categories, the project (1) established a man-hour baseline for the new strategically sourced contract categories and (2) applied a man-hour discount to the new strategically sourced contract categories. In the absence of historical data, the 5MRS (2014) proposed the use of estimates to determine the man-hour demand of a contract. A distinct advantage of this project is the availability of empirically developed man-hour data for open-market contract categories. The man-hour requirements for the new strategically sourced contract categories are derivations from existing open-market man-hour data.

First, the man-hour baselines for the strategically sourced contract categories were established by analyzing comparable open-market contract categories. For example, a decentrally executed, strategically sourced commodity contract is probably most like an open-market DO. If a CO generally follows the same steps for executing each contract, it follows that the man-hour relationship may also have close similarities.

Next, the man-hours of the new strategically sourced contract categories were discounted to account for learning and best-in-class acquisition practices. This project assumes that in the long-run, decentrally executed, strategically sourced contract categories are less man-hour intensive than their comparable open-market contract categories due to best-in-class acquisition practices and enterprise-wide learning (refer to Chapter I). Due to the time and resource limitations of this project, a comprehensive OA based on historical records was not conducted to determine the man-hour requirements of the new strategically sourced contract categories.

c. Developing Differentiated Wage Rates to Determine Transaction Costs

To determine the transaction costs for each contract category, this project established differentiated wage rates based on contract complexity. The transaction cost for each contract category is the product of the contract category's man-hours and its applicable wage rate.

The 5MRS (2014) primarily used "historical records, such as data system reports or queries, electronic file system documentation, or documentation contained in physical records/files" (p. 2) to determine the appropriate work unit mix for a contract category. Due to the resource and time limitations of this project, quantifiable historical data was not collected to develop a work unit mix for each strategically sourced contract category. Despite these limitations, this project used Brown and Potoski's (2015) research on transaction cost theory in public contracting to make logical estimates regarding the transaction costs of different contract categories based on contract complexity. This project assigned work unit man-hour inputs based on the complexity of the contract category. Complex contract categories (i.e., those with more complex activities) required more experienced (and expensive) work units. Conversely, less complex contract categories (i.e., those with less complex activities) used less experienced (and less expensive) work units. The work units were derived from the work centers in the manpower study (Carter, 2014). The transaction cost for each contract category was determined by multiplying the contract category's man-hours by the appropriate wage rate.

d. Limitations of the Revised Transaction Cost Schedule

The primary limitations of the Revised Transaction Cost Schedule were an overreliance on estimates to (1) determine the man-hour requirements for the new strategically sourced contract categories and (2) develop the differentiated wage rates.

The man-hour requirements for the new strategically sourced contract categories were derived using logical inferences from the existing man-hour data contained in the 2014 OC AFMS (Carter, 2014). Consequently, the man-hour requirements for the new strategically sourced contract categories were not independently determined by surveying multiple operational CONSs. It may be possible that this project overestimates or underestimates the man-hour requirements for the new strategically sourced contract categories. For the purposes of establishing a theoretical framework for internal manpower optimization, it is not necessary that the man-hours for the strategically sourced contract categories are accurate.

The work unit man-hour inputs for each contract category were based on the perceived complexity of the category. Although the 5MRS linked complex activities (requiring more expensive work units) with more complex contracts, the actual work unit man-hour inputs for each contract category were not published in the 2014 OC AFMS (Carter, 2014). Consequently, this project may overestimate or underestimate the work unit man-hour inputs for each contract category. For the purposes of establishing a theoretical framework for internal manpower optimization, it is not necessary that the work unit labor inputs for the strategically sourced contract categories are accurate.

2. Developing the Theoretical LP

The objective of the LP is to provide a theoretical framework to optimize manpower with respect to process savings achieved through strategically sourced contracts. The LP is a derivation of the classic production problem. The LP used the data from the Revised Transaction Cost Schedule and the 2014 OC AFMS. Refer to Chapter IV, Section B for the mathematical expression of the LP.

Although the proposed theoretical model is a LP, the relationship between the work unit man-hours for the various contract categories and the workcenter cost is non-linear because the optimized man-hours for each work unit is rounded up to the nearest whole person. Refer to Figure 2 for an illustration of how optimized work unit man-hours are rounded up to nearest whole person.

a. Defining the Problem

The first step of the LP is to define the problem: Given a contracting workload, what is the optimal work unit mix that minimizes cost? This project presupposes that the optimal work unit mix is the least expensive work center that can execute a given contracting workload. Additional work units beyond the optimized work unit mix is considered slack.

b. Defining the Decision Variables

The decision variables represent the work units (expressed in variables) that the LP optimizes. This project used the work unit identified in the 2014 OC AFMS as the decision variables (Carter, 2014). Refer to Table 2 for the work units and their assigned decision variables.

Accurately defining the decision variables is not essential for establishing the theoretical basis for leveraging process savings through internal manpower optimization. Regardless of the decision variables used, internal optimizations that account for man-hour savings should generate less manpower than AFPC's optimizations that do not consider man-hour savings for strategically sourced contracts. An actionable manpower optimization model should consider civilians as well as military members.

Table 2. Operational Contracting FAC 12A0 Work Center Structure with Assigned Decision Variables. Adapted from Carter (2014).

WORKCENTER	
RANK	**DECISION VARIABLES**
Major (Maj)	Let "**A**" equal the number of Maj man-hours
Captain (Capt)	Let "**B**" equal the number of Capt man-hours
Lieutenant (Lt)	Let "**C**" equal the number of Lt man-hours
Chief Master Sergeant (CMSgt)	Let "**D**" equal the number of CMSgt man-hours
Senior Master Sergeant (SMSgt)	Let "**E**" equal the number of SMSgt man-hours
Master Sergeant (MSgt)	Let "**F**" equal the number of MSgt man-hours
Technical Sergeant (TSgt)	Let "**G**" equal the number of TSgt man-hours
Staff Sergeant (SSgt)	Let "**H**" equal the number of SSgt man-hours
Senior Airman (SrA)	Let "**I**" equal the number of SrA man-hours
Airman First Class (A1C)	Let "**J**" equal the number of A1C man-hours

c. Defining the Objective Function

The objective function is the mathematical expression of the stated problem: Given a contracting workload, what is the optimal work unit mix that minimizes cost? The optimal work unit mix is derived from the optimized work unit man-hour solution. Refer to Figure 1 for an illustration of the objective function.

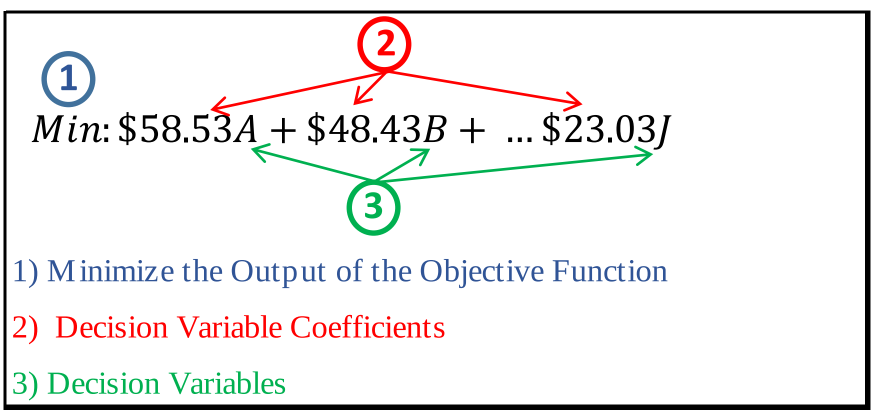


Figure 1. The Objective Function

(1) Minimize the Output of the Objective Function

The goal of the objective function is to minimize the total work center cost while satisfying the manpower requirements of a given contracting workload. The sum product of the objective function represents the least expensive work unit mix necessary to execute a given contracting workload.

(2) Decision Variable Coefficients

The coefficient of each decision variable is the fully burdened hourly wage rate of each work unit. The fully burdened hourly rate of each work unit is contained in AFICA's wage rate calculation (Appendix B).

(3) Converting Man-Hours to Work Units

Each decision variable is expressed in man-hours. Although the problem statement necessitates an integer solution for each decision variable (e.g., 1 Maj, 3 SrA), the LP initially optimizes each decision variable according to man-hours. The integer work unit solution is derived by dividing the optimized work unit man-hours by 1,463.6 work hours. The 1,463.6 contracting work hour standard represents the dedicated contracting production time available to each work unit per year. The 1,463.6 contracting work hour standard was calculated by discounting the 2,087 annual work hour standard by 30% to account for non-contract production time used for mandatory and discretionary activities such as military training, work breaks, physical training, and additional duties.

The Office of Personnel Management (OPM; 2017) defines 2,087 work hours as the annual work hour standard for a federal employee. Although military members are generally not constrained by fixed work hours, the 2014 OC AFMS study presupposes that (on average) "Operational Contracting Squadrons are manned eight hours per day, five days per week, excluding holidays" (5MRS, 2014, p. 7). Refer to Figure 2 for an illustration of how the optimized work unit man-hours are converted to work units.

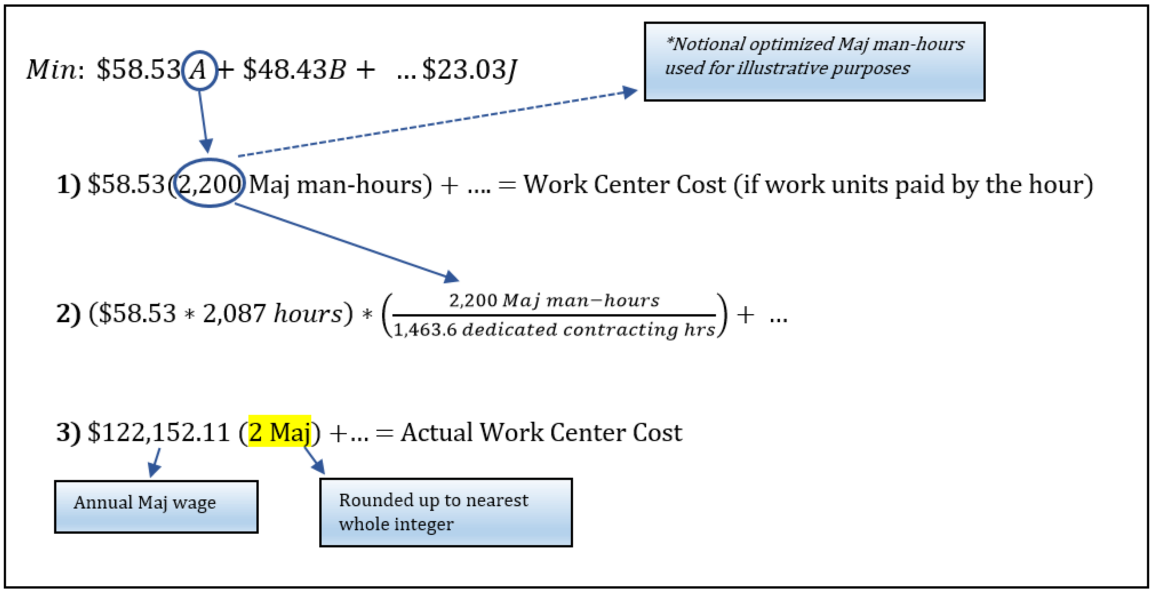
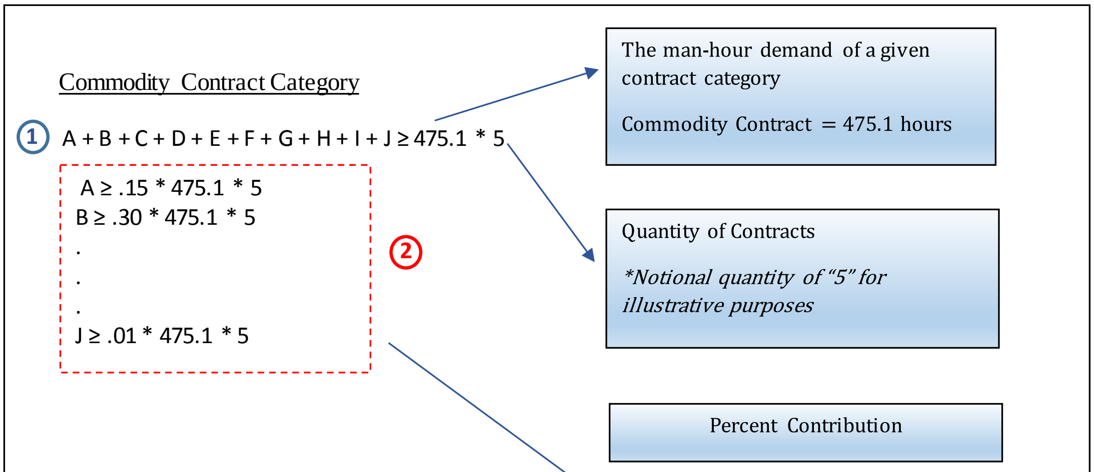


Figure 2. How Work Unit Man-Hours Are Converted to Work Units

d. Defining the Constraints

The constraints provide the basis for the LP to determine how many work units (i.e., Maj, SrA, etc.) are needed to successfully execute a given contracting workload. Each constraint is defined by a contract category. Refer to Figure 3 for an illustration of how a constraint is defined in the LP.



Complex	
MAJ	15.00%
CPT	30.00%
LT	1.00%
CMSGT	1.00%
SMSGT	1.00%
MSGT	27.00%
TSGT	22.00%
SSGT	1.00%
SRA	1.00%
A1C	1.00%

Service,Construction, A&E TO/PO	
MAJ	1.00%
CPT	1.00%
LT	10.00%
CMSGT	1.00%
SMSGT	1.00%
MSGT	10.00%
TSGT	10.00%
SSGT	21.00%
SRA	25.00%
A1C	20.00%

Commodity DO/PO	
MAJ	1.00%
CPT	1.00%
LT	10.00%
CMSGT	1.00%
SMSGT	1.00%
MSGT	5.00%
TSGT	6.00%
SSGT	15.00%
SRA	20.00%
A1C	40.00%

Strategically Sourced	
MAJ	1.00%
CPT	1.00%
LT	10.00%
CMSGT	1.00%
SMSGT	1.00%
MSGT	1.00%
TSGT	5.00%
SSGT	5.00%
SRA	25.00%
A1C	50.00%

Figure 3. The Constraint Structure for Each Contract Category

(1) Total Man-Hour Constraint for a Contract Category

For each contract category, the total work unit man-hours must be greater than or equal to the total man-hour demand of a given contract category. The left-hand side of the constraint is the sum of all work unit man-hours. The right-hand side of the constraint is the total man-hour demand for a given contract category. The total man-hour demand for a given contract category is defined by the product of the man-hour demand of a given contract category and the total quantity of contracts allocated to the contract category. For example, a single commodity contract requires 475.1 man-hours. If the quantity of commodity contracts assumes a value of five, the total work unit man-hours must be greater than or equal to 2,375.5 man-hours.

(2) Individual Work Unit Constraints for a Contract Category

For each contract category, each work unit's man-hours must be greater than or equal to the work unit's man-hour contribution to a given contract category. The left-hand side of the constraint is the work unit's man-hours. The right-hand side of the constraint is the work unit's man-hour contribution for a given contract category. A work unit's man-hour contribution is defined by the product of the work unit's percent contribution, the man-hour demand of a given contract category, and the total quantity of contracts allocated to the contract category. The sum of the individual work unit man-hour contributions must be equal to the product of the man-hour demand of a given contract category and the total quantity of contracts allocated to the contract category.

For example, a commodity contract category requires 475.1 man-hours. If the commodity contract category is considered "complex," the contribution of each work unit is distributed in accordance to the "complex" contribution table depicted in Figure 3. A Maj contributes approximately 92.3 hours (15%), a Capt contributes approximately 184.5 hours (30%), and so on per commodity contract. Each rank's man-hour contribution must be greater than or equal to each respective rank's man-hour requirement for a given quantity of commodity contracts. Refer to Chapter IV, Section A, Subsection d for an analysis of how the percent contribution for each work unit was determined.

(3) Work Units and the "Team Concept"

Each constraint presupposes that each work unit is necessary to execute a contract category regardless of the contract category's complexity. The logical basis for this assumption is that each work unit is co-dependent on all the other work units to execute a contract. For example, a simple contract category may use more inexperienced (and inexpensive) work units and leverage (to a lesser degree) the contracting expertise of more experienced (and expensive) work units. Operationally, this may be expressed when airmen ask their supervisors questions concerning the execution of a simple contract category. Although the more experienced work units may not directly "touch" a contract category, their presence was necessary for contract execution. However, as a percentage of actual man-hour inputs into a simple contract category, the more experienced (and expensive) work units represent a much smaller proportion of the total man-hour requirement of a simple contract category. The application of the work unit man-hour contribution for each constraint captures the "team" dynamic.

e. Limitations of the Theoretical LP

The primary limitations of the theoretical LP are an inability to account for (1) nonproduction-related manpower requirements and (2) civilians. The theoretical LP does not include constraints to account for important manpower factors such as statutory manning requirements and required manpower levels for readiness as defined by the MAF, OLF, and USAF readiness regulations. The theoretical LP exclusively optimizes manpower on the basis of contracting productivity. Despite these limitations, accurately defining the constraints is not essential for establishing the theoretical basis for leveraging process savings through internal manpower optimization. At a minimum, the constraints must capture notional man-hour savings for strategically sourced contract categories.

The theoretical model does not contain decision variables for civilians. An actionable model must account for civilians because they are an integral part of the operation of a typical operational CONS. However, including civilians in this theoretical model is immaterial to demonstrate how process savings may impact manpower at the operational CONS level.

As previously mentioned, the theoretical LP is not meant to replace the manpower allocation tool developed by the 5MRS. The theoretical LP provides a rudimentary tool to mathematically test the manpower implications of leveraging process savings achieved through strategically sourced contracts. Additional studies are required to determine the actual man-hour demand of strategically sourced contracts.

C. PHASE II

The goal of Phase II is to demonstrate how AFICA may identify excess manpower that may be used to address other mission objectives. To achieve this objective, stylized contract data loosely built from the 28 CONS's fiscal year (FY) 2016 contract portfolio was used to optimize manpower with respect to man-hour savings achieved through strategically sourced contracts. The 28 CONS contract portfolio provided the allocation basis for determining how many contracts should be allocated to each contract category for the notional operational CONS.

For purposes of simulating manpower savings, accurate contract data is not necessary. Each operational CONS has a unique contract workload that may be optimized at the CONS level to determine optimal manning. At a minimum, the stylized data should represent a probable distribution of contract categories for an operational CONS.

1. Simulating AFPC's Manpower Optimization for a Notional Operational CONS

The purpose of this step is to simulate how the AFPC would presently assign contract actions. Regardless of how many strategically sourced contract actions a given CONS executes in a FY, the AFMS manpower allocation tool cannot account for man-hour savings achieved through strategically sourced contracts because the allocation tool does not presently account for strategically sourced contract categories.

After assigning the contract actions to the appropriate open-market contract categories, the theoretical LP was used to optimize manpower. The optimized manpower solution represents an approximation of the manpower output generated by AFPC.

2. Simulating AFICA's Internal Manpower Optimization

In order to determine the optimal manpower mix of an operational CONS that uses strategically sourced contracts, the contract data for the notional operational CONS was assigned open-market and strategically sourced contract categories contained in the Revised Transaction Cost Schedule. The purpose of this step is to simulate how AFICA may internally optimize manpower to account for process savings achieved through strategically sourced contracts. The FY2016 28 CONS contract data was used as the allocation basis for assigning strategically sourced contract categories.

After assigning the contract actions to the appropriate open-market and strategically sourced contract categories, the LP was used to optimize manpower. The optimized manpower solution represents manpower savings that may be achieved by leveraging man-hour savings generated by strategically sourced contracts.

3. Analyzing the Variance between the Two Optimized Manpower Solutions

The variance between the two optimized manpower solutions is the manpower savings AFICA may achieve if AFPC actually funded all manpower billets. Even if there is no opportunity to leverage excess contracting capacity, at a minimum, the internal optimization provides a better representation of an operational CONS's contracting capacity because it accounts for process savings achieved through strategically sourced contracts. Refer to Table 3 for the Manpower Variance Table.

Table 3. Comparative Manpower Analysis Table

		MAJ	CAPT	LT	CMSGT	SMSGT	MSGT	TSGT	SSGT	SRA	A1C	
Optimized Manpower (No Strategic Source Spend)	Optimized Man-Hours	1500	3000	3000	200	200	4200	4200	4200	4200	4200	Work Center Cost per FY *(if work units paid by the hour)*
	Fully Burdened Rate per Hour	$58.53	$48.42	$35.74	$50.82	$50.82	$42.68	$38.19	$33.33	$28.28	$23.03	$1,055,802.37
	Optimal Personnel Mix	1	2	1	1	1	3	3	3	3	3	Work Center Cost per FY
	Anuual Wage	$ 122,157.62	$ 101,052.11	$ 74,585.25	$ 106,061.34	$ 106,060.18	$ 89,072.87	$ 79,712.53	$ 69,560.87	$ 59,030.22	$ 48,072.74	**$1,647,316.27**
Optimized Manpower (With Strategic Source Spend)	Optimized Man-Hours	1500	1500	1500	1500	1500	3000	3000	3000	3000	3000	Work Center Cost per FY *(if work units paid by the hour)*
	Fully Burdened Rate per Hour	$58.53	$48.42	$35.74	$50.82	$50.82	$42.68	$38.19	$33.33	$28.28	$23.03	$863,067.76
	Optimal Personnel Mix	1	1	1	1	1	2	2	2	2	2	Work Center Cost per FY
	Anuual Wage	$ 122,157.62	$ 101,052.11	$ 74,585.25	$ 106,061.34	$ 106,060.18	$ 89,072.87	$ 79,712.53	$ 69,560.87	$ 59,030.22	$ 48,072.74	**$1,200,814.94**
	Manpower Savings	0	1	0	0	0	1	1	1	1	1	

Optimized Manpower difference between "No Strategic Source Spend" and "With Strategic Source Spend"

The man-hours included in this table are for illustrative purposes only.

a. *Manpower Savings*

The manpower savings represent the work units that AFICA may use to address other mission objectives. The optimized work unit difference between the solution with "no strategically sourced spend" and with "strategically sourced spend" represent the manpower savings. Refer to Table 3 for an illustration of how manpower savings are calculated. AFICA may also analyze the work unit man-hour difference between the two optimized solutions to determine excess contracting capacity (in man-hours).

b. Using the Excess Manpower to Meet Other Mission Requirements

The optimized manpower solution does not tell AFICA where it should allocate the excess manpower. AFICA leadership must make managerial decisions regarding where the excess manpower may be best utilized. Possibilities include allowing operational CONS commanders to gainfully employ its own workforce, assigning AFICA taskers to operational CONSs with excess contracting capacity, or reassigning personnel to undermanned operational CONSs, ESSs, or SCONSs. Chapter VI addresses these possibilities in detail.

IV. PHASE I FINDINGS

Chapter IV contains the (1) Revised Transaction Cost Schedule and (2) theoretical manpower optimization model. Both products were developed using the methodology detailed in the Chapter III.

A. THE REVISED TRANSACTION COST SCHEDULE

Refer to Table 4 for the Revised Transaction Cost Schedule.

Table 4. Revised Transaction Cost Schedule

Contract Category	Quantity	Man-Hours per Category	Applied Rate	Transaction Cost
Commodity Contracts				
Commodity Contract (Commercial > $150K or Master Strategically Sourced Contract)	0	475.1	$ 42.94	$ -
Commodity DO	0	40.25	$ 25.47	$ -
Commodity PO	0	35.46	$ 25.47	$ -
Decentrally Executed, Strategically Sourced Commodities	0	24.15	$ 23.72	$ -
Service Contracts				
Service Contract (Commercial > $150K or Master Strategically Sourced Contract)	0	615.08	$ 42.94	$ -
Service TO	0	219.66	$ 28.00	$ -
Decentrally Executed, Strategically Sourced Services (Commercial>$150K)	0	131.796	$ 28.00	$ -
Service PO (Commercial <$150K)	0	38.37	$ 28.00	$ -
Decentrally Executed, Strategically Sourced Services (Commercial<$150K)	0	23.022	$ 28.00	$ -
Construction Contracts				
Construction (> $150K or Master Strategically Sourced Contract)	0	477.92	$ 42.94	$ -
Construction TO	0	86.7	$ 28.00	$ -
Decentrally Executed, Strategically Sourced Construction	0	60.69	$ 28.00	$ -
Architecture and Engineering Contracts				
A&E (> $150K or Master Strategically Sourced Contract)	0	449.19	$ 42.94	$ -
A&E TO	0	145.42	$ 28.00	$ -
Decentrally Executed, Strategically Sourced A&E	0	101.794	$ 28.00	$ -
Blanket Purchase Agreements				
BPA	0	69.1	$ 25.47	$ -
Decentrally Executed, Strategically Sourced BPA	0	41.46	$ 23.72	$ -
Sealed Bid				
Sealed Bid	0	214.03	$ 25.47	$ -
Miscellaneous				
Options	0	22.34	$ 23.72	$ -
Modifications	0	17.22	$ 23.72	$ -
Closeouts	0	7.63	$ 23.72	$ -

Strategic Source Contract Categories
Process Cost for Strategic Source Contract Categories

First, strategically sourced contract categories were developed from the open-market contract categories. Next, man-hour baselines for the strategically sourced contract categories were developed based on the man-hour relationships between the open-market and strategically sourced contract categories. The man-hour baselines for the strategically sourced contracts provide the starting point to apply discounts for process savings attributable to best-in-class acquisition practices and enterprise-wide learning.

1. Determining the Decentrally Executed, Strategically Sourced Contract Categories

The following decentrally executed, strategically sourced contract categories were developed from the open-market contract categories contained in the 2014 OC AFMS (Carter, 2014). The strategically sourced contract categories are:

- Decentrally Executed, Strategically Sourced Commodity
- Decentrally Executed, Strategically Sourced Service (Commercial greater than $150,000)
- Decentrally Executed, Strategically Sourced Service (Commercial greater than $150,000)
- Decentrally Executed, Strategically Sourced Construction
- Decentrally Executed, Strategically Sourced A&E
- Decentrally Executed, Strategically Sourced BPA

2. Establishing Man-Hour Baselines for the Decentrally Executed, Strategically Sourced Contract Categories

The man-hour baselines for the decentrally executed, strategically sourced contract categories provide the starting point to apply discounts for process savings attributable to best-in-class acquisition practices and learning. Many decentrally executed, strategically sourced contracts share a strict IDIQ/order relationship. For example, COs contract for medical professionals by awarding TOs against the master Clinical Acquisition for Support Services (CLASS) IDIQ contract. Under this construct, each decentrally executed, strategically sourced IDIQ order functions like an open-market IDIQ order. The most logical inference is that (on average) each decentrally executed, strategically sourced contract category should be (at most) as process-intensive as its comparable open-market contract category. Consequently, the man-hour demand of a comparable open-market contract is a good starting baseline for establishing the man-hour demand for a decentrally executed, strategically sourced contract.

3. Discounting the Decentrally Executed, Strategically Sourced Contract Categories

The man-hour demand for each decentrally executed, strategically sourced contract is 60% of its comparable open-market contract category. The 40% discount represents the process savings achieved through learning and best-in-class acquisition practices discussed in the literature review. The 40% discount is an arbitrary value that may not reflect the actual process savings achieved through using a strategically sourced contract. At a minimum, the discount addresses the premise that decentrally executed, strategically sourced contracts should be more process-efficient than their comparable open-market contract categories.

Although few (if any) decentrally executed, strategically sourced contracts currently reap the full process savings of best-in-class e-procurement platforms, expanded GPC purchasing, and enterprise-wide learning, this project assumes that, in the long-run, all strategically sourced contracts will reap these process savings.

a. *Decentrally Executed, Strategically Sourced Commodity*

40.25 hours (Commodity DO) * 0.6 = 24.15 hours

b. *Decentrally Executed, Strategically Sourced Service (Commercial>$150K)*

219.66 hours (Service TO) * 0.6 = 131.796 hours

c. *Decentrally Executed, Strategically Sourced Service (Commercial<$150K)*

38.37 hours (Service PO (Commercial < $150,000)) * 0.6 = 23 hours

d. *Decentrally Executed, Strategically Sourced Construction*

86.7 hours (Construction TO) * 0.6 = 60.69 hours

e. *Decentrally Executed, Strategically Sourced A&E*

145.42 hours (A&E TO) * 0.6 = 101.794 hours

f. Decentrally Executed, Strategically Sourced BPA

69.1 hours (BPA) * 0.6 = 41.46 hours

4. Determining the Applied Wage Rates

In accordance with Brown and Potoski's (2015) research on transaction cost theory in public contracting, contracts with high transaction costs are typically characterized by complexity, requirement ambiguity, and specialized investments. Conversely, contracts characterized by well-defined requirements typically incur fewer transaction costs (Brown & Potoski, 2015). To reflect this dynamic, the following wage rates were developed: (1) "complex wage rate," (2) "service, construction, A&E TO/PO wage rate," (3) "commodity DO/PO wage rate," and (4) "strategically sourced commodity wage rate." Each wage rate is the sum product of the percent contribution of each work unit and the work unit's fully burdened hourly rate. Refer to Table 5 for an illustration of how each wage rate was calculated.

Table 5. Wage Rate Calculation Table

Complex			Fully Burdened Hourly Rate		
MAJ	15.00%	*	$58.53	=	$8.78
CPT	30.00%	*	$48.42	=	$14.53
LT	1.00%	*	$35.74	=	$0.36
CMSGT	1.00%	*	$50.82	=	$0.51
SMSGT	1.00%	*	$42.68	=	$0.43
MSGT	27.00%	*	$38.19	=	$10.31
TSGT	22.00%	*	$33.33	=	$7.33
SSGT	1.00%	*	$28.28	=	$0.28
SRA	1.00%	*	$23.03	=	$0.23
A1C	1.00%	*	$17.84	=	$0.18
			Complex Wage Rate	=	$42.94
Service,Construction,A&E TO/PO					
MAJ	1.00%	*	$58.53	=	$0.59
CPT	1.00%	*	$48.42	=	$0.48
LT	10.00%	*	$35.74	=	$3.57
CMSGT	1.00%	*	$50.82	=	$0.51
SMSGT	1.00%	*	$42.68	=	$0.43
MSGT	10.00%	*	$38.19	=	$3.82
TSGT	10.00%	*	$33.33	=	$3.33
SSGT	21.00%	*	$28.28	=	$5.94
SRA	25.00%	*	$23.03	=	$5.76
A1C	20.00%	*	$17.84	=	$3.57
			Simple Wage Rate	=	$28.00
Commodity DO/PO					
MAJ	1.00%	*	$58.53	=	$0.59
CPT	1.00%	*	$48.42	=	$0.48
LT	10.00%	*	$35.74	=	$3.57
CMSGT	1.00%	*	$50.82	=	$0.51
SMSGT	1.00%	*	$42.68	=	$0.43
MSGT	5.00%	*	$38.19	=	$1.91
TSGT	6.00%	*	$33.33	=	$2.00
SSGT	15.00%	*	$28.28	=	$4.24
SRA	20.00%	*	$23.03	=	$4.61
A1C	40.00%	*	$17.84	=	$7.14
			Strategic Source Wage Rate	=	$25.47
Strategically Sourced Commodity					
MAJ	1.00%	*	$58.53	=	$0.59
CPT	1.00%	*	$48.42	=	$0.48
LT	10.00%	*	$35.74	=	$3.57
CMSGT	1.00%	*	$50.82	=	$0.51
SMSGT	1.00%	*	$42.68	=	$0.43
MSGT	1.00%	*	$38.19	=	$0.38
TSGT	5.00%	*	$33.33	=	$1.67
SSGT	5.00%	*	$28.28	=	$1.41
SRA	25.00%	*	$23.03	=	$5.76
A1C	50.00%	*	$17.84	=	$8.92
			Strategic Source Wage Rate	=	$23.72

a. *Complex Wage Rate*

The "complex" wage rate reflects the cost of the more experienced (and expensive) work units required for complex contract categories. As a percent of total work unit man-hour inputs, more experienced work units (i.e., Maj and Capt) represent a larger proportion of work unit man-hour inputs into a given "complex" contract category. Although the 2014 OC AFMS did not publish the individual work unit man-hour inputs into a given contract category, contract categories such as Commodity, Service, and Construction contracts contained complex activities such as Acquisition Strategy Panel (ASP) Briefings, Major Command (MAJCOM) Reviews, and market research for complex requirements (Carter, 2014). Complex contracts typically necessitate more experienced work units throughout the contracting process.

The complex wage rate was applied to:

- Commodity Contract (Commercial > $150,000 or Master Strategically Sourced Contract)
- Service Contract (Commercial > $150,000 or Master Strategically Sourced Contract),
- Construction (> $150,000 or Master Strategically Sourced Contract),
- A&E (> $150,000 or Master Strategically Sourced Contract)

b. *Service, Construction, and A&E TO/PO Wage Rate*

The "service, construction, and A&E TO/PO wage rate" reflects the cost of the work unit inputs required for service, construction, and A&E TOs and POs. Service, construction, and A&E TOs and POs are less complex than their respective master contracts because the master contracts have defined most of the service, exchange, and governance terms. Consequently, in respect to the master contracts, TOs and POs require lower skill level work units for execution and management. However, due the inherent complexity of service, construction, and A&E requirements, TOs and POs typically require higher level work unit inputs than a commodity DO. For example, the strategically sourced Roof Replacement and Repair contract presents considerably more complexity and risk than a commodity DO because the requirement complexity is largely driven by regional variables (e.g., the condition of the existing roof) that cannot be mitigated by the contract. Conversely, commodity DOs are inherently less complex and risky because commodity requirement complexity can generally be mitigated by defining the product specifications in the master contract.

The “service, construction, and A&E TO/PO wage rate” was applied to:

- Service TO
- Decentrally Executed, Strategically Sourced Service (Commercial > $150,000)
- Service PO (Commercial < $150,000)
- Decentrally Executed, Strategically Sourced Service (Commercial < $150,000)
- Construction TO
- Decentrally Executed, Strategically Sourced Construction
- A&E TO
- Decentrally Executed, Strategically Sourced A&E

c. Commodity DO/PO Wage Rate

The “commodity DO/PO wage rate” reflects the cost of less experienced (and inexpensive) work units required for commodity DOs and POs. As a percent of total work unit man-hour inputs, less experienced work units (i.e., A1C, SrA, SSgt) represent a larger proportion of work unit man-hour inputs into a given commodity DO or PO. Although the 2014 OC AFMS did not publish the individual work unit man-hour inputs into a given contract category, contract categories such as the Commodity PO contained simple activities such as market research for low-dollar items and oral solicitations (Carter, 2014). Commodity DOs and POs typically necessitate less experienced work units throughout the contracting process. This project assumed that the BPA and Sealed Bid categories also assumed this wage rate since both (1) may be used for commodities or services and (2) are generally used for simpler procurements.

The “commodity DO/PO wage rate” was applied to:

- Commodity DO
- Commodity PO
- BPA

- Sealed Bid

d. Strategically Sourced Commodity Contract Wage Rate

The "strategically sourced commodity contract wage rate" reflects the cost of the least experienced (and most inexpensive) work units required for decentrally executed, strategically sourced commodity contracts. As a percent of total work unit man-hour inputs, less experienced work units (i.e., A1C and SrA) represent the largest proportion of work unit man-hour inputs into a given simple contract category. Relative to other contract categories, decentrally executed, strategically sourced commodity contracts typically represent the lowest risk procurement vehicles because (1) the master strategically sourced commodity contract generally defines the product, exchange, and governance rules in whole and (2) commodities are generally less complex requirements.

For example, the master Air Force Way (AFWay) contract is a robust strategically sourced contract that clearly defines product, exchange, and governance rules. The products (e.g., computers, printers, and IT hardware) and their associated specifications (e.g., CPU, processor speed, RAM) are strictly defined in the product list. The cost of each product and the method of payment is also strictly defined. Lastly, the terms and conditions clearly spell out how the buyer and seller will interact during the course of the contract. Each decentralized AFWay order is a relatively low risk procurement because the contract is complete in nature. COs will typically assign low-risk procurements to less experienced members because there is a low probability of failure. This project assumed that the Decentrally Executed, Strategically Sourced BPA, Options, Modifications, and Closeouts also required the least expensive work units for execution. The "strategically sourced commodity wage rate" was applied to:

- Decentrally Executed, Strategically Sourced Commodity
- Decentrally Executed, Strategically Sourced BPA
- Options
- Modifications
- Closeouts

e. Work Unit Estimates

The "complex wage rate," "service, construction, and A&E TO/PO wage rate," "commodity DO/PO wage rate," and the "strategically sourced commodity wage rate" work unit man-hour estimates are only meant to reflect the relative work unit man-hour demand as a function of contract complexity.

The CMSgt and SMSgt work units were assigned a one percent work unit contribution for all wage rates. CMSgts and SMSgts typically assume supervisory roles that are not directly involved in contract production. Consequently, the size of a given contract workload will have very little impact on the overall manpower demand for CMSgts and SMSgts.

B. THE MANPOWER OPTIMIZATION MODEL

The objective of the theoretical manpower optimization model is to leverage process saving through manpower optimization. The mathematical expression of the LP is displayed below. Refer to Appendix C for the long notation of the manpower optimization model.

1. Variables and Definitions

Let:

X_i = annual man-hours per unit; where "i" is: A = MAJ, B = CAPT… J = AIC

Y_c = Required man-hours for each contract type; where "c" is: 1 = Commodity, 2 = Commodity DO … 21 = Closeouts

Q_c = Annual demand for each contract type; where "c" is: 1 = Commodity, 2 = Commodity DO… 21 = Closeouts

Z_{ij} = Contribution percentage of each unit for each contract type; where "i" is: A = MAJ,

B = CAPT… J = AIC; and "j" is: 1 = Complex, 2 = Service, Construction, A&E TO/PO,

3 = Commodity DO/PO, and 4 = Strategically Sourced Commodity

(Refer to Table 5 for the work unit contribution percentages for "complex," "simple," and "strategic source" contract categories)

2. Objective Function

Min: $58.53X_A + 48.42X_B + 35.74X_C + 50.82X_D + 42.68X_E + 38.19X_F + 33.33X_G + 28.28X_H + 23.03X_I + 17.84X_J$

3. Constraints

Subject To:

$$\sum_{i=1}^{10} X_i \geq Y_c Q_c$$

$$X_i \geq Z_{ij}\left(Y_c Q_c\right)$$

$$X_i; Y_c Q_c; Z_{ij} \geq 0$$

V. PHASE II FINDINGS

Chapter V contains the manpower optimization results of the notional operational CONS. The theoretical manpower optimization model developed in Chapter IV was used to optimize the manpower of the notional operational CONS.

A. SIMULATING AFPC’S MANPOWER OPTIMIZATION FOR A NOTIONAL OPERATIONAL CONS

This step simulated how the AFPC would assign manpower since AFPC does not account for process savings achieved through strategically sourced contracts. First, stylized contract data was developed for optimization.

The contracting workload for the notional operational CONS was loosely built on the FY2016 28 CONS contract data. As previously mentioned, the 28 CONS contract data only serves as a baseline for developing a construct of what a typical operational CONS may execute during any given FY. Refer to Table 6 for the notional operational CONS workload.

The workload data was optimized using the theoretical manpower optimization model. The results are displayed in Table 7.

Table 6. Notional Operational CONS Workload—No Strategically Sourced Spend

Contract Categories	Quantity	Man-Hours per Category	Applied Rate	Transaction Cost
Commodity Contracts				
Commodity Contract (Commercial > $150K or Master Strategically Sourced Contract)	16	475.1	$ 42.94	$ 326,375.47
Commodity DO	100	40.25	$ 25.47	$ 102,528.95
Commodity PO	100	35.46	$ 25.47	$ 90,327.37
Decentrally Executed, Strategically Sourced Commodity	0	24.15	$ 23.72	$ -
Service Contracts				
Service Contract (Commercial > $150K or Master Strategically Sourced Contract)	16	615.08	$ 42.94	$ 422,536.36
Service TO	59	219.66	$ 28.00	$ 362,839.67
Decentrally Executed, Strategically Sourced Service (Commercial>$150K)	0	131.796	$ 28.00	$ -
Service PO (Commercial <$150K)	10	38.37	$ 28.00	$ 10,742.46
Decentrally Executed, Strategically Sourced Service (Commercial<$150K)	0	23.022	$ 28.00	$ -
Construction Contracts				
Construction (> $150K or Master Strategically Sourced Contract)	14	477.92	$ 42.94	$ 287,273.62
Construction TO	50	86.7	$ 28.00	$ 121,367.07
Decentrally Executed, Strategically Sourced Construction	0	60.69	$ 28.00	$ -
Architecture and Engineering Contracts				
A&E (> $150K or Master Strategically Sourced Contract)	2	449.19	$ 42.94	$ 38,572.04
A&E TO	15	145.42	$ 28.00	$ 61,069.89
Decentrally Executed, Strategically Sourced A&E	0	101.794	$ 28.00	$ -
Blanket Purchase Agreements				
BPA	16	69.1	$ 25.47	$ 28,162.98
Decentrally Executed, Strategically Sourced BPA	0	41.46	$ 23.72	$ -
Sealed Bid				
Sealed Bid	12	214.03	$ 25.47	$ 65,423.91
Miscellaneous				
Options	38	22.34	$ 23.72	$ 20,135.59
Modifications	228	17.22	$ 23.72	$ 93,124.86
Closeouts	25	7.63	$ 23.72	$ 4,524.41
			TOTAL TRANSACTION COST	**$ 2,035,004.66**

Table 7. Optimized Manpower—No Strategically Sourced Spend

	MAJ	CAPT	LT	CMSGT	SMSGT	MSGT	TSGT	SSGT	SRA	A1C	
Man-Hours	1476	2952	1296	130	130	2657	2165	2722	3240	2592	
Fully Burdened Rate per Hour	$58.53	$48.42	$35.74	$50.82	$42.68	$38.19	$33.33	$28.28	$23.03	$17.84	**$659,294.00**
Personnel Mix	2	3	1	1	1	2	2	2	3	2	
Anuual Wage	$ 122,157.62	$ 101,052.11	$ 74,585.25	$ 106,060.18	$ 89,072.87	$ 79,712.53	$ 69,560.87	$ 59,030.22	$ 48,072.74	$ 37,229.76	**$1,452,474.82**

B. SIMULATING AFICA'S INTERNAL MANPOWER OPTIMIZATION

First, the FY2016 28 CONS contract data was reviewed to develop a notional allocation basis for migrating open-market contract categories into their associated strategically sourced contract categories. The FY2016 28 CONS Federal Procurement Data System-Next Generation (FPDS-NG) data revealed that the 28 CONS extensively leveraged or could have leveraged strategically sourced contracts for various commodities and services. In total, 28 CONS COs executed or may have potentially executed 62 strategically sourced contract actions across a variety of different requirements. Excluding modifications, strategically sourced contracts accounted for 26% of all contract actions. Any FY2016 28 CONS contract actions that satisfied any of the following criteria were counted as strategically sourced contract actions:

- Contracts executed against a strategically sourced contract
- Contracts that a CO could have procured through a strategically sourced contract
- Contracts that a CO will likely procure through a strategically sourced contract in the near future (e.g., Carpeting, Transient Alert)

Based on the findings, (1) 25% of all open-market commodity contracts were migrated to the Decentrally Executed, Strategically Sourced Commodity contract category, (2) 25% of all open-market service contracts were migrated to either the Decentrally Executed, Strategically Sourced Service (Commercial > $150,000) or Decentrally Executed, Strategically Sourced Service (Commercial < $150,000) contract categories, (3) 10% of all open-market construction contracts were migrated to the Decentrally Executed, Strategically Sourced Construction contract category, and (4) 50% of all open-market BPAs were migrated to the Decentrally Executed, Strategically Sourced BPA category.

Refer to Table 8 for the notional operational CONS workload with strategically sourced contracting. The workload data was optimized using the theoretical manpower optimization model. The results are displayed in Table 9.

Table 8. Notional Operational Contracting Squadron Workload—With Strategically Sourced Spend

Contract Categories	Quantity	Man-Hours per Category	Applied Rate	Transaction Cost
Commodity Contracts				
Commodity Contract (Commercial > $150K or Master Strategically Sourced Contract)	12	475.1	$ 42.94	$ 244,781.61
Commodity DO	75	40.25	$ 25.47	$ 76,896.71
Commodity PO	75	35.46	$ 25.47	$ 67,745.53
Decentrally Executed, Strategically Sourced Commodity	54	24.15	$ 23.72	$ 30,932.04
Service Contracts				
Service Contract (Commercial > $150K or Master Strategically Sourced Contract)	12	615.08	$ 42.94	$ 316,902.27
Service TO	45	219.66	$ 28.00	$ 276,742.12
Decentrally Executed, Strategically Sourced Service (Commercial>$150K)	0	131.796	$ 28.00	$ -
Service PO (Commercial <$150K)	8	38.37	$ 28.00	$ 8,593.96
Decentrally Executed, Strategically Sourced Service (Commercial<$150K)	20	23.022	$ 28.00	$ 12,890.95
Construction Contracts				
Construction (> $150K or Master Strategically Sourced Contract)	12	477.92	$ 42.94	$ 246,234.53
Construction TO	45	86.7	$ 28.00	$ 109,230.36
Decentrally Executed, Strategically Sourced Construction	7	60.69	$ 28.00	$ 11,893.97
Architecture and Engineering Contracts				
A&E (> $150K or Master Strategically Sourced Contract)	2	449.19	$ 42.94	$ 38,572.04
A&E TO	15	145.42	$ 28.00	$ 61,069.89
Decentrally Executed, Strategically Sourced A&E	0	101.794	$ 28.00	$ -
Blanket Purchase Agreements				
BPA	8	69.1	$ 25.47	$ 14,081.49
Decentrally Executed, Strategically Sourced BPA	8	41.46	$ 23.72	$ 7,867.14
Sealed Bid				
Sealed Bid	12	214.03	$ 25.47	$ 65,423.91
Miscellaneous				
Options	38	22.34	$ 23.72	$ 20,135.59
Modifications	228	17.22	$ 23.72	$ 93,124.86
Closeouts	25	7.63	$ 23.72	$ 4,524.41
			TOTAL TRANSACTION COST	**$ 1,707,643.40**

Table 9. Optimized Manpower—With Strategically Sourced Spend

	MAJ	CAPT	LT	CMSGT	SMSGT	MSGT	TSGT	SSGT	SRA	A1C	
Man-Hours	1107	2214	988	99	99	1993	1624	2076	2471	1977	
Fully Burdened Rate per Hour	$58.53	$48.42	$35.74	$50.82	$42.68	$38.19	$33.33	$28.28	$23.03	$17.84	**$497,728.33**
Personnel Mix	1	2	1	1	1	2	2	2	2	2	
Anuual Wage	$ 122,157.62	$ 101,052.11	$ 74,585.25	$ 106,060.18	$ 89,072.87	$ 79,712.53	$ 69,560.87	$ 59,030.22	$ 48,072.74	$ 37,229.76	**$1,181,192.36**

C. MANPOWER VARIANCE BETWEEN THE OPTIMIZED MANPOWER OUTPUTS

The manpower variance between the optimized manpower outputs revealed one Maj, one Capt, and one SrA in manpower savings. Refer to Table 10 for the manpower variance results.

Table 10. Manpower Variance Table

		MAJ	CAPT	LT	CMSGT	SMSGT	MSGT	TSGT	SSGT	SRA	A1C	
Optimized Manpower (No Strategically Sourced Contracting)	Optimized Man-Hours	1476	2952	1296	130	130	2657	2165	2722	3240	2592	
	Fully Burdened Rate per Hour	$58.53	$48.42	$35.74	$50.82	$42.68	$38.19	$33.33	$28.28	$23.03	$17.84	$659,294.00
	Optimal Personnel Mix	2	3	1	1	1	2	2	2	3	2	
	Anuual Wage	$122,157.62	$101,052.11	$74,585.25	$106,060.18	$ 89,072.87	$79,712.53	$69,560.87	$59,030.22	$48,072.74	$37,229.76	$1,452,474.82
Optimized Manpower (With Strategically Sourced Contracting)	Optimized Man-Hours	1107	2214	988	99	99	1993	1624	2076	2471	1977	
	Fully Burdened Rate per Hour	$58.53	$48.42	$35.74	$50.82	$42.68	$38.19	$33.33	$28.28	$23.03	$17.84	$497,728.33
	Optimal Personnel Mix	1	2	1	1	1	2	2	2	2	2	
	Anuual Wage	$122,157.62	$101,052.11	$74,585.25	$106,060.18	$ 89,072.87	$79,712.53	$69,560.87	$59,030.22	$48,072.74	$37,229.76	$1,181,192.36
	Manpower Savings	1	1	0	0	0	0	0	0	1	0	Cost Savings
												$271,282.46

Optimized Manpower difference between "No Strategic Source Spend" and "With Strategic Source Spend"

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VI. CONCLUSIONS AND RECOMMENDATIONS

In summation, this project sought to answer one central question: How can AFICA leverage process savings to identify manpower savings that may be used to address other mission objectives? The findings suggest that internal manpower optimizations may reveal excess contracting capacity that may be used to meet other mission objectives. The paragraphs below contain (1) an analysis of the findings, (2) recommendations for how AFICA may use the manpower savings to meet mission objectives, (3) topics for future research, and (4) closing remarks.

A. FINDINGS

Due to a lack of empirical (1) man-hour data for strategically sourced contracts, (2) labor input data for open-market contracts, and (3) data for MAFs and OLFs, the model can only be used to consider the potential manpower benefits of process savings achieved through strategically sourced contracts. Despite the limitations of the model, the LP was sufficient for demonstrating how AFICA may theoretically identify manpower savings at the operational CONS level that may be used to address other mission objectives.

1. The Revised Transaction Cost Schedule

The most important contributions of the Revised Transaction Cost Schedule are the inclusion of (1) strategically sourced contract categories and (2) the tacit assumption that not all man-hour savings are the same.

As previously mentioned, AFICA's (2017) Process Savings Table cannot ascertain the true process savings of a strategically sourced contract because it is missing strategically sourced contract categories. Consequently, operational CONSs can only report man-hour savings achieved by comparing open-market contract categories. The Revised Transaction Cost Schedule incorporated strategically sourced contract categories and their associated man-hour estimates to provide a better framework to analyze process savings achieved through strategically sourced contracts.

Additionally, AFICA's (2017) Process Savings Table assumes all man-hours are equal regardless of the actual labor inputs that went into a given hour of work. Conversely, the Revised Transaction Cost Schedule accounts for manpower inputs in respect to contract complexity. Consequently, man-hour savings involving converting complex contract categories into simple categories (e.g., reducing the number of commodity contracts and increasing commodity TOs) are more valuable because the man-hour savings account for the lower transaction costs of executing a simpler contract category (e.g., less Capt labor inputs and more SrA labor inputs).

Although the Revised Transaction Cost Schedule offers a more refined framework to analyze man-hour and transaction cost differences between open-market and decentrally executed, strategically sourced contracts, there is no empirical evidence that explicitly supports the idea that decentrally executed, strategically sourced contracts require less man-hours than comparable open-market contracts. As previously mentioned, anecdotal evidence suggests that currently, there is little to no man-hour difference between comparable open-market and decentrally executed, strategically sourced contracts. However, evidence from the commercial sector, foreign public procurement agencies, and the OMB's aggressive push to leverage best-in-class acquisition practices suggests that over the long-run, AFICA may reap significant man-hour savings through strategically sourced contracts.

2. Can AFICA Leverage Process Savings to Identify Excess Manpower that May be Used to Address Other Mission Objectives?

Theoretically, yes. The manpower optimization model provided a theoretical framework to analyze the manpower impact of leveraging process savings achieved through strategically sourced contracts at the operational CONS level. As evidenced by the optimization output in Chapter V, the notional operational CONS may save one Maj, one Capt, and one SrA by leveraging man-hour savings achieved through strategically sourced contracts. Although the model is insufficient for making definitive manpower decisions, the model provided a theoretical framework that affirmed the plausibility of optimizing manpower in respect to process savings.

Although the model generates notional manpower savings, it does not provide an answer to how the manpower savings should be used to address other mission objectives. The following section contains a discussion on recommendations for how AFICA may use the excess manpower.

B. RECOMMENDATIONS FOR HOW AFICA MAY USE THE MANPOWER SAVINGS TO MEET MISSION OBJECTIVES

The following paragraphs contain recommendations for how AFICA may use manpower savings to address other mission objectives. Possibilities include allowing CONS commanders to gainfully employ its own workforce, assigning AFICA taskers to CONSs with excess contracting capacity, or reassigning personnel to undermanned operational CONSs, ESSs, or SCONS.

1. Allow Operational CONS Commanders to Leverage Manpower Savings

The most intuitive decision is to allow CONS commanders to gainfully employ its own workforce. CONS commanders may consider using the slack manpower to focus on improving market intelligence, forecasting requirements, analyzing spend, refining requirements, engaging in supplier relationship management, enhancing outreach to socioeconomic and/or local suppliers, etc.

2. AFICA May Delegate Work to CONSs with Excess Capacity

An important aspect of internal manpower optimization is that it gives AFICA leadership a top-down view of which operational CONSs may have the capacity to take on additional work or meet emergent readiness requirements. AFICA may decide to task operational CONSs with additional contracting capacity with more work (e.g., data collection and market research).

3. Horizontal Reassignment

If possible, AFICA may decide to reassign excess manpower to undermanned operational CONSs. Although the utilization rate for each member at the losing CONS will increase, the optimized workforce should still be capable of executing their contracting mission. Assuming that horizontal reassignment is possible, AFICA must ensure that the losing operational CONS does not anticipate a significant change in its contracting workload in the foreseeable future.

4. Vertical Reassignment

If possible, excess manpower may be reassigned to an understaffed ESS or SCONS that is responsible for developing and implementing strategically sourced contracts. As AFICA implements more strategically sourced contracts, future manpower savings may be achieved at the operational CONS level. Future manpower savings may be kept within the CONS or redistributed horizontally or vertically to meet mission needs. Figure 4 depicts the manpower optimization loop. If vertical reassignment is possible, AFICA must ensure that the losing operational CONS does not anticipate a significant change in its contracting workload in the foreseeable future.

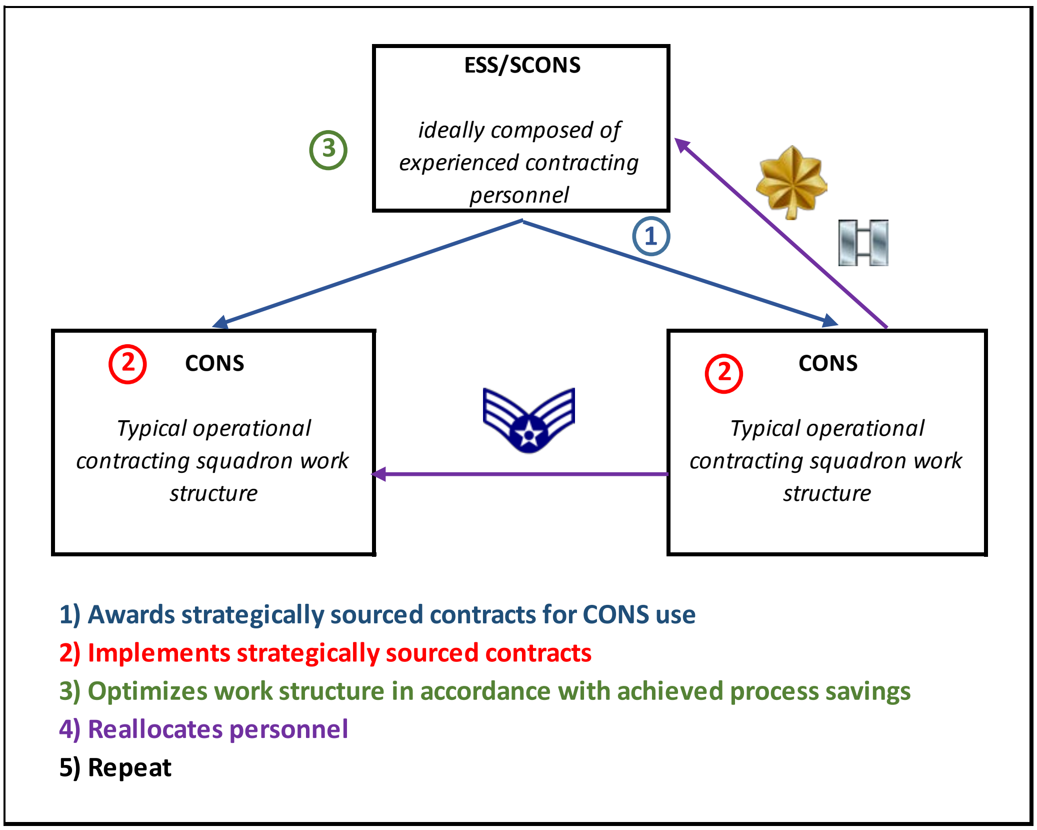

Figure 4. Manpower Optimization Loop

C. AREAS FOR FUTURE RESEARCH

1. Revised Manpower Standards

The contract categories contained in the 2014 OC AFMS are inadequate for describing the actual man-hour requirement for various contract actions because the contract categories are too general. Instead, contract categories should be defined by requirement complexity. Brown and Potoski's (2005) research on transaction cost theory suggests that requirement complexity is the major cost driver for a given contract action. It may be more helpful to differentiate contracts according to the requirement. For example, a grounds maintenance TO is inherently different than a medical service TO even though both are service TOs. The requirement type (grounds maintenance versus medical) is the transaction cost driver because the complexity of each requirement ultimately drives the labor and time inputs necessary for execution and management. Although AFPC is responsible for developing manpower standards, AFPC and AFICA may benefit from more accurate manpower standards that are defined by requirement complexity.

2. Empirical Man-Hour Data for Strategically Sourced Contracts

AFICA may consider analyzing the man-hour impact of each strategically sourced contract and tracking changes over time. Over the long-run, decentrally executed, strategically sourced contracts should require fewer man-hours to execute and manage due to increased learning across the enterprise and best-in-class acquisition practices.

3. Maximization Model

AFICA may develop a production model that considers an operational CONS's current manning and optimizes productivity in respect to process savings achieved through strategically sourced contracts. The model must find ways to interpret productivity as an indicator for things like readiness, quality, efficiency, etc. The framework for a possible maximization LP is outlined as follows:

a. Problem Definition

Given an operational CONS's workforce, what is the maximum amount of contracts that the CONS can produce?

b. Decision Variables

Assume that the Sealed Bid, Options, Modifications, and Closeouts categories are not considered for maximization.

Let:

A = The number of commodity contracts, B = The number of commodity DOs, … Q = The number of decentrally executed, strategically sourced BPAs

c. Objective Function

May consider assigning decision variable coefficients that reflect the level of "worth" AFICA attributes to each contract category.

Maximize: 100A + 12B + … + 7Q

d. Constraints

Assume contract complexity as described by Table 5.

Assume 1,463.6 annual man-hours per work unit.

Available Maj Time
((.15*475.1)/1,463.6)A+((.01*40.25)/1,463.6)B+ … ((.01*40.25)/1,463.6)Q ≤ Number of available Majs

.

.

.

Available A1C Time
((.01*475.1)/1,463.6)A+((.40*40.25)/1,463.6)B+ … ((.50*40.25)/1,463.6)Q ≤ Number of available A1Cs

D. CLOSING REMARKS

AFICA may be able to leverage process savings achieved through strategically sourced contracts to identify excess manpower that may be used to address other mission objectives. The Revised Transaction Cost Schedule and manpower optimization model offer a theoretical framework to consider the implications of process savings on manpower across the enterprise. Although the Revised Transaction Cost Schedule and the manpower model theoretically demonstrate the efficacy of manpower optimization, in practice, AFICA may not be able to achieve manpower savings in the short-run due to relatively immature strategically sourced contracts that lack best-in-class e-procurement platforms, expanded GPC purchasing, and enterprise-wide learning. In the long-run, significant process savings achieved through strategically sourced contracts may create opportunities for AFICA to leverage manpower savings to accomplish other mission objectives.

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APPENDIX A. AFICA'S TRANSACTION COST COMPARISON TABLE

How were these requirements previously purchased?					What type of process savings is this?	How were these requirements being purchased?		
					Change of KT Vehicle/ KT Consolidation			
Contract Type	**Quantity**	**Hours**	**Rate**	**Total**		**Contract Type**	**Quantity**	**Total**
Commodity		475.1	$ 33.02	$ -	What was being purchased?	Commodity		$ -
Commodity Delivery Order	17	40.25	$ 33.02	$ 22,593.94	Commodity	Commodity Delivery Order	17	$ 22,593.94
Commodity Purchase Order		35.46	$ 33.02	$ -		Commodity Purchase Order		$ -
Service		615.08	$ 33.02	$ -	Previouse Cost	Service		$ -
Service Task Order		219.66	$ 33.02	$ -	$ 22,593.94	Service Task Order		$ -
Service Purchase Order (Commercial <$150K)		38.37	$ 33.02	$ -		Service Purchase Order (Commercial <$150K)		$ -
Construction		477.92	$ 33.02	$ -	New Cost	Construction		$ -
Construction Task Order		86.7	$ 33.02	$ -	$ 24,875.62	Construction Task Order		$ -
A&E		449.19	$ 33.02	$ -		A&E		$ -
A&E Task Order		145.42	$ 33.02	$ -	Diffrence (Savings)	A&E Task Order		$ -
Sealed Bid		214.13	$ 33.02	$ -	$ (2,281.68)	Sealed Bid		$ -
Blanket Purchase Agreement		69.1	$ 33.02	$ -		Blanket Purchase Agreement	1	$ 2,281.68
Options		22.34	$ 33.02	$ -		Options		$ -

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APPENDIX B. AFICA'S WAGE RATE CALCULATION

	B	C	D	E	F	G	H	I	J	K	L	M	N
3	**WORK CENTER**			**APPLICABILITY MAN-HOUR RANGE**									
4	**Operational Contracting FAC 12A0**			3595.29-18208.53									
5	**AIR FORCE SPECIALTY CODE TITLE**	**AFSC**	**GRD**	**MANPOWER REQUIREMENTS**									**Fully Burdened Rate**
6	Contracting	64P3	MAJ	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	$58.53
7	Contracting	64P3	CPT	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	$48.42
8	Contracting	64P3	LT	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**7**	$35.74
9	Contracting Manager	6C000	CMS	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	$50.82
10	Contracting Superintendent	6C091	SMS	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	$42.68
11	Contracting Craftsman	6C071	MSG	**6**	**6**	**7**	**7**	**7**	**7**	**7**	**7**	**7**	$38.19
12	Contracting Craftsman	6C071	TSG	**11**	**11**	**11**	**11**	**11**	**12**	**12**	**12**	**12**	$33.33
13	Contracting Journeyman	6C051	SSGT	**10**	**11**	**11**	**12**	**12**	**12**	**13**	**13**	**13**	$28.28
14	Contracting Journeyman	6C051	SRA	**9**	**9**	**9**	**9**	**10**	**10**	**10**	**10**	**10**	$23.03
15	Contracting Apprentice	6C031	A1C	**6**	**6**	**6**	**6**	**6**	**6**	**6**	**7**	**7**	$17.84
16	Totals			=SUM(E6:E15)	=SUM(F6:F15)	=SUM(G6:G15)	=SUM(H6:H15)	=SUM(I6:I15)	=SUM(J6:J15)	=SUM(K6:K15)	=SUM(L6:L15)	=SUM(M6:M15)	
17				=(SUMPRODUCT(E6:E15,$N6:$N15))/E16	=(SUMPRODUCT(F6:F15,$N6:$N15))/F16	=(SUMPRODUCT(G6:G15,$N6:$N15))/G16	=(SUMPRODUCT(H6:H15,$N6:$N15))/H16	=(SUMPRODUCT(I6:I15,$N6:$N15))/I16	=(SUMPRODUCT(J6:J15,$N6:$N15))/J16	=(SUMPRODUCT(K6:K15,$N6:$N15))/K16	=(SUMPRODUCT(L6:L15,$N6:$N15))/L16	=(SUMPRODUCT(M6:M15,$N6:$N15))/M16	
18													
19							**=AVERAGE(E17:M17)**	=	**33.02276306**	**--> AFICA's Wage Rate**			

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APPENDIX C. LONG NOTATION OF MANPOWER OPTIMIZATION MODEL

A. DECISION VARIABLES

Let:

X_A = annual man-hours for a Major
X_B = annual man-hours for a Captain
X_C = annual man-hours for a Lieutenant
X_D = annual man-hours for a Chief Master Sergeant
X_E = annual man-hours for a Senior Master Sergeant
X_F = annual man-hours for a Master Sergeant
X_G = annual man-hours for a Technical Sergeant
X_H = annual man-hours for a Staff Sergeant
X_I = annual man-hours for a Senior Airman
X_J = annual man-hours for an Airman First Class

Y_1 = required man-hours for "Commodity Contract"
Y_2 = required man-hours for "Commodity Delivery Order"
Y_3 = required man-hours for "Commodity Purchase Order"
Y_4 = required man-hours for "Strategically Sourced Commodity Contract/ Delivery Order/ Purchase order"
Y_5 = required man-hours for "Service Contract (Commercial > $150,000 & Master Strategic Source Contract)"
Y_6 = required man-hours for "Service Task Order"
Y_7 = required man-hours for "Strategically Sourced Service Contract/ Task Order/ Purchase Order (Commercial > $150,000)"
Y_8 = required man-hours for "Service Purchase Order (Commercial < $150,000)"
Y_9 = required man-hours for "Strategically Sourced Service Contract/Task Order/ Purchase Order (Commercial < $150,000)"
Y_{10} = required man-hours for "Construction (> $150,000 & Master Strategic Source Contract)"
Y_{11} = required man-hours for "Construction Task Order"
Y_{12} = required man-hours for "Strategically Sourced Construction Contract/ Task Order"
Y_{13} = required man-hours for "Architecture and Engineering (> $150,000 & Master Strategic Source Contract)"
Y_{14} = required man-hours for "Architecture and Engineering Task Order"
Y_{15} = required man-hours for "Strategically Sourced Architecture and Engineering Contract/ Task Order"
Y_{16} = required man-hours for "Blanket Purchase Agreement"
Y_{17} = required man-hours for "Strategically Sourced Blanket Purchase Agreement"
Y_{18} = required man-hours for "Sealed Bid"
Y_{19} = required man-hours for "Options"
Y_{20} = required man-hours for "Modifications"
Y_{21} = required man-hours for "Close-outs"

Z_{A1} = contribution percentage of a Major for "Complex Contract"
Z_{B1} = contribution percentage of a Captain for "Complex Contract"
Z_{C1} = contribution percentage of a Lieutenant for "Complex Contract"
Z_{D1} = contribution percentage of a Chief Master Sergeant for "Complex Contract"
Z_{E1} = contribution percentage of a Senior Master Sergeant for "Complex Contract"
Z_{F1} = contribution percentage of a Master Sergeant for "Complex Contract"
Z_{G1} = contribution percentage of a Technical Sergeant for "Complex Contract"
Z_{H1} = contribution percentage of a Staff Sergeant for "Complex Contract"
Z_{I1} = contribution percentage of a Senior Airman for "Complex Contract"
Z_{J1} = contribution percentage of an Airman First Class for "Complex Contract"

Z_{A2} = contribution percentage of a Major for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{B2} = contribution percentage of a Captain for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{C2} = contribution percentage of a Lieutenant for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{D2} = contribution percentage of a Chief Master Sergeant for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{E2} = contribution percentage of a Senior Master Sergeant for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{F2} = contribution percentage of a Master Sergeant for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{G2} = contribution percentage of a Technical Sergeant for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{H2} = contribution percentage of a Staff Sergeant for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{I2} = contribution percentage of a Senior Airman for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"
Z_{J2} = contribution percentage of an Airman First Class for "Service, Construction, Architecture and Engineering Task Order/ Purchase Order"

Z_{A3} = contribution percentage of a Major for "Commodity Delivery Order/ Purchase Order"
Z_{B3} = contribution percentage of a Captain for "Commodity Delivery Order/ Purchase Order"
Z_{C3} = contribution percentage of a Lieutenant for "Commodity Delivery Order/ Purchase Order"
Z_{D3} = contribution percentage of a Chief Master Sergeant for "Commodity Delivery Order/ Purchase Order"
Z_{E3} = contribution percentage of a Senior Master Sergeant for "Commodity Delivery Order/ Purchase Order"
Z_{F3} = contribution percentage of a Master Sergeant for "Commodity Delivery Order/ Purchase Order"
Z_{G3} = contribution percentage of a Technical Sergeant for "Commodity Delivery Order/ Purchase Order"

Z_{H3} = contribution percentage of a Staff Sergeant for "Commodity Delivery Order/ Purchase Order"
Z_{I3} = contribution percentage of a Senior Airman for "Commodity Delivery Order/ Purchase Order"
Z_{J3} = contribution percentage of an Airman First Class for "Commodity Delivery Order/ Purchase Order"

Z_{A4} = contribution percentage of a Major for "Strategically Sourced Commodity"
Z_{B4} = contribution percentage of a Captain for "Strategically Sourced Commodity"
Z_{C4} = contribution percentage of a Lieutenant for "Strategically Sourced Commodity"
Z_{D4} = contribution percentage of a Chief Master Sergeant for "Strategically Sourced Commodity"
Z_{E4} = contribution percentage of a Senior Master Sergeant for "Strategically Sourced Commodity"
Z_{F4} = contribution percentage of a Master Sergeant for "Strategically Sourced Commodity"
Z_{G4} = contribution percentage of a Technical Sergeant for "Strategically Sourced Commodity"
Z_{H4} = contribution percentage of a Staff Sergeant for "Strategically Sourced Commodity"
Z_{I4} = contribution percentage of a Senior Airman for "Strategically Sourced Commodity"
Z_{J4} = contribution percentage of an Airman First Class for "Strategically Sourced Commodity"

B. USER INPUT VARIABLES

Let:

Q_1 = annual demand for "Commodity Contract"
Q_2 = annual demand for "Commodity Delivery Order"
Q_3 = annual demand for "Commodity Purchase Order"
Q_4 = annual demand for "Strategically Sourced Commodity Contract/ Delivery Order/ Purchase order"
Q_5 = annual demand for "Service Contract (Commercial > \$150,000 & Master Strategic Source Contract)"
Q_6 = annual demand for "Service Task Order"
Q_7 = annual demand for "Strategically Sourced Service Contract/ Task Order/ Purchase Order (Commercial > \$15,000)"
Q_8 = annual demand for "Service Purchase Order (Commercial < \$150,000)"
Q_9 = annual demand for "Strategically Sourced Service Contract/ Task Order/ Purchase Order (Commercial < \$150,000)"
Q_{10} = annual demand for "Construction (> \$150,000 & Master Strategic Source Contract)"
Q_{11} = annual demand for "Construction Task Order"
Q_{12} = annual demand for "Strategically Sourced Construction Contract/ Task Order"
Q_{13} = annual demand for "Architecture and Engineering (> \$150,000 & Master Strategic Source Contract)"
Q_{14} = annual demand for "Architecture and Engineering Task Order"
Q_{15} = annual demand for "Strategically Sourced Architecture and Engineering Contract/ Task Order"

Q_{16} = annual demand for “Blanket Purchase Agreement”
Q_{17} = annual demand for “Strategically Sourced Blanket Purchase Agreement”
Q_{18} = annual demand for “Sealed Bid”
Q_{19} = annual demand for “Options”
Q_{20} = annual demand for “Modifications”
Q_{21} = annual demand for “Close-outs”

C. OBJECTIVE FUNCTION

Min: $58.53X_A + 48.42X_B + 35.74X_C + 50.82X_D + 42.68X_E + 38.19X_F + 33.33X_G + 28.28X_H + 23.03X_I + 17.84X_J$

D. CONSTRAINTS

$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_1 * Q_1$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_2 * Q_2$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_3 * Q_3$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_4 * Q_4$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_5 * Q_5$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_6 * Q_6$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_7 * Q_7$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_8 * Q_8$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_9 * Q_9$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{10} * Q_{10}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{11} * Q_{11}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{12} * Q_{12}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{13} * Q_{13}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{14} * Q_{14}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{15} * Q_{15}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{16} * Q_{16}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{17} * Q_{17}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{18} * Q_{18}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{19} * Q_{19}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{20} * Q_{20}$
$X_A + X_B + X_C + X_D + X_E + X_F + X_G + X_H + X_I + X_J \geq Y_{21} * Q_{21}$

$X_A \geq Z_{A1}(Y_1 * Q_1)$
$X_A \geq Z_{A3}(Y_2 * Q_2)$
$X_A \geq Z_{A3}(Y_3 * Q_3)$
$X_A \geq Z_{A4}(Y_4 * Q_4)$
$X_A \geq Z_{A1}(Y_5 * Q_5)$
$X_A \geq Z_{A2}(Y_6 * Q_6)$
$X_A \geq Z_{A2}(Y_7 * Q_7)$
$X_A \geq Z_{A2}(Y_8 * Q_8)$
$X_A \geq Z_{A2}(Y_9 * Q_9)$
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