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AN ANALYSIS OF A U.S. ARMY GARRISON'S CENTRALIZED HUMAN RESOURCES CUSTOMER QUEUING PROCESS AND RECOMMENDED TOOLS FOR IMPROVEMENT

September 2018

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LIST OF ACRONYMS AND ABBREVIATIONS

ACL	Access Control List
CAC	Common Access Card
CAO	Casualty Assistance Office
CEAC	Cost and Economic Analysis Center
CEF	Cost Effectiveness Function
COA	Course of Action
CoN	Certificate of Networthiness
COTS	Commercial off-the-Shelf
CY	Calendar Year
DAC	Department of Army Civilian
DAV	Disabled American Veteran
DEERS	Defense Enrollment Eligibility Reporting System
DFARS	Defense Federal Acquisition Regulation Supplement
DISA	Defense Information Systems Agency
DISN	Defense Information Systems Network
DMDC	Defense Manpower Data Center
DMV	Department of Motor Vehicles
DoD	Department of Defense
DREN	Defense Research Engineering Network
FY	Fiscal Year
GDP	Gross Domestic Product
HPCMP	High Performance Computing Modernization Program
ICE	Interactive Customer Evaluation
ID	Identification
JAP	Joint Applied Project
LOE	Lines of Effort
LSS	Lean Six Sigma
MIL	Military
MILPO	Military Police
MIPR	Military Interdepartmental Purchase Request

NAF	Non-Appropriated Funds
NIST	National Institute of Standards and Technology
NEC	NETCOM
NETCOM	Network Enterprise Technology Command
NRE	Non-Recurring Engineering
NVA-R	Non-Value Added Requirement
OUF	Operational Utility Function
PCS	Permanent Change of Station
PII	Personally Identifiable Information
RAPIDS	Real-Time Automated Personnel Identification System
RDT&E	Research, Development, Test and Evaluation
SE	Systems Engineering
SES	Senior Executive Service
SFL	Soldier for Life
SME	Subject Matter Expert
SMS	Short Message Service
SQL	Structures Query Language
TCS	Temporary Change of Station

EXECUTIVE SUMMARY

The Joint Applied Project team conducted a comprehensive study of the queuing system utilized at an Army garrison's human resources service facility. This study collected data from the hard copy and electronic systems already in use and defined the issues currently limiting the existing infrastructure. The team was able to obtain RAPIDS hard copy reports and Q-matic electronic reports. The data was analyzed using statistical methods and illustrated a deficiency in the wait times at the service facility. Excessive wait times were defined as the key factor to be addressed by the team in this study.

The focus of this study was to define and analyze alternatives to improve the functionality of the service facility. The team used a rigorous systems engineering approach to create a weighting system for comparing different solutions, incorporating cost, schedule, and performance impacts across a variety of factors. The team researched commercial and government software developers to define four potential solutions. These were a government-developed software solution, a current vendor (Q-matic) software package, a competing commercial software design (Q-flow), and a hybrid of upgraded existing software and government support functions. The factors evaluated included cost, system integration, reporting, customer experience, and reliability, maintainability, and supportability. These were further developed into discrete criteria within each factor to increase fidelity of the analysis.

The results developed by the team through the comprehensive scoring analysis demonstrated that a hybrid solution utilizing Q-matic software and government support would be the best value solution to improve service. The baseline was compared against all four alternatives and earned a lower score. The hybrid solution was ranked as the best technical solution, followed by the government developed software, upgraded Q-matic, Q-flow, and current solutions respectively. The best value to the government was determined to be the current baseline, followed by the hybrid, upgraded Q-matic, Q-flow, and government solutions in order. This ranking validated that conclusion that the overall best solution for implementing improvements, including continued use of the current baseline software, was the hybrid software approach.

The team also identified improvements that could be made in current management processes and software, both current software and recommended software, that could be implemented in a modular approach to expand capability in the future. This forward plan could be implemented generally with any solution, but was expected to provide the best value as follow-on effort to implementation of the recommended hybrid software approach. The principles used in this forward planning reference Lean Six Sigma practices for efficiency and engineering best practices that are considered standard for process improvement across both commercial and government institutions.

This study comprehensively utilized the systems engineering process to research and define a problem, propose solutions, analyze alternatives, determine value, and recommend both a single solution and path to implementation and improvement for the future. The data was gathered directly from the service facility and converted into tables and graphs to detect trends and determine the key issues. The proposed solutions were rigorously evaluated against a weighted scoring system to determine both technical effectiveness and value. The forward planning incorporated engineering practices regarded as industry standards for process improvement. All data was collated and referenced in the appendices of this study for further review to verify the conclusions reached. The final proposed solution to the problem identified as excessive service wait times was a hybrid approach, a combination of commercial software and government support structure to tailor the complete service package to the specific needs of the customer. The team expects the implementation of this solution to be the best value and most significant performance increase for the service facility.

I. INTRODUCTION

A. PROBLEM CONTEXT

In July 2012, a U.S. Army garrison's centralized human resources services were consolidated into one building in an effort to provide efficient and convenient services to their customers. However, over time, the demand for the facility's services has far exceeded their throughput capability. The installation is home to more than 70 Federal organizations and contractor operations and employs approximately 40,000 people. Limited resources and operational constraints have contributed to wait times deemed unacceptable by the user community. The type of services rendered at this facility include retirement services, personnel services support, transition services, job related outreach and training, identification cards and tags, as well as casualty assistance. An overwhelming majority of the services rendered from this facility falls into the identification card category, specifically working with Defense Enrollment Eligibility Reporting System (DEERS) and Real-Time Automated Personnel Identification System (RAPIDS). Customers of this facility include, but are not limited to, active duty military, civilian, retirees, veterans, dependents, spouses, contractors, and foreign nationals.

Currently, the customers are experiencing an 8- to 12-week lead time in the ability to schedule appointments online through the RAPIDS appointment scheduler, hosted by the Defense Manpower Data Center (DMDC). Identification card appointments are scheduled from 0730–1330 Monday through Friday; however, the facility only accepts 18 appointments per day. At full operating surge capacity (running two additional machines with Government resources), the facility can process 120 to 144 customers each day. At normal capacity, the facility is only authorized 4 support contractors for the DEERS/RAPIDS section. The normal capacity is 80 people per day with authorized resources. Although the last appointment is for 1330, the facility accepts walk-ins. Upon arrival, walk-ins are required to pull a number through the onsite Qmatic system and physically wait in the waiting room for potential availability. Given the throughput limitations, wait times for walk-ins can range from hours to multiple business days.

Qmatic is the queue management system used by the service facility. The Qmatic system allows customers, upon entry into the facility, to pull a ticket with an alpha numeric code. The alpha character identifies the type of service the customer is requesting (Department of Motor Vehicles, identification cards, etc.), while the numeric character identifies the queue in line. The Qmatic software program resides on a computer internal to the service facility and is not connected to a network to support any external communication purposes. The Qmatic software at the service facility has not been updated in years and Qmatic's technical support service technicians are not familiar with trouble shooting techniques for this outdated software type. Currently, the Qmatic system at the facility does perform its intended function and provides a queuing service to walk in customers who remain onsite at the facility until their number is called.

The senior commander of the installation created lines of effort (LOEs), illustrated in Figure 1, that strive to meet goals which create a Federal Center of Excellence. These LOEs have been widely communicated with the installation's tenants as well as the local community leaders. The senior commander and garrison commander have previously supported improvement initiatives that align with these LOEs. The senior commander is the officer responsible for the main mission activities on the installation and holds executive-level authority of installation management services (U.S. Army War College, 2011, p. 386). The garrison commander is responsible for day-to-day operations which include living and working conditions for installation personnel (Department of the Army, 2007, p. 107). The garrison commander is also the lead for base support operations management for the senior commander. The authors obtained approval from the garrison commander and the human resources facility leadership to commence the analysis.

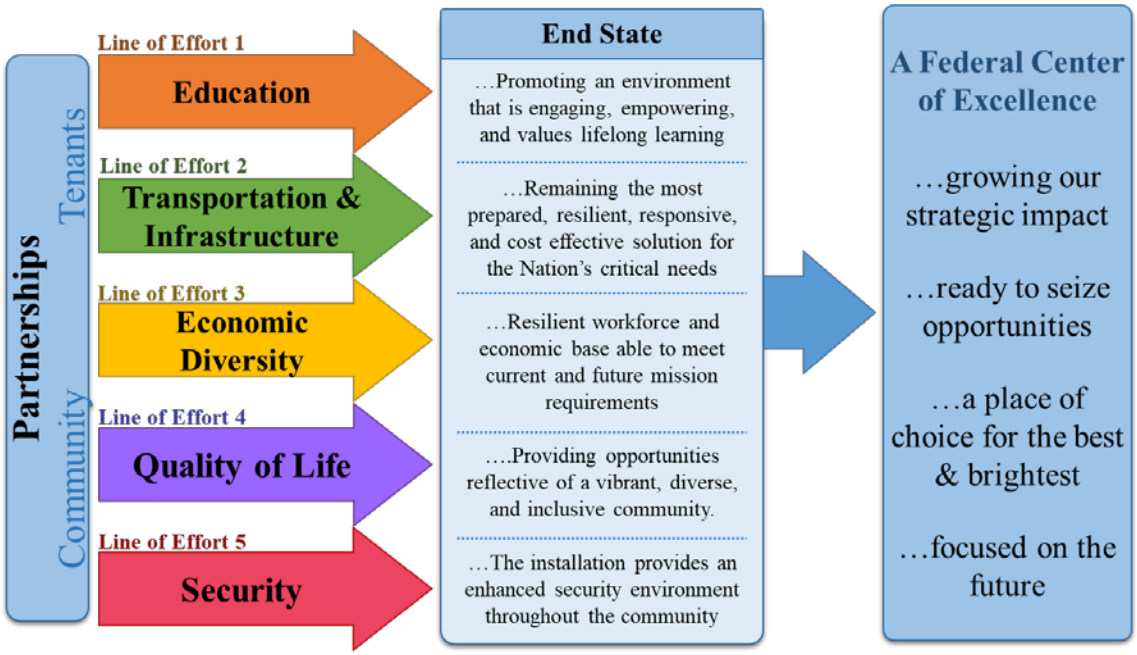

Figure 1. Installation Senior Commander's Lines of Effort

This human resources facility's extensive waiting room times and its inability to provide streamlined services to their customers negatively impacts LOE 2 (transportation and infrastructure), LOE 4 (quality of life) and LOE 5 (security). Given that this issue touches multiple LOEs which have the attention of the senior commander and garrison commander, immediate changes (beyond the scope of this project) are being addressed to allow for more streamlined operations of this facility and increase throughput. Clearly, quality of life is impacted when personnel are expending valuable hours waiting onsite for service. Without proper and timely badging through this facility, security of the workforce and installation is of great concern. Proper badging is imperative for daily transportation of the workforce. Resources (financial, time, personnel), and the responsiveness, resiliency and productivity of the customer base continue to see impacts due to the throughput issues at this facility.

This joint applied project (JAP) provides an analysis of a U.S. Army garrison's centralized human resources customer queuing process and provide recommended tools for improvement. These improvements can be evaluated by the garrison commander to compliment additional throughput solutions being developed by the command. To

maintain an open line of communication with the garrison commander, JAP endorsement was obtained (Figure A-1) to ensure leadership involvement in the research process.

B. RESEARCH GOAL

The primary goal of this project is to propose a solution that decreases the non-value added, but required (NVA-R) wait time that the garrison customer base experiences while waiting in the lobby of the service facility and convert it into value-added wait time. Figure 2 provides a visual representation of current process that displays how a large majority of the current process is spent by the individual physically waiting in the garrison service facility lobby for a service. This excessive wait time for walk-in customers can affect quality of life, security, resources (financial, time, and personnel), and the responsiveness, resiliency, and productivity of the workforce. This project proposes a solution to decrease that physical wait time in the lobby, thereby allowing the individual to reallocate their time toward value-added activities whether that be at home, in the office, or other location. Figure 3 provides a visual representation of the future state of the process this project addressed.

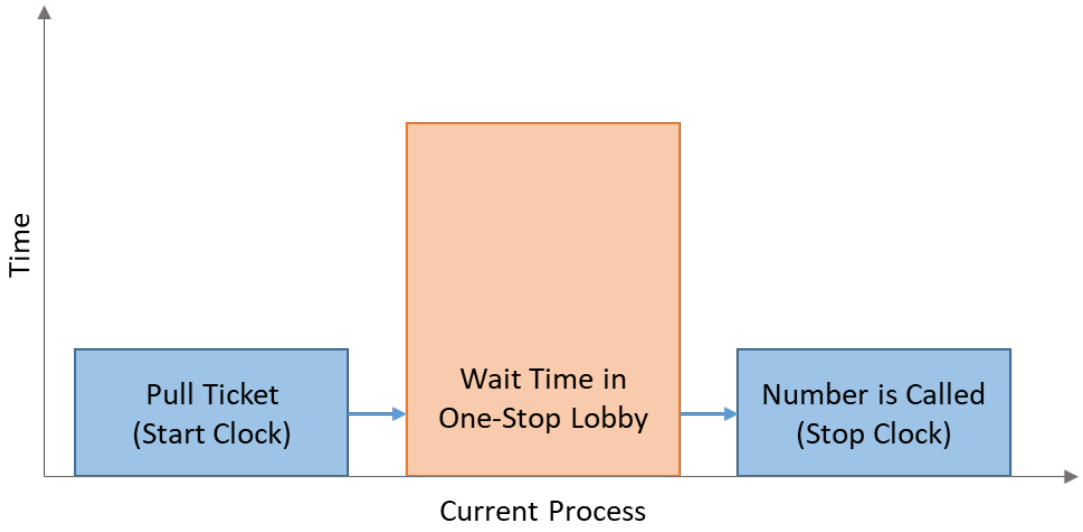

Figure 2. Current State of the Process

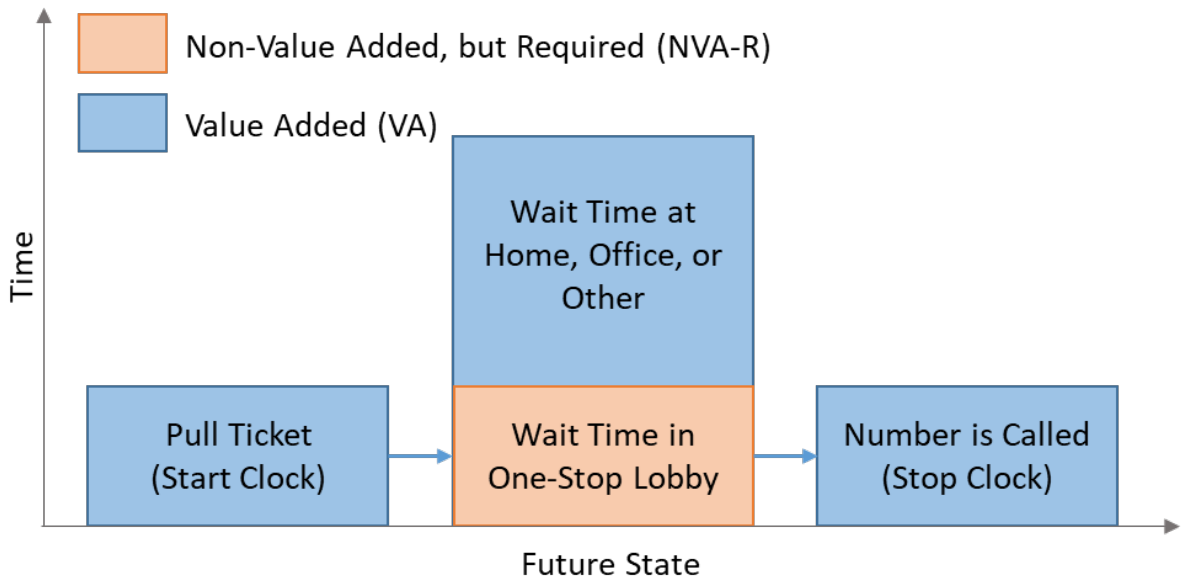

Figure 3. Future State of the Process

The secondary goal is to provide a proposed means to increase customer satisfaction and communication of the Department of Defense (DoD) workforce when they require services from the garrison service facility. In order to accomplish both primary and secondary goals, this JAP sought to accomplish the following objectives:

- Understand and document the current challenges and queuing process implemented at the service facility for walk-in appointments.
- Collect and analyze the data associated with walk-in customers.
- Identify and research new tools and/or methodologies to solve the wait time issues or mitigate its impacts. Conduct a trade study on those technical solutions.
- Provide recommendations to garrison commander for consideration and potential implementation.

C. RESEARCH SCOPE

This project researches and addresses the wait times associated with the queuing system for walk-in customers only. Upon arrival, walk-ins are required to pull a number through the Qmatic system onsite and physically standby in the waiting room for potential availability. Given the throughput limitations, wait times for walk-ins can range from hours to multiple business days. Walk-ins account for a large majority (approximately 85%) of the daily appointments that are processed per day at the garrison service facility. This project does not focus on customers who arrive at the garrison service facility with a pre-scheduled appointment through the online RAPIDS appointment scheduler. Although customers are experiencing an 8–12-week lead time before they can identify an open appointment in RAPIDS, they are typically seen on average within 7–10 minutes of their scheduled appointment time once they arrive for service at the facility. Additionally, customers with appointments only account for approximately 15% of the daily appointments that are processed per day at the service facility.

It is significant to note that this project does not research ways to increase throughput per day (i.e., increasing the number of customers that the service facility can process per day or decreasing the actual wait time required of each customer). Using the data report generated by the current queueing system in Appendix B, it is estimated that the service facility can process 120–144 customers per day at a full surge capacity. The report also suggests that at normal capacity, the facility services 80 customers per day through the DEERS/RAPIDS support areas. Throughput issues at this facility have the attention of the garrison commander and the senior commander of the installation. While they are committed to resolving the throughput issue of this high demand facility, this project predominately focuses on decreasing the physical wait time in the lobby, thereby allowing the individual to reallocate their time toward value-added activities elsewhere. This recommended solution for this project mitigates and eliminates the impacts and symptoms of those weight times experienced by the customer. This project complements any future throughput enhancement implemented by the garrison commander.

The data collection process for this project starts when a customer “pulls” a ticket for a particular service. It does not include the time it takes to travel to the service facility

or stand in line prior to the ticket pull. This process stops when the service facility calls the customer back to render the requested service. This project did not seek to decrease the time it takes the staff to perform the service. It has been proven through the facility's previous analysis that each action at the service facility takes approximately 20 minutes for the service to be completed.

Lastly, this project serves as a technical resource only and in no way obligates the garrison commander to fund or sustain the recommendations provided in this report. This JAP delivers a final report to both the Naval Postgraduate School and the garrison commander that documents the technical solutions that were analyzed, the courses of action that were explored, and the final recommendations for potential paths forward. This project does not produce the finalized, or funded, technical capability ready for implementation. Upon receipt, the garrison commander can review the provided report and determine if the garrison or other organization can utilize and fund its recommended technical solutions to complement existing improvement projects being implemented across the garrison.

D. RESEARCH CONSTRAINTS

This research is limited by the broad nature of the subject Army garrison's human resources. The sample size used in the data collection for this research is representative of only a portion of services offered by the subject Army garrison in terms of categories of services. This study evaluated services which require the customer's physical presence to render the service, necessitating either a walk-in or pre-scheduled appointment. There are over 80 human resources services categorized under seven sections, each which have different management practices, performance, funding, and limitations on staffing. As such, the sample size collected for this study is moderately impacted by each service's collection and maintenance of process drivers and manually recorded data. Baseline data for customer wait times is collected for each service through the Qmatic queueing system, which provided a basis for general customer flow. Data limitations are discussed in Chapters IV and V and provide recommendations for how further studies can supplement the limitations of this research project.

E. RELATED WORK

In addition to the research scope addressed in this report, related data is collected to further justify the need for change at the installation's centralized human resources facility. As with any commercial service, reviews and feedback received from the customer should be earnestly considered as process improvements are implemented into a service. The evaluation of the facility's services includes an assessment of existing social media data as well as customer feedback from the public interactive customer evaluation (ICE) website.

II. BACKGROUND

A. OVERVIEW

In July 2012, a U.S. Army garrison consolidated several human resources services into one location. On average, the facility services 2,500 to 4,000 customers each month; however, due to fluctuations in contractor support and various other circumstances, the demand can spike to over 10,000 customers a month (as evidenced in Appendix B). The facility has a limited throughput and cannot render timely services given their operational constraints. This environment has resulted in extensive waiting room times, spanning hours to days. The service facility continues to operate at full capacity and cannot accept additional customers. Current customers are impacted negatively by the wait times experienced at the human resource service facility in multiple ways. These negative impacts extend to the garrison as a whole, affecting productivity, responsiveness, and resources needed for normal operations.

1. Services

The services rendered at the human resources service facility include, but are not limited to, the following categories of support:

Retirement services

- Retirement applications
- Retirement orders
- Survivor benefits program
- Retiree assistance
- Service calculations

Personnel services support

- Awards

- Badges
- Special pay
- In-processing
- Out-processing
- Temporary change of station (TCS) orders
- Permanent change of station (PCS) orders
- Records updates
- Voting assistance

Transition services

- Separation orders
- Records updates
- Separation certificates
- Transition counseling
- Survivor benefits program

Job-related outreach and training

- Counseling
- Community outreach
- Boots to business
- Employment opportunity distributions
- Course scheduling

- Job fairs
- Organizational liaison

Identification cards and tags

- CAC issuance
- ID card issuance
- DEERS updates
- CAC reporting
- Supply management/accountability
- ID tags
- Equipment maintenance

Casualty Assistance Office (CAO) support

- Referrals
- CAO roster
- CAO training coordinator
- Unit liaison
- Customer service

Other

- Notary
- Government purchase card
- Files management
- Performance management

- Interactive customer evaluation (ICE)
- Work orders
- Department of Motor Vehicles (DMV)

The majority of the services rendered from the service facility falls into the identification card and tags category, specifically working with DEERS and RAPIDS. Table B-2 (Appendix B) details each service and the customer flow through each.

DEERs is a DoD database that contains information on the majority of customers serviced through the human resources facility. This data is predominantly composed of the garrison workforce including uniformed service members, civilians, sponsored foreign military members, family members (dependents), and other personnel (Military Advantage, n.d.b). The RAPIDS is a U.S. DoD system used to issue the definitive credentials within DoD. RAPIDS uses information stored in the DEERS when providing these credentials. Used together, these two systems are commonly referred to as a DEERS/RAPIDS system.

2. Customer Base

Customers of the service facility include, but are not limited to, active duty military, civilian, retirees, veterans, dependents, spouses, contractors, and foreign nationals providing support to the garrison. The service facility not only services the garrison workforce, it also serves a customer base that spans across state and county lines, including metropolitan and rural residents (My Base Guide, 2015). The garrison leadership is committed to supporting the diverse workforce and all of the citizens that use garrison services. Leadership recognizes that cooperation with local industry and civil government across fifteen counties is essential to providing the highest level of support to both the active military presence and all of the support and families that rely on the garrison services (My Base Guide, 2015).

This garrison is considered as a nationally recognized Federal center of excellence focused on serving the joint Warfighter. A Federal center of excellence provides support,

best practices, leadership, research, and training to set the standard for other garrisons. Best practices across garrisons should be shared for continuous improvement. While the human resources facility provides many valuable services, the impact of their throughput issues are noticed across the garrison as an area that desperately requiring senior leadership attention for change.

According to the garrison overview from My Base Guide, the operations performed by garrison personnel support five main operations:

1. Logistics services including acquisition, materiel management, contracting, and life-cycle sustainment
2. Space exploration operations and missile defense capabilities
3. Homeland security, threat analysis, and explosives training and research
4. Innovative research, development, test and evaluation to be applied into advanced systems and equipment
5. Installation sustainment activities to ensure proper resources are allocated for long term installation and workforce operation. (My Base Guide, 2015)

My Base Guide also reports the demographics for the garrison and the customer base of the service facility:

- Veterans, retirees, spouses, and dependents
- Senior soldiers
    - 14 flag officers and greater than 100 senior executive service (SES) members
- Employees 37,000 active duty military ≈ 835
    - Government civilians ≈ 20,500
    - Contractors ≈ 16,000
- Highly educated and skilled workforce
    - 68% w/bachelor's degree or higher
    - Major career fields: science and engineering, logistics management, acquisition and contracting

- Garrison houses more than 70 Federal Government organizations and contractor operations which support the most prestigious defense and civil space programs.
- Management of over $50 billion in annual Federal budgets (My Base Guide, 2015)

B. PROBLEM DOMAIN

1. Description

The service facility's customers are encountering extensive waiting room wait times for walk-in service. With the RAPIDS online appointment scheduler, customers have an 8–12-week lead time to schedule the next available appointment. The facility cannot render service to all customers in a timely manner using the current process.

There is an obvious throughput issue at the service facility and resources are a known limiting factor in being able to increase the level of throughput desired to support the customer base. Throughput issues at this facility have the attention of the garrison commander and the senior commander of the installation. While they are committed to resolving the throughput issue of this high demand facility, this project focuses more on decreasing the physical wait time in the lobby thereby allowing the individual to reallocate their time toward value-added activities whether those be at home, in the office, or other. This project mitigates and eliminate the impacts and symptoms of those physical weight times experienced by the customer.

Specifically, this study focuses on accomplishing the following objectives:

- Understand and document the current challenges and queuing process implemented at the service facility for walk-in appointments.
- Collect and analyze the data associated with walk-in customers.
- Identify and research new tools and/or methodologies to solve the wait time issues or mitigate its impacts. Conduct a trade study on those technical solutions.

- Provide recommendations to garrison commander for consideration and potential implementation.

This study recommends an option for customers to remotely schedule "walk in" appointments, communicate appointment status, and provide information on service time, reminders, and cancellations (walk-ins and appointments). Allowing customers to "wait" anywhere and providing updates about the status of their wait is expected to improve morale, quality of life, and productivity of the workforce. While communicating through today's primary mode of communication, a mobile device (Murtagh, 2014), is imperative, recommendations to allow the option for the customer to use a web browser is necessary, as some organizations do not allow mobile devices inside their buildings.

2. Customer Impact

As stated, the customers of the service facility are a highly skilled workforce making critical contributions to missions aligned in national defense and civil space efforts. Insufficient resources have plagued the service facility in being able to efficiently support the necessary throughput of their vast customer base.

Currently, the customers are experiencing an 8- to 12-week lead time in the ability to schedule appointments online through the RAPIDS appointment scheduler, owned by the DMDC. Identification card appointments are scheduled from 0730–1330 Monday through Friday; however, even at full operating surge capacity, the facility can only process 120–144 customers each day. However, at normal capacity using authorized resources, the facility serves 80 customers per day in the DEERS/RAPIDS section. The service facility also accepts "walk-ins." Upon arrival, walk-ins are required to pull a number through the Qmatic system onsite and physically wait in the waiting room for potential availability. Given the throughput limitations, wait times for walk-ins can range from hours to multiple business days. It is common for a sign to be placed on the lobby door of the service facility by 1000 stating that they are at capacity for the day and cannot take any additional walk-ins. It is anticipated that hundreds of potential customers are turned away, voluntarily leave, or miss their number being called. There is no way to fully quantify a customer impact metric as the current Qmatic system does not offer a framework to assess a comprehensive

metric of all customers. Customers with appointments through RAPIDS do not obtain a number from the Qmatic system. The service facility has a hard copy print out of the customers with appointments scheduled through RAPIDS and Qmatic has a variety of automated reports for metrics regarding walk in customers. Data must be manually merged to obtain a consolidated metric.

The impact of the service facility's waiting room is extensive and while there is no tangible method to capture a complete metric of customers unable to be served, the service facility captures a limited amount of manual metrics and they have feedback from the ICE system. Both methods relay a consistent theme of dissatisfied customers unable to attain timely service.

The ICE system is a DoD-wide application utilizing web services to collect feedback on multiple government organizations. ICE works by giving users the ability to input comment cards to detail their experience at service centers on military installations and related facilities. The intent of ICE is to allow managers to monitor customer satisfaction and improve services by responding to individual comments and aggregate reports (Interactive Customer Evaluation [ICE], n.d.). The human resources facility manager has access to the ICE system and receives information from the surveys, specific to his mission. The facility manager downloaded the summary information and provided it to the authors of this analysis. According to the service provider summary from ICE, customer evaluations provide several benefits:

- Allows customers to provide feedback to service provider managers
- Provides leadership with data on service quality
- Allows management to compare performance against similar DoD organizations
- Provides an enterprise wide capability to manage the resources necessary to collect and report on customer feedback and satisfaction ratings. (ICE, n.d.)

ICE Survey results collected for the military ID and CAC services from 1 January 2017 to 31 December 2017, obtained responses from 428 customers with only 67% of them being satisfied customers.

As reported in the ICE survey website, a recent survey yielded the following metrics:

- 49% stated that the product or service met their needs
- 75% stated that staff members were courteous
- 54% stated that their actions were completed the first time
- When asked if the customer was seen in a timely manner…
    - 16% - Immediately
    - 71% - Waited too long
- When asked if the customer was satisfied with the service provided…
    - 24% - Excellent
    - 59% - Poor service
- Customer was asked to rate the overall service
    - 18% - Excellent
    - 69% - Poor
- Military rank or civilian grade
    - 5% - Military rank 01–06
    - 31% - Civilian grade GS 11–15
    - 32% - Retired military
    - 14% - Dependent
    - 14% - Contractor (ICE, n.d.)

Additionally, there are public comments on social media sites with dissatisfactory reviews.

> I have come here 3 days now showing up at 9am which a person would think is plenty early enough to get an ID made. I have had to leave twice because the "system crashed" which seems to happen around lunch each time. So far today I have been here 4 hours and have yet to be helped. My reserve unit is out of (the neighboring state) and by now I could have drove there for a new ID and been on my way home. This isn't anything new for this place from everyone I've spoken to. (Jeans, 2018)

> I was amazed at how many folks were told after 10 AM that they were too late to receive any service and to come back at 7:30 AM and try again. Or they were told to go on-line to make an appointment and the earliest available date was in mid-September (when this is July). Really, this is how you run an organization whose sole purpose is to take care of essential customer needs? Getting proper credentials, identification, or CAC cards is necessary for these people to function every day. Blaming the customer because they didn't arrive there before 7:30 AM to get a number, who do you think you work for? The hours of operation on the door are the hours you better be open for business and doing everything in your power to serve the customers that enter your office. I saw a distinct increase in the pace the customers were called after lunch when no more customers were being added. I saw an endemic process to fill up the waiting area to capacity and then cut off folks rather than quickly process people. I saw at times three people on the front desk for the sole purpose of telling folks they were unable to do their jobs and help them. I fought wars with less than a full complement of troops and equipment, what's your excuse for providing less than your best all the time. My next step is an Inspector General complaint and a letter to (our Congressman) if I don't hear from someone about how this problem has been solved. Think about how much productivity is wasted by folks sitting at the (service facility) instead of at work. (Heinse, 2017)

There is a distinct trend of customer frustration from the workforce. Poor customer service coupled with unsatisfied customers who felt as though they waited too long for service, or did not receive the service they anticipated, reflects poorly on their experience in the military ID and CAC services during this timeframe. The customers are a majority of highly skilled workforce that is reflected in the higher grade and salaries of the ICE survey participants. Limited resources, among other factors, have affected the ability to provide the support needed to adequately service this community. While the service facility may be using every available resource to serve their customer base, the perception of poor customer service is a natural assessment when the customer is frustrated, morale and quality of life are impacted, and their professional and personal productivity is impacted.

Throughput issues at this service facility have the attention of the garrison commander and the senior commander of the installation. While they are committed to resolving the throughput issue of this high demand service facility, this project deliverable focuses on improving the customer queuing process and physical wait room times. If implemented, the recommendations provided in this study can complement any future throughput enhancement implemented by the garrison.

3. Economic Impact

This garrison serves as the "Economic Engine" of the local area and houses the region's top two employers with a workforce of more than 37,500 (My Base Guide, 2018). As noted in the base guide, the local community and businesses are directly impacted by the workforce size of the garrison, which continues to grow with the constant need for DoD acquisition programs.

According to the garrison base guide (2018):

> DoD's Office of Economic Adjustment commissioned a study conducted by the University of Illinois at Chicago's Natalie P. Voorhees Center that was released in early 2012. After analyzing the total economic impact of Redstone Arsenal and its activities, the 2013 total economic impact for all direct, indirect and induced activities is estimated at $12.7 billion annually. This is equivalent to nearly 7% of the entire State of Alabama's Gross Domestic Product (GDP). In addition to more than 37,500 direct jobs located on Redstone Arsenal, 66,500 indirect and induced jobs are created across the region for a combined total of 104,000 jobs attributed to the Arsenal. (My Base Guide, 2018)

In summary, workforce wages account for nearly $3.3B while an additional $5.9B go towards contractor services and direct procurement, resulting in approximately $460M in economic impact to the local area in the form of personal income, sales and property taxes, and corporate taxes (My Base Guide, 2018).

4. Community and Installation Impact

The installation senior commander has communicated LOEs associated with strategic alignments across the community and installation tenants to achieve recognition as a Federal center of excellence. The senior commander has focused these partnerships on the lines of effort shown in Figure 1.

The services rendered at the facility touch every member of the partnerships (community and tenants) identified in support of the installation senior commander's LOEs. Specifically, LOE 4 and 5, quality of life and security are impacted with the issues arising from the service facility's throughput for ID card support. Customers are wasting hours sitting in a waiting room while they could be doing valuable work or accomplishing

personal actions. Additionally, customers siting in the waiting room for hours with their young dependents lead to an uncomfortable situation for the young children and other professional customers waiting for service. Being respectful of each customer's valuable time by decreasing frustration and the amount of physical waiting room wait time, is a benefit to the quality of life and productivity for the workforce. Proper and timely badging of the customer base additionally fosters an environment of security and safety for the installation and neighboring communities.

In reference to LOE 2, transportation and infrastructure, timely military ID and CAC issuance fosters a prepared, responsive, resilient, and productive workforce. These attributes contribute to the foundational infrastructure to providing a cost effective workforce to the installation.

5. Previous Attempts to Streamline the Process

A very small portion of the service facility's processes have been the subject of a previous Lean Six Sigma (LSS) project established in 2009. The LSS project sought to reduce in-processing and out-processing lead times by 10% for Government stakeholders to include managers, civilian employees, and contractors (Reese, 2009). The project evaluated how long it takes for a new garrison employee to process into the workplace (i.e., complete required actions for official ID cards, computer/network access, clearance, orientation, authorizations, etc.) and to begin productive work. It was determined through this LSS project that it took nearly 55 days to process in a new employee, highlighting the issues related to customer throughput as a result of inconsistent processes. Consequently, other areas of concern were highlighted in the current process, with wait times and communications recommended as areas of further study.

C. RELEVANT FACTS AND ASSUMPTIONS

The scope of this academic study focuses on the research of available technologies/programs that can be used to create a remote waiting room and mobile communication capability for the human resources facility. With increased communication to the customer base, it is expected that a mobile communication tool decreases the amount of time that the customer has to physically spend in the waiting room anticipating potential

service, thereby increasing likely productivity of the workforce, morale and quality of life of the customer base, and the security and safety of the installation. The contents of this study are to be released to the garrison commander, providing documentation of the technical solutions that were analyzed, the courses of action (COA) that were explored, and the final recommendations identified through this assessment. The garrison commander has agreed to review the recommendations and determine if the garrison or other organizations can use its contents to complement existing processes.

Should the garrison choose to implement the recommendations from this study, they will be responsible for providing initial operations and maintenance funds to support the hardware and software purchase. Through negotiations with a local Federal research agency, the authors of this study have secured program integration support for a proof of concept phase. This local Federal agency has agreed to provide the program integration support to coordinate the new workflow, security, safeguarding of personally identifiable information (PII), and website interface. Based on the research conducted in this JAP, developing a mobile communication capability could serve to increase the productivity of their Government and contractor workforce with a cost avoidance of $2 million to $4 million dollars. Hence, the local Federal agency sees great benefit in investing in the development. The local Federal agency will provide support for program integration and hosting through an initial proof of concept phase. Following the successful demonstration of the website and interface, the garrison would be responsible for sustainment funding of the software and program integration support through operations and maintenance dollars.

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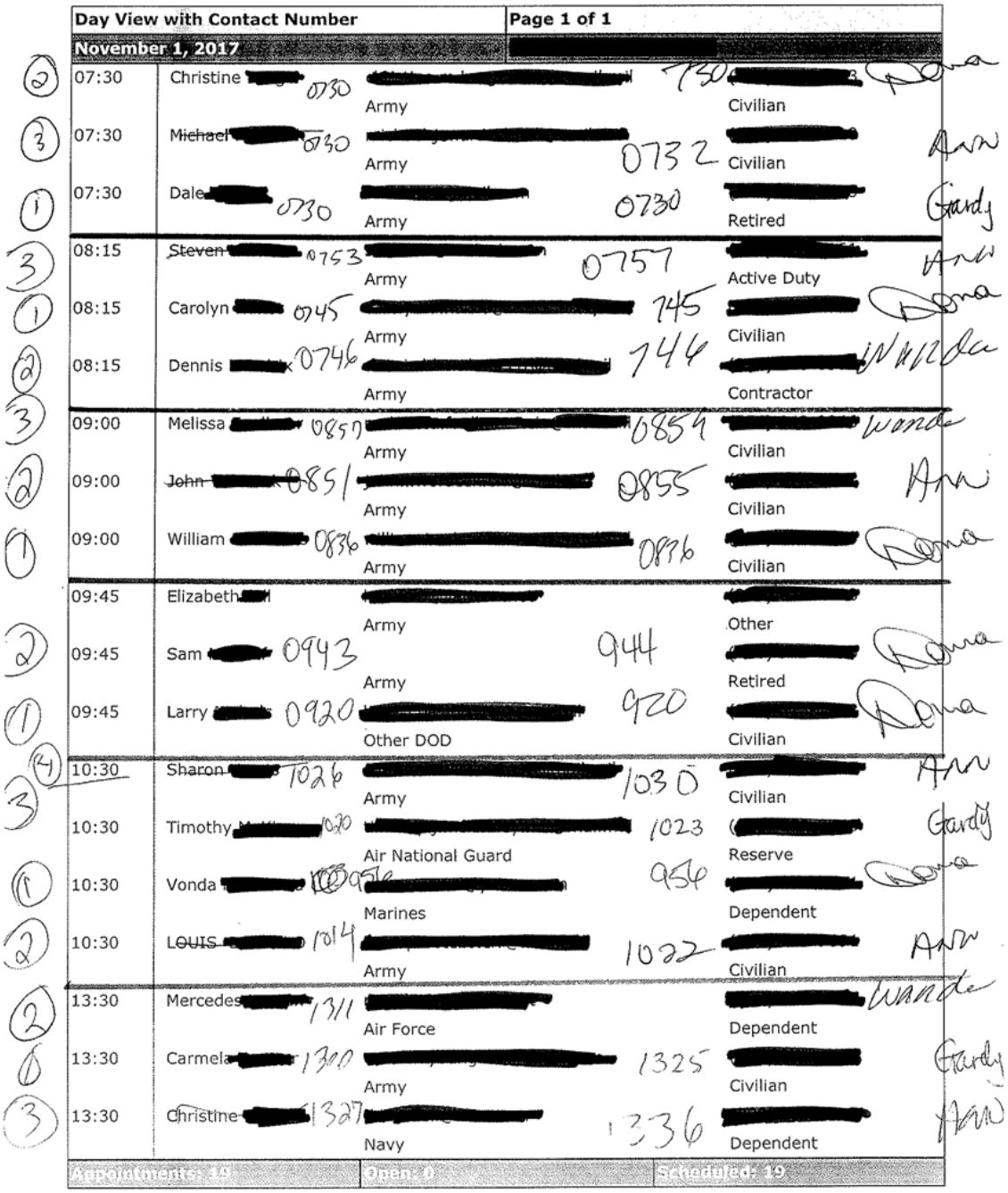
III. DATA

A. DATA SOURCES AND LIMITATIONS

1. Physical Data

Performance data for services rendered is currently collected through two main data sources. The first is a daily schedule that is printed on paper that shows the appointment time established in RAPIDS for each of its planned customers that day. Typically, only 18 timeslots are reserved for appointments per day. There are only six appointment times (0730, 0815, 0900, 0945, 1030, 1330) and each time has three or four appointments. The facility staff records the customer's order of arrival (1, 2, 3, 4) for the scheduled appointment time so they can serve the customer this order of priority. Additionally, when the customer arrives for service, their arrival time is documented by hand, as well as the time at which they are seen. The name of the service provider is also noted on this data sheet. Unfortunately, all of this data is collected and stored as hard copies for each business day and none of the information readily exists in electronic format for analysis purposes. An image of this data collection methodology is provided in Figure 4.

For the scope of this study, it was determined that RAPIDS appointments would not be the primary source for analysis of this project, due primarily to the lack of confidence and scarcity of the source data. Therefore, this manual data collection mechanism does not have a large impact on data collection and analysis. It is recommended, however, that the service facility implement a process or system to capture this data electronically in the future so it can be utilized to generate more comprehensive performance metrics to evaluate queueing services of RAPIDS customers.



Day View with Contact Number			Page 1 of 1		
November 1, 2017					
07:30	Christine [redacted] 0730	[redacted] Army	750	[redacted] Civilian	Dona
07:30	~~Michael~~ [redacted] 0730	[redacted] Army	0732	[redacted] Civilian	Ann
07:30	Dale [redacted] 0730	[redacted] Army	0730	[redacted] Retired	Gardy
08:15	~~Steven~~ [redacted] 0753	[redacted] Army	0757	[redacted] Active Duty	Ann
08:15	Carolyn [redacted] 0745	[redacted] Army	745	[redacted] Civilian	Dona
08:15	Dennis [redacted] 0746	[redacted] Army	744	[redacted] Contractor	Wanda
09:00	Melissa [redacted] 0857	[redacted] Army	0854	[redacted] Civilian	Wanda
09:00	~~John~~ [redacted] 0851	[redacted] Army	0855	[redacted] Civilian	Ann
09:00	William [redacted] 0836	[redacted] Army	0836	[redacted] Civilian	Dona
09:45	Elizabeth [redacted]	[redacted] Army		[redacted] Other	
09:45	Sam [redacted] 0943	Army	944	[redacted] Retired	Dona
09:45	Larry [redacted] 0920	[redacted] Other DOD	920	[redacted] Civilian	Dona
10:30	Sharon [redacted] 1026	[redacted] Army	1030	[redacted] Civilian	Ann
10:30	Timothy [redacted] 1020	[redacted] Air National Guard	1023	[redacted] Reserve	Gardy
10:30	Vonda [redacted] 0956	[redacted] Marines	956	[redacted] Dependent	Dona
10:30	~~LOUIS~~ [redacted] 1014	[redacted] Army	1022	[redacted] Civilian	Ann
13:30	Mercedes [redacted] 1311	[redacted] Air Force		[redacted] Dependent	Wanda
13:30	Carmela [redacted] 1320	[redacted] Army	1325	[redacted] Civilian	Gardy
13:30	Christine [redacted] 1327	[redacted] Navy	1336	[redacted] Dependent	Ann
Appointments: 19		Open: 0		Scheduled: 19	

Figure 4. RAPIDS Wait Time Data Collection Methodology

2. Automated Data

The primary data source for this project is collected electronically for walk-in customers through pre-defined data reports within the Qmatic system. The Qmatic system automatically collects data on the waiting times of customers and transaction times for services rendered by the garrison service facility. The Qmatic system, however, does not allow access to discrete values of customer queue times over certain time periods, which would have been ideal for analysis via statistical tools. The Qmatic system provides reports which are pre-defined and pose an insurmountable limitation on the scope of data available to analyze in this project. A Qmatic technical support representative was consulted for access to the raw data and potential custom reports, but was unable to assist in obtaining additional data after repeated attempts. The technical support representative stated that the version of Qmatic software being used by the service facility was no longer being actively supported. Therefore, the overall scope of the project is limited by the level of information provided by the Qmatic pre-defined reports as shown in Appendix B.

The pre-defined report used for this project is called queue summary. It records the number of customers served per day per service type, along with the average and maximum wait times for each service. This report does not detail individual wait times, individual arrival/service times, or other statistical details such as mean of standard deviation. Qmatic has no way to track individuals through its system, only entries into the queue.

3. Constraints and Assumptions

The major data constraint for this project is the lack of high fidelity quantitative information that can be easily analyzed with statistical methods. Due to the subjective nature and lack of reliability in the user-driven RAPIDS system, although it records ideal data for analysis, it cannot be used to draw conclusions or generate statistics. Due to the technical restrictions of the Qmatic system, data can only be pulled indirectly through the pre-defined summary-level reports.

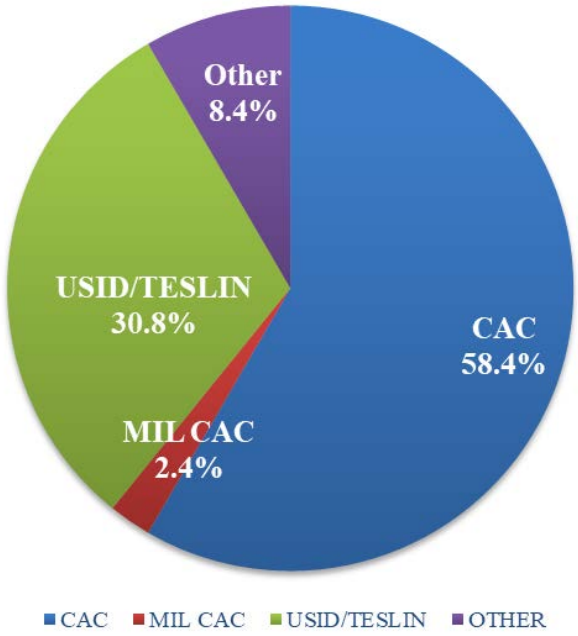
For purposes of this project, all of the Qmatic and RAPIDS data, where available, is considered to be fully accurate. No effort has been made to adjust the raw data or apply confidence bounds based upon any uncertainty in the numbers provided by the either the

handwritten RAPIDS reports or the Qmatic pre-defined report. Each data source is known to apply to only a particular subset of the total service population of the garrison service facility; although this is a constraint on the use of the data it is not an assumption but an inherent characteristic of the data source used. It is assumed that the application of each data set is therefore discrete, for example, no double counting of RAPIDS appointment holders by the Qmatic system is assumed to have occurred for the scope of this project. Qmatic also allows service providers to adjust the customer count served for cases where a single "customer" may enter the queue with dependents; this is assumed to have been properly and fully accounted for.

B. BASELINE DATA

1. Customer Base

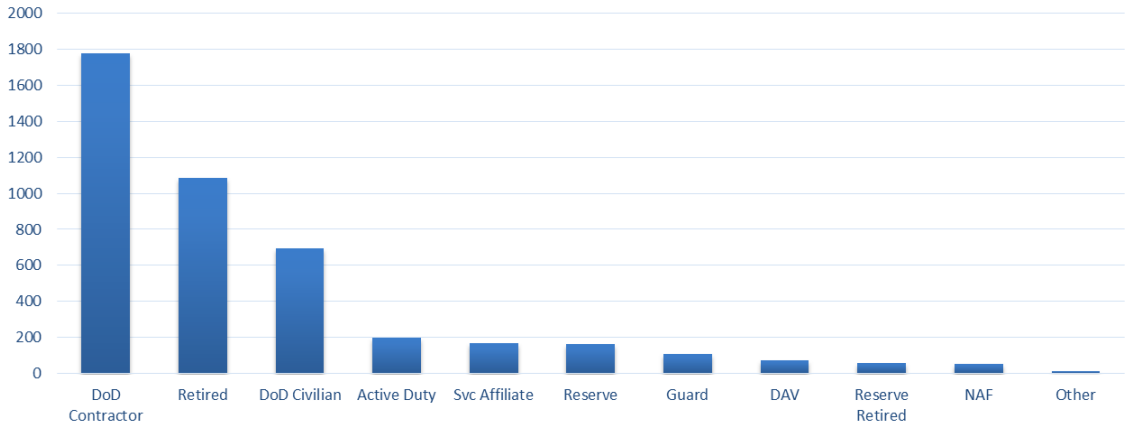
The garrison service facility provides a multitude of services including, but not limited to retirement services, personnel service support (awards, special pay, in/out processing, etc.), transition services, and CAC/ID card issuance to civilians, contractors, military, retirees and more. A DoD installation overview website reports that in calendar year 2017, over 44,500 customers were processed through the garrison service facility (U.S. Department of Defense [DoD], 2017). The installation overview also noted that the garrison's current population within a 40-mile radius includes 835 active duty military with 2600 family members, 60,000 retirees with 70,000 family members, and 37,100 DoD civilian employees and contractors, for a total of 170, 535 supported personnel. Therefore, the service facility provides services to approximately 26% of this population on an annual basis. The most common service rendered by the facility is CAC-related issuance and support. Using a report generated by service facility's current queueing system (see Appendix B, Table B-1), it was determined that for civilian and contractor CAC-related services, the garrison service facility served over 26,000 customers in 2017 accounting for 58.4% of the services rendered at garrison that year. See Figure 5 for a visual diagram of the card requests by type.



Data obtained from Qmatic report (Appendix B).

Figure 5. Percentage of Card Requests by Type (2017)

The queueing system report also shows that when examining the types of customers that process through the garrison for services, a large majority of the customers are DoD contractors, retirees and DoD civilians, with the largest percentage being DoD contractors (reference Figure 6).



Data obtained from Qmatic report (Appendix B).

Figure 6. Serviced Customer Affiliations

This is a function of the CAC process for DoD contractors requiring a new CAC issued with each new contract, regardless of whether the individual CAC holder is close to expiration. Each contract is unique and could require renewals annually. For DoD civilians and retirees, CACs are issued with an expiration date of either three years or the end of service, whichever is earlier. This discrepancy between contract-driven CAC renewals and calendar-driven CAC renewals can heavily affect the data for this project by creating a flood of thousands of CAC services required in a very short time frame to support new contracts as they are awarded.

2. Customer Processing

a. Service Rendering

The garrison service facility uses two methods to service customers: appointments entered through RAPIDS and walk-in service. Qmatic records the number of tickets issued each day for each queue, each queue relating to a specific service tenant. This system therefore counts only individuals who chose to walk-in for service and does not count those who made prior appointments or those who were turned away prior to queueing for a particular service, typically due to the service facility having already accepted its maximum number of customers for the day. The service methods currently employed at the facility are depicted in Figure 7.

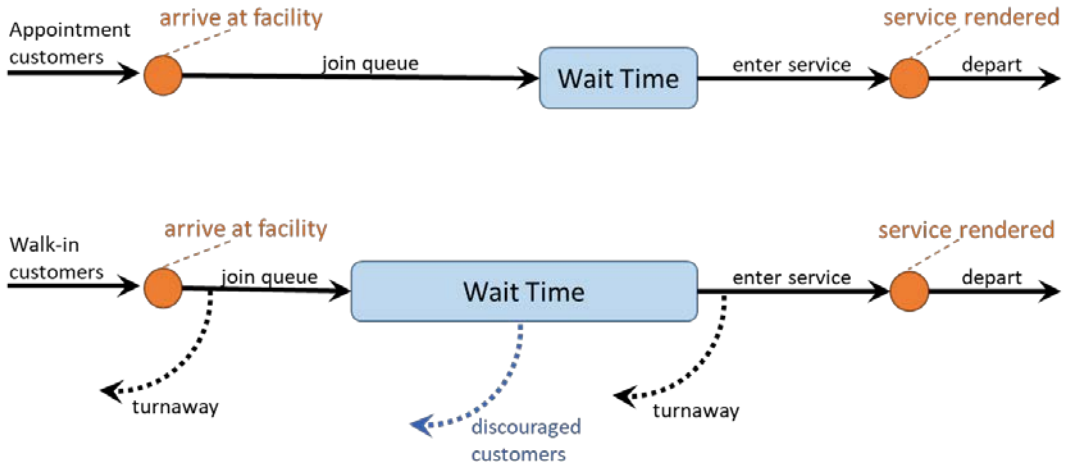


Figure 7. Service Handling

b. Throughput

Data from the Qmatic program was pulled for the time period of 1 Jan 2017–31 Dec 2017 in a pre-defined report called queue summary. This report shows the number of customers that arrived, the number of customers served, and their respective waiting times (both average and max) per queue. See Table 1 for the total customer counts for 2017. Over the calendar year 2017, queue summary reports showed customers experienced an average wait time of 1 hour and 43 minutes with a maximum waiting time of 9 hours and 15 minutes. If a customer could not be seen that day (i.e., the service facility reached their maximum daily capacity for customers) and they had to return the following day for service, their daily wait time would start over again the subsequent day and would not be reflected as total wait time. Therefore, this data does not correctly calculate the maximum waiting time per customer if they come in for service over a multi-day period. Due to the Qmatic data lacking specific customer tracking, a bias is introduced towards a lower waiting time average than what is likely occurring in reality. Additionally, these numbers do not include the multitude of people that arrive for service and are unable to receive a number because the maximum customer capacity has been reached for the day before they had a chance to get in the queue. Data collected from 1 Jan 2017–31 Dec 2017 showed that there were a total of 6,915 people that were turned away for service (i.e., denied service due to max capacity or system outages).

Table 1. Throughput for Various Services (2017)

Service	Customers Arrived	Customers Served
CAC and ID	26,690	24,950
Driver's License	2,249	2,223
MILPO	121	66
Motor Vehicle	8,900	8,857
Others DMV	1,352	1,291
Renew/Replace DMV	637	630

Data obtained from Qmatic report (Appendix B).

c. Wait Times

A key data point for this report are the wait times experienced by customers for the services at the garrison service facility, as illustrated in Table 2. The wait time for each service is ultimately indicative of the efficiency of the service provided and has a direct impact on the value added to the garrison and overall DoD operations. Longer wait times create more customer hours away from work activities and negatively impacts public perception of the garrison, as well as quality of life. Shorter wait times benefit both customers and Government. Wait times are directly available in the Qmatic and RAPIDS data, even though it is understood that they are a function of many different factors and Qmatic may not precisely record total wait time experienced by individuals who walked in to the facility for service over multiple days. In some situations, customers are lining up outside the facility as early as 0500 to secure priority walk in service. By the time the facility opens its doors, more than 40 people are in line to obtain service. Even during inclement weather or freezing temperatures, customers are waiting for hours outside and even bringing lawn chairs. See Appendix F for a personal account of a contractor's badge renewal process spanning 11 hours.

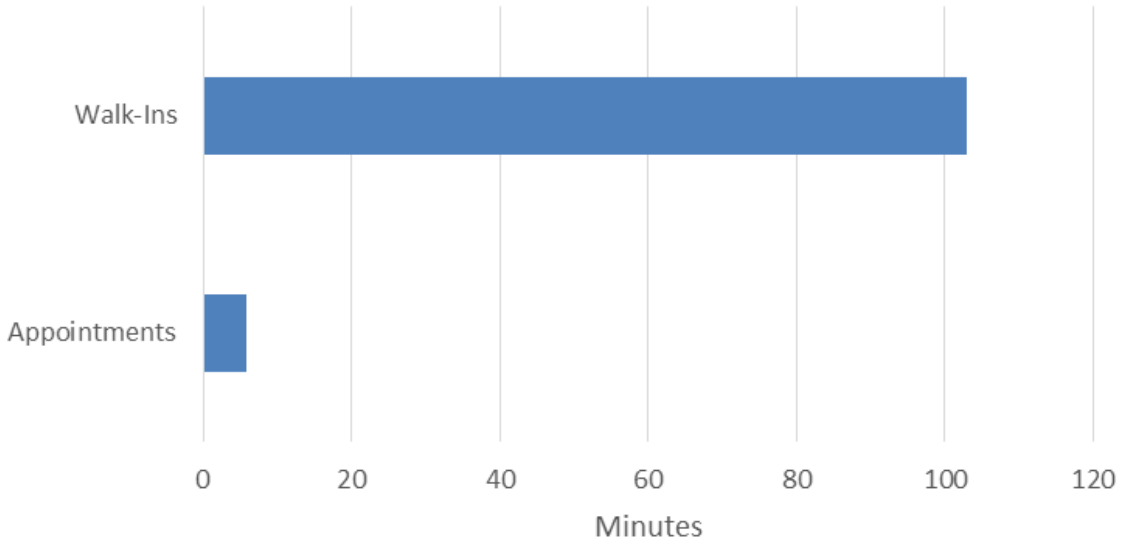
Table 2. Wait Time for Various Services (2017)

Service	Waiting Time Average	Waiting Time Max
CAC and ID	1:43:21	9:15:08
Driver's License	0:08:10	1:23:56
MILPO	1:17:22	6:21:58
Motor Vehicle	0:08:58	3:27:12
Others DMV	2:34:24	6:56:48
Renew/Replace DMV	0:08:21	1:00:12

Data obtained from Qmatic report (Appendix B).

Appointment wait time was examined in comparison in the first quarter of FY18 (November–December 2017). While the average wait time for walk-ins is almost 2 hours per customer, the average wait time for appointment customers was only 5.9 minutes.

Based on the queueing system data in Appendix B, walk-in customers are waiting approximately 17 times longer than customers that scheduled appointments through walk-ins, as shown in Figure 8.



Data obtained from Qmatic report (Appendix B).

Figure 8. Average Wait Times for Walk-in and Appointment Customers

It is reasonable to assume that most clients of the service facility are aware of the advantages of making an appointment instead of simply walking in. This is inferred from the public perception of long wait times at the service facility and the lack of scheduled appointment slots. To determine appointment availability, the RAPIDS appointment scheduler was consulted on 1 May 2018 to see when the next appointment time was offered. The first possible appointment time available for scheduling was on 20 August, approximately 3.5 months away. For many customers, it is not feasible to wait 3.5 months for an appointment, especially when facility and computer access is often solely dependent on having a functional CAC. It is hypothesized that this is due to the limited time slots made available in RAPIDS for appointments. At full surge capacity, 120 people can be seen at the service facility in any given day. Only 18 timeslots are reserved for appointments per day in RAPIDS (RAPIDS Appointment Scheduler, n.d.); therefore, only 12% of the overall population of customers that are processed daily through the service

facility can have pre-scheduled appointments. The unavailability of appointments in a reasonable timeframe from the date the customer attempts to book an appointment forces customers to then become a walk-in customer, with associated increases in wait time.

d. Turn Away

The maximum appointment count and average number of customers are both significantly lower than demand for services. This results in a number of customers being turned away after the maximum number for a day has been reached. This number however is not captured in Qmatic or RAPIDS data, so can only be understood as a factor and caveat to maximum individual wait times.

3. Customer Impact

Wait time is a non-value added activity in any organization and any effort that can be implemented to reduce or mitigate wait time can help improve efficiencies of operations, increase workforce readiness, improve customer satisfaction, and provide a significant cost avoidance to the DoD. Wasted cost on wait time can be reallocated to value-added task that directly affect, and provide support, to the Warfighter. By utilizing the data from the 2017 queue summary output from Qmatic as shown in Table 2, the average non-value added cost or waste incurred by the DoD while patrons are waiting for services to be rendered is calculated. Utilizing the Cost and Economic Analysis Center (CEAC) pay rate that was calculated by the service facility's leadership, the average annual salary of a service patron has been calculated as approximately $99,546 per year, or $47.70 per hour for each customer. Given that average salary, the average wait times collected for services rendered at the facility, and the number of customers that were served in 2017, it is estimated that the total, non-value added cost for patrons to wait for services rendered is over $2.29M dollars per year. This demonstrates why it is so incredibly important to identify ways to reduce the physical wait times in the lobby of the garrison service facility. If customers were allowed to virtually wait for service at their place of work, they could continue to support the true mission of the DoD and apply their labor costs towards the most valuable activity, serving the Warfighters.

C. SYSTEM REQUIREMENTS SPECIFICATION

1. System Requirement Development

a. Systems Engineering Process

Systems Engineering is a multi-disciplinary approach that seeks to enable the creation of successful systems within cost and time constraints. It helps to define customer needs and the required functions of the system as well as document those requirements for system design and development. For this specific project, the JAP team followed one of the systems engineering process models, using MIL-STD-499 (depicted in Figure 9) as a general guide, to first understand the queuing process at the service facility. During this part of the systems engineering process, the JAP team sought to define the problem and identify the customer's needs, objectives and requirements of a new virtual waiting room system. This included understanding the mission, environments and constraints of the current garrison service facility and Qmatic system. In order to complete these activities, the team researched the current system and processes as well as conducted multiple meetings with the system owners, system developers and users of the service facility to determine if there was a valid need for the new system, if there was a feasible approach to satisfying the need, and if there was available technology to meet the needs of the new system.

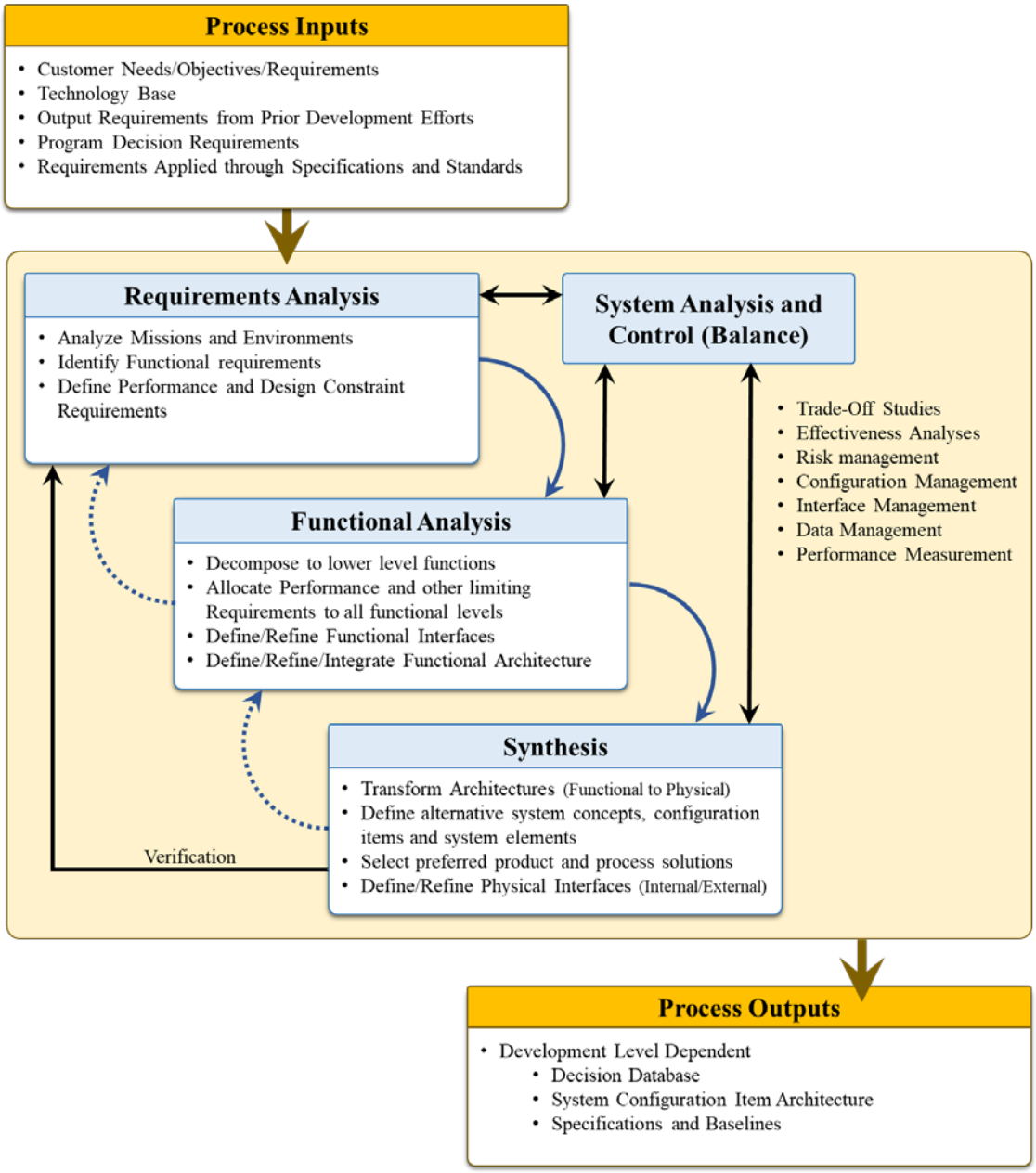


Figure 9. Systems Engineering Process. Adapted from Air Force Systems Command (1969).

The JAP team used a functional analysis and requirements analysis process to help define the functional requirements of the system and convert those into system level specifications for a virtual waiting room capability. The JAP team met with the user, both the system owner and service customers, to gather and collect input on the desired capabilities of the new system. The JAP team documented those requests as baseline requirements and developed derived and implied requirements to achieve the desired level of performance by the users. Once an initial draft of the performance specifications was created by the JAP team, the specifications were then sent back to the user community for review and approval. The performance specifications were distributed to subject matter experts (SMEs) to research and provide feasible technical solutions. The requirements that were defined in the performance specification document are outlined in the following section of this report.

These performance specifications were used by the contractor to research and explore both commercial off-the-shelf (COTS) and Government-developed solutions, allowing the JAP team to conduct a trade-study on proposed alternatives and recommend an acceptable solution to the garrison commander.

2. Requirements

What follows is a list of the proposed technical requirements developed by the JAP team based on the systems engineering (SE) process.

a. Communication

- The system shall allow for two-way communication:
    - The system shall be able to communicate information to user through text and/or email.
    - The system shall be capable of accepting return information from the user to notify the system of user cancellations, confirmations of appointments, etc.
- The system shall notify the user of their assigned appointment time.

- For RAPIDS pre-scheduled appointments only, the system shall notify the customer of their appointment date through text and/or email three days prior to their scheduled appointment. The system should request confirmation or cancellation of appointment from the user.
- For both RAPIDS and walk-in appointments, the system should send a notification to the user at least one hour prior to their appointment time through text and/or email.

- The system should send a reminder text and/or email to each customer to bring applicable documents required for services with them to the appointment. System should be capable of knowing what documents are required for each service to be rendered given what service the user enters on the "input" screen.

- If any of the databases or networks go down that support U.S. Army garrison service operations and render services down for the day, the system shall send a text and/or email to the user that states, "Services have been cancelled for the remainder of the day due to technical issues beyond our control. Please sign up for another appointment on the next scheduled business day. We sincerely apologize for any inconvenience this may cause."

- If any of the databases or networks go down that support garrison service operations and render services down for only a few hours, the system shall initiate the next appointment at the current time. However, the service facility staff shall make every attempt to incorporate personnel that were skipped into the schedule within the same day.

- The system shall notify the user when the queue has reached max capacity for the day. The system shall ask, "If cancellations occur on this day, do you want to be notified." If the user selections, "yes," then take their information listed in Section 3.2 and create a secondary, "back-up" list. If a cancellation occurs, the system shall retrieve the first person on that list and notify them that an

appointment time has become available and ask if they want to accept that appointment time.

b. System Input

- The system needs an input page for the user to provide the following information:
    - User name (free text, format: Last, First MI)
    - Two phone numbers (free text, Format: 123–456-7890)
    - Email address (free text)
    - Contact preferences (drop down, options: “Email,” “Phone,” or “Both”)
    - Service required (check box that allows for multiple selections: options: CAC, DMV, etc.)
        - Yes/No question: Do you have two valid forms of the following required documents? (system is smart to know these, auto generates these documents)
    - User type (drop down, options: contractor, civilian, military, retiree, dependent, spouse, etc.)
        - If the user selections “Military,” the system shall ask the user, “Will you arrive to the facility in uniform?” If the user responds “yes,” then the system will prompt the user, “Since you will arrive in uniform, please proceed to the service facility for priority of service. Please be sure to arrive in uniform with your X, Y Z documents.”
    - Do you have dependents/spouse you are representing? What service are they here for?
    - Submit button

c. System Logic and Output Display

- They system shall retain all current capability and process requirements of the Qmatic legacy system as defined by the system owner. These capabilities include, but are not limited to:
    - Categorical information
    - Personnel type
    - Priority of issue
- The system shall be capable of understanding and prioritizing services based on this predefined logic.
- The system shall be capable of calculating an estimated wait time for service based on the service required by the user and the previous data received for that day. The system shall notify the user of an initial estimated time the service will be rendered as well as their virtual queue in the line upon the user submitting their personal information.
- They system shall be able to calculate if the current or actual wait time is exceeding 30 minutes beyond their initial estimated wait time. If so, the system will send the affected customers an email and/or text that it is taking X amount longer than predicted.
- The system shall have the capability to link queuing numbers when a customer selects that they are representing a dependent or spouse. The system will generate multiple queue number per dependent (based on a per service rendered basis).

d. Scheduling

- The system must be able to schedule walk-in customers around RAPIDS appointments on a particular day. While the system could interface with RAPIDS directly to automate the data extraction at a minimum, the scheduled

appointment details should be extracted weekly to have a comprehensive view of the schedule.

- The system shall go live daily at 0700 for people to sign up for a walk-in and close when the service facility has reached maximum capacity for the day. Maximum capacity is defined such that the total number of appointments per day does not exceed 70 appointments, or if the calculated wait time of the next customer would exceed services ending at 1530.

- If the user logs into the system after it has exceeded the maximum number of appointment slots for that day, it will notify the user that: "The service facility has reached its maximum capacity for the day. Please sign up for a scheduled appointment through RAPIDS or log in at 0700 on the following business day to schedule a same-day appointment."

- The system shall provide a "live" feed or display for average wait time and current queue number to the user per day.

    - The live feed shall be accessible through a user-owned mobile device or computer.

    - The live feed shall be accessible through a central website.

e. Customer Service Feedback

- The system shall ask the customer if they care to rate the system itself.

- The system shall ask if the user wants to rate their experience at the garrison service facility after service has been rendered.

- The system shall retain that data until it is accessed by the system owner.

f. System Owner Requirements

- The system owner shall be capable of inputting into the system that services have been temporarily postponed or permanently canceled for the day. The system shall notify the user of that information with instructions what to do next.
- The system will be accessible on a kiosk or laptop in the service facility lobby so if actual walk-ins come into the building they can sign in for a time within the system. Kiosk or laptop shall have access to the internet.
- System shall be able to prepare system owner specific reports.
- The System shall have a user friendly, intuitive interface that requires minimal to no training.
- The system shall be modular so that it can easily be modify or improved for future needs.
- The system should have a frequently asked questions section to help users navigate through the system.
- The system shall have a contacts page that directs the user to help if they have a technical support capability question.
- The system shall have technical support capability from the system developer.

g. Technical Specifications

- Storage space, speed, connectivity, security, PII, etc., to support customer demand
- System back up/redundancy for user information

D. PROPOSED SOLUTIONS

The team reviewed four potential solutions based upon the system requirements: a Government-developed solution; expanded Qmatic solution; Q-Flow product; and a hybrid approach. The Government developed solution analyzed was a proposal by a Federal research organization that would meet system requirements and be fully sustained through this agency. The Qmatic solution investigated was the Orchestra Essentials 6 software suite, a full COTS solution. The Q-Flow solution is an alternate COTS approach, through the Q-nomy company. The hybrid approach analyzed using a COTS product, in this case Qmatic Orchestra 6, with Government technical support to cover capability gaps and inherent drawbacks to using a COTS product.

1. Qmatic

Qmatic Corporation develops, distributes, sells, and installs queuing management and customer flow management solutions in the United States and internationally. It also provides various professional services, which support the purchase, installation, and usage of the company's customer flow management solutions. It serves retail shops, healthcare facilities, motor vehicle agencies, banks, and credit unions, as well as various local, state, and Federal level Government organizations through distributors. The company was founded in 1987 and is based in Duluth, Georgia with additional offices internationally. Qmatic has installed over 65,000 systems across more than 120 countries globally with over 2 billion customers engaging in their queue-management systems (Qmatic, n.d.b).

The garrison is currently a customer of Qmatic Corporation and has their product installed and operational at the service facility. However, the garrison service facility is utilizing an antiquated version of Qmatic's queuing management software, Orchestra Ensemble Release 4 was installed in August 2012 to operate the internal queuing system. The current software version that is being utilized has several existing limitations. It does not possess the capability to connect or enter the user into a queue for service at the service facility virtually. It also does not have the capability to communicate or notify the customer of their queue in line. One must manually pull a ticket from the dispenser in the lobby of the service facility and physically wait in the lobby until the system calls out the customer's

number. It is not currently connected to a network and is not backed up by a secondary server; therefore, if they system were to experience a system failure, there is no method for Qmatic technical support to enter and fix the system remotely. A Qmatic technical support representative would have to physically drive to the service facility to resolve the issue. Furthermore, technical support representatives are not fully trained to support Orchestra Ensemble Release 4 and could not resolve questions and issues throughout this analysis period. They have transitioned their support focus to newer versions.

Qmatic offers an updated solution called Orchestra Essentials 6 and Business Intelligence (Qmatic, n.d.a). This Qmatic solution offers a virtual queuing capability that allows customers to check-in via a kiosk on site, receive communications and alerts via a mobile app or text message, and rate their experience before they leave the environment. It also has the capability to provide instant customer satisfaction insights that can help direct constant improvement. Lastly, it provides customizable dashboards that allow you to organize, understand, visualize, and analyze the customer's journey management data to identify the most important business metrics, trends and exceptions.

For this specific project, Qmatic Corporation was contacted and a thorough review of the capability gaps was conducted between the current queuing system and their new product. The new performance specifications were communicated to the Qmatic team and it was determined that the current system needed an upgrade to Orchestra 6 Essentials. This would require a system upgrade of 30 user licenses with digital communications, mobile ecosystem and appointment management modules. It would also be inclusive of two lobby monitors to allow for digital check-in in the lobby. The technical evaluation and cost estimate included training, installation, and Qmatic Care (1-year maintenance and technical support).

Implementing the upgraded version of Qmatic at the service facility still presents several challenges that can limit, or prohibit in some case, implementation. In order for the capabilities of Orchestra 6 to be fully realized, the service facility must commit to bringing the system online through a network connection. This would require placing the upgraded queuing application on a new server platform and operating system to provide integrated internet access and remote capabilities to include text notifications and mobile ticket visual

presentation status. The current product does not currently address DoD security and cybersecurity requirements based on operation system requirements. There is not a current certificate of networthiness (CoN) in place or security integration effort identified at this time to ensure this can be accomplished. It is assumed that PII concerns have been addressed or resolved as other Government organizations utilized Qmatic for their support; however, that path forward has not be specifically approved for use at this garrison service facility. Additionally, Qmatic does not have the capability to post the current customer's queue number or wait time through a web-based system. This is a useful feature identified in the performance specifications that they were unable to achieve at this time. Lastly, the pre-defined reports in the system are not fully customizable by the system owners. It is also unclear how the system owner can extract the raw data out of the system for evaluation and performance metrics. These capabilities and limitations were considered during technical evaluations.

2. Q-Flow

Q-nomy, Inc. is a software vendor for product solutions that optimize customer experiences for large organizations. Q-nomy, Inc. was founded in 2002 and is based in New York, New York (Q-nomy Solutions, n.d.). According to the Q-nomy solutions web page, their flagship product is Q-Flow 6, a software product that includes appointment scheduling, customer flow management, business process and customer interaction management. Q-nomy reports that Q-Flow 6 is being marketed and sold to customers around the world, including both government and industry customers.

Q-Flow was also evaluated against the performance specifications for the service facility virtual waiting room system. Q-Flow has the capability to implement an appointment management application that includes a mobile-enabled online appointment portal for public customers. It can also send automated reminders and alerts via text messaging and/or email. The customer is able to self-check-in via their cell phone or mobile device through use of a "location code" to verify the customer is on the premise. Similar to Qmatic's Orchestra 6 solution, the service facility must commit to bringing the system online through a network connection. This would require placing the upgraded queuing

application on a new server platform and operating system to provide integrated internet access and remote capabilities to include text notifications and mobile ticket visual presentation status. The current product does not currently address DoD security and cybersecurity requirements based on operation system requirements. There is not a current CoN in place or security integration effort identified at this time to ensure this can be accomplished. Additionally, Q-Flow does not appear to have the capability to calculate or post the customer's current queue number or wait time through a live, web-based system. It only sends you a text message or email alert at a predetermine time for service. This is a useful feature identified in the performance specifications that they were unable to achieve at this time.

A potential issue with Q-Flow is that your response time depends on criticality and it could take up to 10 days for resolution of any hardware or software issues. The cost estimate included an estimated number of technical support hours, but if you ran out of those hours, the service facility may end up having to identify and send additional funds, which could result in a delay in service or technical support. There is not currently an option for gathering user feedback after service. This may limit or minimize the amount of customer feedback and data the service facility could receive in order to track performance to make any future modifications or improvements to the system. Lastly, the estimate includes training to the system owners, but it is noted that implementing any new product solution can be a cultural challenge. The system owners and operators may be resistant to change if implementation of the new product is not strategically considered and employed correctly.

3. Government-Developed Solution

The garrison's Federal software agency is one of the Army's software engineering life cycle management centers and is a key component in supporting the full product life cycle of sophisticated weapon systems. The software agency also provides state-of-the-art software support to non-tactical Government agencies and programs, and remains an expert in the Army's policies and practices regarding cyber security, software metrics, post-deployment software support, digital process improvement, computer resource margins

analysis and cyber risk management (U.S. Army Aviation and Missile Research Development and Engineering Center [AMRDEC], n.d.). According to the software agency's web page, the agency provides high-quality support in the diverse areas of joint interoperability testing, gaming, and software systems engineering using development facilities and both tactical hardware and software laboratories.

The software agency was selected to evaluate the performance specifications of the virtual waiting room system and develop a technical approach and cost estimate to design and construct this new application. The software agency background includes games, comics, and apps that revolve around the life or Army soldiers and showcase Army values (AMRDEC, n.d.). The development of games by the software agency has even matured to the point of applying to operational training simulations. They also have extensive experience in developing mobile applications as they were the software developers of the successfully launched, Explorer mobile application for the garrison in 2016. The app provides timely and up-to-date information for garrison employees and their families regarding gate closings and re-openings, accidents, emergencies, severe weather warnings, events and programs, and general policies affecting the workforce.

The software agency reviewed the performance specification and provided technical feedback, a proposed solution, and general cost estimate. A mockup of the proposed solution is depicted in Figure D-1 (Appendix D). The proposed technical solution was determined to meet all objectives provided and the JAP team is confident that this agency has the technical capability to execute a software development effort and create a product that meets all system requirements. However, their feedback included caveats to the proposed solution that could negatively impact cost and schedule. The software agency is a Government organization postured to support the Warfighter, and without direct leadership involvement or management emphasis, any software effort to support the garrison service facility may be de-prioritized or delayed. The software agency utilizes a contractor workforce to support many of its development efforts; creating or modifying contracts to support development of the proposed solution could impact any proposed schedule prior to development work starting. The software agency does not maintain an

after-hours or weekend workforce, which could delay technical support during and after implementation of the proposed solution.

Cost estimates of the Government solution proposed by the software agency included the understanding that they would be required to develop new queueing algorithms. The software agency would be required to document and research current queuing systems to create this logic, and the associated development cost burden would be required to be funded solely by the garrison service facility as the only current customer. This is in sharp contrast to any COTS queuing software, where the company would have absorbed the initial algorithm development costs or distributed it amongst a much larger customer base. The result of this development burden on the software agency increased their general cost estimate for the Government-based software solution to more than 10 times the cost of the commercial systems available on the market.

4. Hybrid

The final potential solution analyzed was a hybrid solution that combined the existing, commercial queuing capability of the upgraded Qmatic software (Orchestra Essentials 6 and Business Intelligence) with a Government integrator and technical support team that could address the aforementioned shortfalls in implementing the purely COTS-based product. This solution set combines the cost effectiveness and existing technical solution of the COTS product with the Government technical support needed to successfully tailor that product to meet a DoD application, security and cybersecurity requirements needed to ensure a successful end product to the end user. The Mission Support Team located on the garrison installment was chosen to operate as the Government integrator and technical support team for this trade study analysis. They are considered experts in the area of software development and network infrastructure requirements.

For this potential solution, Federal research agency will implement a phased approach to field the enhanced Qmatic system to include upgraded queuing application software hosted on a new server platform and current operating system. Acting as a system integrator, the resident garrison research facility will expand and extend the current physical network infrastructure into the service facility. Utilizing the High Performance

Computing Modernization Program (HPCMP) Defense Research Engineering Network (DREN) as the network service provider, the queuing system will have integrated Internet access for providing remote capabilities to include short message service (SMS) text notifications and mobile ticket visual presentation status. Phase 1 will consist of three major efforts: (1) procurement and planning, (2) implementation and configuration, and (3) testing and validation. Within the procurement and planning effort, the garrison research facility will procure the upgraded Qmatic Orchestra 6 Essentials and Business Intelligence software component and services, select and procure SMS services, identify and procure server resources, define and document a network schema addressing security and cybersecurity requirements based on operational system requirements, develop a physical hardware installation plan for queuing system accessories (signage, monitors, kiosk, etc.), and develop and document a test plan. For the implementation and configuration part of the effort, the garrison research facility will request domain name system registration for online presence, setup and install server resources (operating systems, SQL), request and install DoD server certificates, setup and install Qmatic application software and accessories, and more. During the testing and validation effort, the garrison research facility will test and validate network connectivity and SMS capabilities, check and ensure valid backup and restore operations, and monitor system operations for proper operations.

Upon initial implementation of phase I, an analyst will monitor, gather, and review customer feedback and system data. Results will be analyzed and decisions will be made to determine if system modifications or standard operating procedures need to be adjusted to enhance operational performance. Note that establishing the proof of concept hosted via DREN fits within the network model for the research and development of systems to solve problems related to DoD organizations, military and industry applications, processes and programs. Once the proof of concept has been completed and operations go into a sustainment phase, efforts will begin to transition the service facility's queuing system off of the DREN and onto the service provider managed by the Network Enterprise Center (NEC). Prior to transitioning, a plan must be developed and documented between the organizations to ensure a smooth transition. The plan should examine all factors which are

impacted due to the move to include the physical network schema changes required, domain name system transition, subscription services for SMS texting, and cybersecurity requirements on the new hosted network. Once all of the items have been documented and addressed, system analysts should schedule and stage the transition ensuring system backups are good before executing the move.

IV. ANALYSIS

A. ANALYSIS PROCESSES

1. Root Cause Analysis

The garrison tenant population has grown exponentially since the service facility opening in July 2012 (U.S. DoD, 2017), thus causing longer delays and wait times for services rendered. Additionally, the current queuing system in place only provides for in-facility notification. Under this JAP, engineers have researched and devised a project plan and proof of concept to address and reduce the physical waiting room times at the service facility. In coordination with the service facility's leadership, the JAP team conducted a trade study analysis reviewing several industry COTS solutions as well as the current in-place solution for queuing capabilities and remote notifications.

2. Methodology

To address the root cause experienced by the service providers, a proposed set of alternatives was evaluated to determine the most balanced queueing system solution. To do this, a multidisciplinary team of individuals and subject matter experts employed a trade study methodology. Using this process, subjective data was transformed into more quantitative information to achieve an objective optimum system solution that is defended with consistent information.

Five alternatives were considered based on the root cause analysis. The trade study process used herein allows for re-assessment when updated information or additional alternatives become available. For this process, cost is treated as an independent variable. Appendix E details the methodology used in conducting this trade study.

The complete trade study was conducted in three parts:

(1) Trade study initiation

- The purpose/need statement is documented based on feedback from key stakeholders

- Support is identified
- Trade study plan is established
- Viable alternatives are identified
- Criteria is established to assess alternatives (Table E-2)
- Criteria is prioritized and weighted with rationale (Table E-3)

(2) Trade Study Matrices Development

- Alternatives are evaluated and assessed per the pre-defined criteria (Table E-4)
- Raw scores are assigned to each alternative (Table E-3)
- Weighting is applied to raw scores
- Uncertainty is evaluated for each criteria
- Summary matrix is compiled to determine scoring (Table E-5)

(3) Result Evaluation

- Cost, risk, issues, and concerns are addressed (with stakeholder involvement)
- Course of action proposal

Figure 10 depicts the overall trade study process.

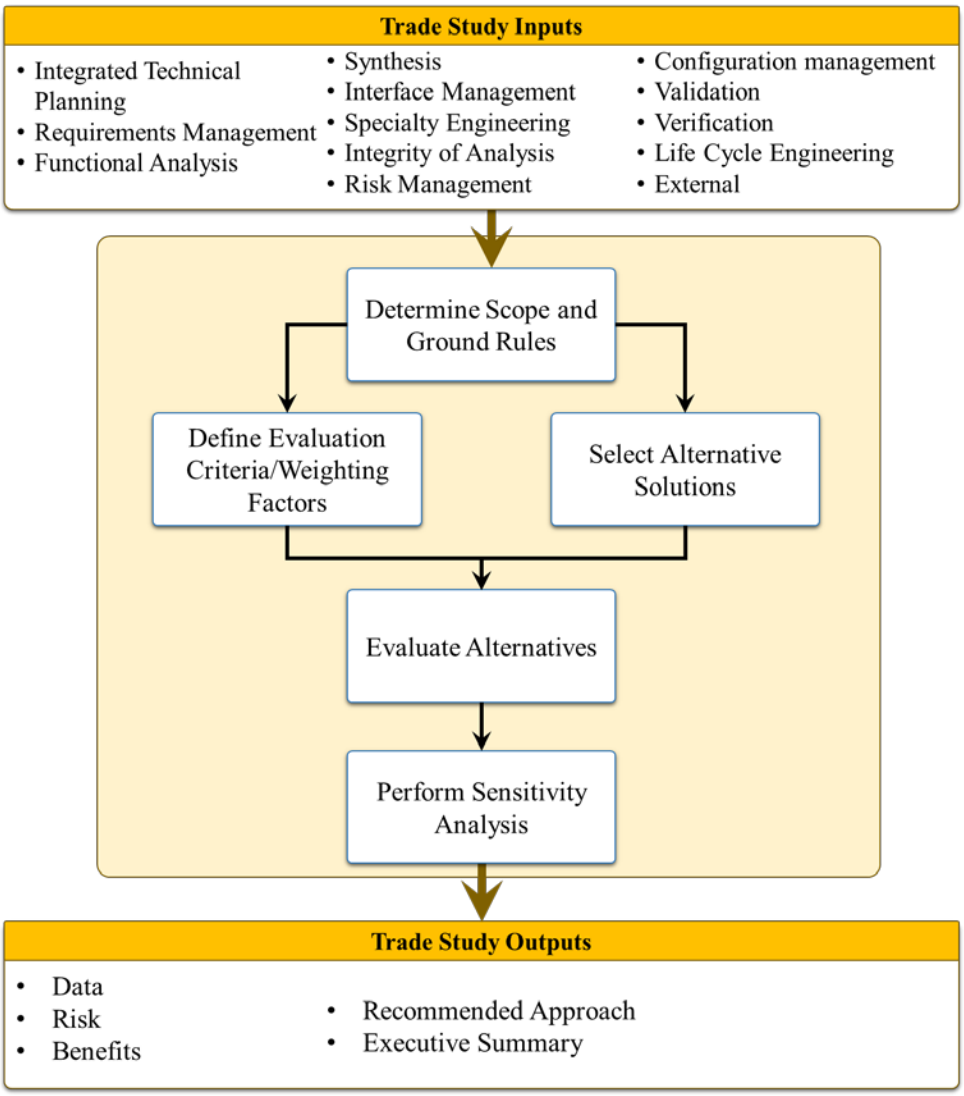


Figure 10. Trade Study Process. Adapted from Federal Aviation Administration (2006).

3. Objectives and Requirements

The objective solution should provide an optimal queueing process for the service provider that decreases the physical wait time in the lobby of the garrison's service facility, while taking into account how the solution affects the service provider, customers, and staff. The objective solution is also evaluated on the direct and indirect impacts to key performance indicators (e.g., customer throughput). Execution of the trade study results are ultimately dependent on resource and cost constraints.

Typically, the Government has a preference for best value solutions when buying COTS or developing new systems. For this purpose, cost is evaluated as an independent variable, as shown in Table E-5. Using this method, the best value is determined from the cost-effectiveness function (CEF) ranking, while the best technical solution is determined from the operational utility function (OUF) ranking.

B. ALTERNATIVES

For this trade study, five potential alternative solutions were analyzed. The baseline system was included as an anchor when evaluating the alternatives, providing a basis for the currently employed system. The proposed solutions for this study shall include:

- Baseline system
- Qmatic upgrade system
- Q-Flow system
- Government developed system
- Hybrid system

C. EVALUATION CRITERIA

The assumption was made that each of the criteria are independent of one another for evaluation purposes.

The evaluation criteria for this effort are broken into broad categories:

- **Cost.** This category is broken into 1) procurement cost and 2) sustainment cost.
- **Reliability, maintainability, and supportability**. This category is broken into 1) upgradeability, 2) maintainability, and 3) support personnel.
- **Customer experience**. This category is broken into 1) interface, 2) remote accessibility, and 3) communication.

- **System integration**. This category is broken into 1) hardware compatibility, 2) network compatibility, 3) data storage, 4) security, and 5) expertise.

- **Reporting**. This category is broken into 1) report customization and 2) queue status.

The rationale for the selection of these criteria is shown in Table E-1. Each criterion selected for evaluation of the alternatives was chosen based on a specific need from the service facility or from user demand. Fifteen total evaluation criteria were used in this trade study.

To determine the priority level and weighting for each criterion, each was measured separately against the other 14 criteria, as shown in Table E-1.

1. Procurement Cost

a. Definition

Procurement cost is equal to the sum of the costs to obtain equipment and support items required to set up an operable queuing system from current state operations. These costs are the initial investment to set up physical equipment and digital infrastructure required to meet the defined queue processing requirements. Procurements costs are not long-term and are subjective to the supplier of the analyzed system. In instances where certain equipment is purchasable from a third-party supplier (such as in the case for television monitors or computer systems), the procurement cost is normalized across each analyzed alternative.

b. Rationale

Cost efficiency has a large impact on overall garrison operations and is often the primary focus of leadership budgetary decisions. The garrison budget for human resources operational improvement is finite and subject to thorough scrutiny.

An analysis of the procurement cost can also determine if the alternative's company has proposed a reasonable cost for supplies as compared with other alternatives with comparable quality.

c. Weighting

Procurement cost ranks 3 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on the evaluation criteria weighting in Table E-1, where it is determined to be of high importance when compared to the other criteria. Based on criteria comparisons, procurement cost is weighted 8.44% of the total alternative score. This ranking is to be expected, as procurement costs are typically high priority to management and decision makers who must work within a constrained budget and seek best value solutions.

2. Sustainment Cost

a. Definition

Sustainment costs are any costs incurred to the garrison command after initial deployment of the queuing system to include operating, maintaining, and support costs of the system. Sustainment costs do not factor in the man-hours of currently employed garrison personnel who will routinely utilize the system. In this case, sustainment costs are any that go beyond the current operational state. Specifically, this consists of the costs of equipment, supplies, software, training, and services associated with operating, modifying, maintaining, supplying, or otherwise supporting the queuing system.

Sustainment costs for the queueing system are evaluated based on the following lower level elements:

- Operating material/consumables (such as physical paper tickets, training manuals)
- Support services
- Replacements or repairs
- System-specific training
- Hardware modifications
- Software maintenance

- Other maintenance
- Installation support
- Personnel support
- General training and education
- Data storage (such as for ‘cloud’ services)
- Software licenses
- Communication services (for mobile communication, texts, calls, etc.)
- Service hosting (such as website domains)

b. Rationale

Human resource operations are essential to the garrison community and as such are expected to have a longevity and lifespan for years into the future. Sustainment costs often account for a majority of the life cycle costs for a program and must be taken in to account when choosing the queueing system alternative. These costs also must be treated separate from procurement costs, as sustainment funds typically come from a different budgetary allocation.

c. Weighting

Sustainment cost ranks 5 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate to high importance when compared to the other criteria. Based on criteria comparisons, sustainment cost is weighted 7.59% of the total alternative score. This ranking is to be expected, as the service provider has limited funds to support sustainment activities such as software and hardware upgrades, technical support, or modifications, thus must choose an alternative that presents the best value.

3. Upgradeability

a. Definition

Upgradeability is the queueing system's potential to accommodate incremental hardware or software changes/improvements of its functionality. Ease of upgrade of the system is represented in terms of its technological, functional, and physical components. Subsequently, there are several indicators used to assess the queueing system's upgradeability such as component modularity, past developments, and compatibility with generational systems.

Upgradeability for the queueing system is based on the following lower level elements:

- Physical commonality
    - Hardware commonality (amount of unique components/subsystems)
    - Software commonality (amount of unique software standards or languages)
- Operational commonality
    - Estimated operational training time (initial and refresh from the previous system)
    - Degree of unique skills required
    - Degree of automation
- Modularity
    - Physical modularity
    - Functional modularity (ease of adding new functionality or upgrading existing software)
    - Interfaces (number of unique interfaces)

- Standards
    - Hardware standards (standard maturity)
    - Software standards (number of non-standard languages, databases, or unique/proprietary operating systems)
- Reliability, maintainability, and testability
    - Reliability
    - Critical points of fragility (such as network loading, data processing)
    - Maintainability (expected time to repair, whether the system is operational during maintenance)
    - Testability (error logging/recording capability, reproducibility, automation)

b. Rationale

A queueing system with a high degree of upgradeability ensures that operational continuity is maintained and that the system is failure avoidant. As experienced in the baseline state, older software versions can become a cost burden when more attention, time, and workarounds are required to maintain functionality. New features and integration with current technology trends and advancements can lead to a significant operational advantage through increased productivity and improved ease of use.

Because of the uncertain availability, amount, and timing of funding, modularity is an important characteristic of upgradeability. A highly modular system allows for upgrades when funding becomes available, which would allow garrison leadership to "pick and choose" which subsystems can be affordably upgraded. This of course assumes that there is some measure of mutual independence of the individual components in the selected queueing system. Upgradability is used as a criterion here to determine the degree to which the analyzed system can meet this objective of functional allocation.

c. Weighting

Upgradeability ranks 13 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of low importance when compared to the other criteria. Based on criteria comparisons, upgradeability is weighted 5.49% of the total alternative score. This ranking is to be expected, as the service provider is concerned for future modifications and the ease of integrating additional components or upgrades. It ranks lower in importance due to the nature of the queueing system and its associated systems – it is assumed that the low complexity of the system does not demand the need for frequent upgrades.

4. Maintainability

a. Definition

Maintainability is the queueing system's ability to be retained in, or restored to, nominal condition when skilled personnel perform the maintenance. Specifically, the measure of maintainability is based on how easily and quickly the system is restored to full operational capability after a failure.

The measure of maintainability is based on the following elements:

- Skill of the company performing software/hardware maintenance
- Time to repair failures
- Software and hardware quality/stability
- Technical properties of the system (size and complexity)
- Quality

b. Rationale

The ability to maintain hardware and software in a timely and economical manner is of critical importance to operational leadership. A higher degree of maintainability can result in lowered life cycle costs. Additionally, thousands of people in the garrison community utilize the human resources services and depend on those services being

successfully rendered. Finally, better maintainability can improve the ability to adapt the system to changes in operating environment, improve performance, or otherwise execute modifications to the system.

c. Weighting

Maintainability ranks 11 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate importance when compared to the other criteria. Based on criteria comparisons, maintainability is weighted 5.91% of the total alternative score. It is assumed that maintenance operations generally fall within the range of expertise of the service facility's staff, thus making this a less important criterion.

5. Support Personnel

a. Definition

Support Personnel is defined as the skilled technical expertise provided by the system's company that provides users with assistance in solving problems. This criterion is measured through personnel availability, skill, quality of services, and interaction method. Technical support personnel may be utilized in person, over telephone, via email, or via chat services.

b. Rationale

Long term support for the utilized queueing system is an important factor in determining the optimal alternative. It is imperative that the system's company be capable of providing rapid response and solutions to immediate operational issues. If the queueing system ceases operation, services cannot be rendered to hundreds of customers. The result of this downtime is lost productivity for both the customer and the service renderer, as well as lost customer satisfaction. Subsequently, technical support is a valuable and necessary criterion for the selected alternative.

c. Weighting

Support personnel ranks 8 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate importance when compared to the other criteria. Based on criteria comparisons, support personnel is weighted 6.33% of the total alternative score. Due to the nature of operations carried out at the service facility, it is important to have support personnel from the queueing system's parent company to resolve issues quickly and efficiently.

6. Interface

a. Definition

Interface is defined here as the customer interaction with the queueing system. This criterion is measured in the ease of use and intuitive nature of the user interface and features of the system. The interface can extend to the customer via multiple methods, interacting via website, mobile application, kiosk, emails, phone, and text systems.

An additional aspect used to determine the value of the system's interface is the customer's ability to provide feedback while within the queueing process. The ability to capture this information could add valuable insight to the customer experience, giving leadership the opportunity to react and adapt to the provided feedback.

b. Rationale

An efficient and familiar interface is an important aspect of the customer experience, which can facilitate the queueing process. If a customer is unable to navigate the user interface, the opportunity for errors and customer dissatisfaction increases. Additionally, requesting and receiving customer feedback on their experience provides valuable metrics to track daily issues and resolutions. This information is a useful tool in future issue mitigation, creating awareness of issue among service staff, and providing an opportunity to justify future improvements.

c. Weighting

Interface ranks 4 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of high importance when compared to the other criteria. Based on criteria comparisons, interface is weighted 8.02% of the total alternative score. This is an easily understood weighting, as the system is intended to be user friendly and intuitive to those seeking service. When the user is able to interact easily with the system, it facilitates the queueing process, making this a valuable criterion.

7. Remote Accessibility

a. Definition

Remote Accessibility is defined as the user's ability to access the system remotely via web or mobile device to enter, exit, monitor, or modify their queue request. This can also include customers who enter the queue in person via a kiosk, but whom desire the ability to utilize a remote wait capability. This user would ideally enter the queue at the service location with the intention of returning when their service is ready to be rendered.

A virtual queueing system would allow the customer to remain within the queue in a first in, first out basis that would maintain the customer's place in line until their service request can be handled. A highly accessible system would prompt the customer to enter some contact information (such as phone number or email) and notify them when their turn is ready. An ideal system would also allow the customer to monitor their status in the queue and present them with an option to exit the queue is they are unable to arrive at the anticipated service time.

b. Rationale

A virtual queueing capability would allow customers the ability to receive a call, text, email, or mobile notification instead of waiting in a physical queue. This option opens opportunities for the customer to be productive in other ways, e.g., returning to their work station or accomplishing other tasks. The amount of lost productivity experienced within the garrison human resources services center is paired directly to opportunity cost at the

expense of the U.S. Government. With an objective to be a responsible steward of taxpayer dollars, it is the obligation of Government leadership to reduce the amount of wasted man hours and increase productivity. Thus, the introduction of a virtual waiting room could be a viable solution to combat the issues currently experienced within the garrison human resources service operations.

c. Weighting

Remote accessibility ranks 2 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of very high importance when compared to the other criteria. Based on criteria comparisons, remote accessibility is weighted 8.86% of the total alternative score. A high amount of importance is placed on this criterion, as it is a main goal of the service facility to provide queueing visibility, as well as a strong desire from the customers to regain value in their day. An open connection to the customer can result in third-order effects, facilitating several areas of the queueing process.

8. Communication

a. Definition

Communication is defined as the ability of the queueing system to provide the customer with updates and information regarding any condition that may affect their status in the queue. These communications can include (but are not necessarily limited to) the following:

- Estimated wait time for service (calculated)
- Average wait time for services (calculated)
- Notification of operations stoppage (in the case of system failures)
- Notification to proceed to the service location within a prescribed time frame
- Notification of required supplementary documentation needed for the requested service (e.g., identification cards, passports, proof of insurance)

- Option for “self check in,” allowing the user to provide supplementary information
- Notification when service capacity has been reached (queue is full)

b. Rationale

The ability to provide customers with valuable information regarding operational status can translate directly to increased customer satisfaction. In its current state, the garrison queueing system results in time waste for customers on a daily basis due to lack of operational awareness. As an example, a retired military customer can travel to the service location for an hour or more, only to be turned away due to the service queue cap being reached. If the customer had some prior awareness of this possibility, they may have avoided the lengthy and time consuming drive, as well as the obligation to return at a later date to receive their service. Another common issue experienced by customers is the lack of supporting documentation to complete their service request (those that require identification cards, passports, birth certificates, and so on). These customers may wait for hours in the physical waiting room, but are turned away without proper documentation. Once again, the customer leaves deeply dissatisfied. Having the prior knowledge of this requirement would save both time and effort while increasing customer satisfaction.

When paired with remote accessibility to the queueing system, communication to the customer becomes a beneficial tool for streamlining operations. If the customer can be kept informed of their place in line and be directed to proceed to the service location with proximate accuracy, both the customer and garrison would experience many third-order benefits. The ability of a customer to return to their work station, rather than wait in a physical location, grants reduced opportunity cost to the garrison on a grand scale. The majority of customers who utilize the human resources services are current employees of the garrison or their contractors. These employees are paid their full salary for the typical 2 to 6 hour wait times, resulting in significant productivity and monetary losses.

c. Weighting

Communication ranks 6 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate importance when compared to the other criteria. Based on criteria comparisons, communication is weighted 7.17% of the total alternative score. This ranking is in line with expectation, with text and email notification being a desired capability of the system in order to add customer value.

9. Hardware Compatibility

a. Definition

Hardware compatibility is defined as the modular compatibility of the proposed queueing system's hardware components with the baseline hardware being utilized at current time. This criterion determines to what extent current equipment is utilized to integrate with a new system. This may include computers, television monitors, speakers, kiosks, ticket printers/dispensers, displays, servers, and more. This criterion is measured by the degree to which the analyzed system integrates with current equipment, determined by the company's technical support experts.

b. Rationale

The ability to retain legacy components may afford the garrison an opportunity to reduce the procurement cost incurred from obtaining a new queueing system. Additionally, a particular vendor/supplier may already be utilized for all purchases of a particular equipment (such as the Government contract preference to purchase computers from Dell and television monitors from Samsung), so the modularity with these auxiliary components is an important determination with long-term impacts.

c. Weighting

Hardware compatibility ranks 14 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of low importance when compared to the other criteria. Based on criteria comparisons, hardware compatibility is weighted 3.80% of the total alternative score. This

criterion ranks low due to the modular nature of most modern systems, making compatibility a low concern. This criterion is also equally ranked with the network compatibility criterion, as the two share similar concerns.

10. Network Compatibility

a. Definition

Network compatibility is defined as the queueing system's ability to integrate with the baseline network(s) being utilized at current time. This criterion also determines if the selected alternative meets minimum operational requirements for performance, security features, low downtime, seamless integration, and protection from potential cyber attacks.

b. Rationale

The need for the queueing system to operate on the current operation's private network is essential to maintaining secure data when communicating or storing a customer's PII. While it is possible to implement additional networks to the system (such as internet communications), the proposed system must be capable of interfacing with the private network, at a minimum. A highly network compatible system would also interface with (with minimal modifications) the DoD's Defense Information Systems Network (DISN).

c. Weighting

Network Compatibility ranks 14 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of low importance when compared to the other criteria. Based on criteria comparisons, network compatibility is weighted 3.80% of the total alternative score. This criterion ranks low due to the ease of integration for most modern systems, making compatibility a low concern. Compliance with DoD network standards is a must for this criterion. This criterion is also equally ranked with the hardware compatibility criterion, as the two share similar concerns.

11. Data Storage

a. Definition

Data storage is defined as the queueing system's ability and capacity to store information in the form of databases, reports, documents, emails, customer data, or any other data to be utilized by the human resources service providers. This criterion measures how well the network-attached data storage is centrally managed, maintained, backed up, and archived for current and future use by multiple service providers. The network-attached storage is dictated by the applications to be handled as well as the volume of data stored by the queueing system itself. Larger volumes of data require larger capacity disks, more memory, and more powerful network processing.

b. Rationale

Network-attached storage is essential to the service-rendering operations as well as process control. Personnel on a local area network must have access to shared storage via a standard Ethernet connection. Storing and sharing this data enables management to have greater visibility and control into the queuing process. Physical paper copies of data carry a risk of PII leakage when dealing with customer information, making effective and secure electronic storage more desirable.

Low cost data storage and maintenance is vital to daily operations and management activities. The solution must fall within the space limitations of the current facility and have a minimal physical footprint.

c. Weighting

Data storage ranks 8 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate importance when compared to the other criteria. Based on criteria comparisons, data storage is weighted 6.33% of the total alternative score. Moderate importance is expected for this criterion, as the alternative must fit within the physical constraints of the service facility as well as projected data constraints when dealing with customer communications.

12. Security

a. Definition

Security is defined as the queueing system's ability to ensure integrity, confidentiality, and availability of information. Security is also measured by the system's ability to defend and recover from accidents or attacks by adversaries. According to the U.S. Department of Commerce's National Institute of Standards and Technology (NIST) Special publication 800-171, cybersecurity is defined in fourteen categories:

- Access control
- Awareness and training
- Audit and accountability
- Configuration management
- Identification and authentication
- Incident response
- Maintenance
- Media protection
- Personnel security
- Physical protection
- Risk assessment
- Security assessment
- System and communication protection
- System and information integrity (U.S. Department of Commerce, 2018)

In each of these areas, the selected queueing system must meet specific security requirements or be interoperable with the DoD's cyber systems as well as adhering to DoD policies and the Defense Acquisition Regulation Supplement (DFARS) security requirements.

b. Rationale

Disruptive or destructive cyber-attacks on the network could lead to a critical breach in PII, with potential significant consequences to the vast number of clients who use services at the facility. It is the DoD's responsibility to protect customers from this type of cyber-attack, ensuring confidentiality, availability, and integrity of data at the service facility. The selected solution must be capable of prioritizing the systems and data that they need to protect, assess risks and hazards, and provide (or be interoperable with) cyber defense capabilities to meet DoD security goals and objectives.

c. Weighting

Security ranks 1 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate to high importance when compared to the other criteria. Based on criteria comparisons, security is weighted 9.28% of the total alternative score. Naturally, security is of the utmost importance when dealing with user information. This criterion ensures that the selected system is in line with DoD security requirements; an absolute necessity when implementing any new system on a DoD network.

13. Expertise and Training

a. Definition

In this context, the criterion of expertise and training is defined as the amount of education and instruction that current (or new) personnel must have in order to operate and maintain the selected queueing system. This criterion is measured by the amount of new or unique skills the operations personnel are expected to possess, as well as the time investment to achieve full operational proficiency. Solutions that are provided with

manuals or learning plans to supplement technical support score higher in this criterion, as well as those with built-in software assistance.

b. Rationale

Throughput is a key concern and primary issue experienced at the service facility, hence, ease-of-use paired with a highly intuitive interface is deeply valuable to daily operations. Less hands-on time for both customers and service personnel can assist in achieving higher throughput. Additionally, down time experienced by necessary training activities or continuous learning may present a detriment to mission operations and should be kept to a minimum level. The expectation is that hands-on training is the primary method of learning.

c. Weighting

Expertise and Training ranks 8 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate importance when compared to the other criteria. Based on criteria comparisons, expertise and training is weighted 6.33% of the total alternative score. This criterion falls in the middle of criteria importance; while it is expected and necessary for the service staff to have training and some level of expertise, it is arguably more beneficial to have an intuitive system that minimizes time spent in training. Thus, a ready-to-use system that has a high ease of use factor is important to this trade study.

14. Report Customization

a. Definition

Report customization is defined as the queueing system's ability to generate a custom report based on the service provider's needs. This criterion is measured by the ease, understanding, and manipulation required from service staff to create a customized report, as well as level of detail. Each service tenant has individualized goals and strategies for their specific service, thus making report manipulation an invaluable asset.

b. Rationale

With customizable reports, management can positively identify process weaknesses or bottlenecks, providing them with valuable information on where change must occur within the process. This may also serve as justification for personnel additions or movements to area of need, or simply pinpoint areas where supplementary training is required. In the event of an audit, custom reports are an invaluable tool that save time and reduce the investment of man hours required to gather data from multiple locations. It is preferable for the service provider to be given the option of pre-built reports as well as customizable reports, with the ability to reproduce the same custom format for standardized reporting.

At a minimum, reports must include some combination of the following:

- Date
- Client time in / time out
- Client wait time
- Transaction time
- Requested service (with sub categories per service)
- Average service time per day / per service provider
- Average wait time per day / per service provider
- Number of clients serviced per day / per service
- Number of clients turned away (no service rendered)
- Number of no-show clients
- Weekly/monthly summaries of all data

A queueing system that can produce a report with any combination of these items scores higher in this criterion. The ease at which the user can produce this custom report is also a deciding factor.

c. Weighting

Report Customization ranks 7 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of moderate importance when compared to the other criteria. Based on criteria comparisons, report customization is weighted 6.75% of the total alternative score. This is a fairly important criterion, particularly to management, who get the most utility from the system's data. Greater visibility to the entire process is a valuable asset in decision making for the future.

15. Queue Cognizance

a. Definition

Queue cognizance is defined as the system's ability to provide transparent information regarding the customer's progression through a queue. The evaluated queueing solutions rank higher in this criterion based on the user's ease of access to this information and level of detail. For example, a web-based solution that offers generic information based on average wait time for the day scores lower than a solution offering real-time mobile updates customized to the client's specific place in the queue. Therefore, this criterion is measured by the user experience in two ways:

- Dynamic communication directly to waiting customers
- Information about expected service time and progress to waiting customers

b. Rationale

It can be argued that the amount of time a customer spends waiting isn't as important as their perception of the wait. By allowing customers to queue virtually and providing them with information on their place in line and estimated wait time, it eliminates customer uncertainty about the queueing expectation. Even when wait times are perceived

as lengthy, research has shown that known wait times are more tolerable than unknown wait times.

c. Weighting

Queue cognizance ranks 11 of 15 total analyzed criteria (with 15 being the lowest priority criteria). This ranking is justified based on Table E-1, where it is determined to be of low to moderate importance when compared to the other criteria. Based on criteria comparisons, queue cognizance is weighted 5.91% of the total alternative score. This particular criterion is ranked lower than ‘remote accessibility’ and ‘communication’ as it is merely a method to convey to the customer their place in the queue. It is deemed more important to inform the customer of their expected wait time and, potentially, their expected service time.

D. ALTERNATIVE EVALUATIONS

Each alternative is scored using the scoring definitions defined in Table E-3. Having a measurable basis for evaluating each alternative allows the assignment of a raw score. The raw score is assigned for each alternative based on the scoring key. For raw scores without a specific measurement (such as ‘ease of use’), subject matter expertise and facility staff are used to provide an accurate estimation.

1. Baseline

The baseline system is evaluated against the evaluation criteria in Table 3.

Table 3. Baseline System Evaluation

Baseline		
Criterion	**Score**	**Evaluation Justification**
Procurement Cost	4	The Baseline alternative requires no investment, as the service facility would retain the status quo system.
Sustainment Cost	4	Little to no sustainment cost to upkeep the status quo system.
Upgradeability	1	Little to no functional modularity (adding new functionality or upgrading existing software). System-unique components/subsystems used to support the queueing processes. Clearly identified critical points of fragility that cause full operational stops. Little to no testability/error logging/recording capability.
Maintainability	1	Time to repair failures is high. System failures necessitate a full reset, with such a failures often spanning a full day.
Support Personnel	1	Due to the antiquated hardware/software versions used in the baseline system, the parent company has little to no skilled support capability to maintain the legacy system.
Interface	1	No web/mobile interface. Physical kiosks are stationed at the physical facility with little self-service capability.
Remote Accessibility	1	No remote accessibility.
Communication	1	No communication capability. Users intake passive information from a television at the service facility's lobby.
Hardware Compatibility	4	Status quo hardware utilized.
Network Compatibility	4	Status quo network utilized.
Data Storage	2	Data stored on-site at the service facility. One dedicated server for all services.
Security	2	Baseline system utilizes two separate systems - queue system is used on a separate, isolated system from the network which stores customer information (PII).
Expertise & Training	4	Baseline system is currently in use; assuming the service facility staff maintains a low turnover rate, no new training or specialized skills are required to maintain current operations.
Report Customization	1	Little to no ability for service facility staff to retrieve or manipulate system data.
Queue Cognizance	1	No queue status offered remotely. Status limited to physical location.

2. Qmatic Upgrade

The Qmatic upgrade system is evaluated against the evaluation criteria in Table 4.

Table 4. Qmatic Upgrade Evaluation

Qmatic Upgrade		
Criterion	**Score**	**Evaluation Justification**
Procurement Cost	3	Hardware and software upgrades to the baseline system necessitate an initial investment of $53.5K (Table C-1).
Sustainment Cost	1	Support services, hardware/software modifications, maintenance, training, and other services are estimated at $33.77K annually.
Upgradeability	3	System utilizes several system-unique components.
Maintainability	2	Company offers a limited warranty for system components for 1 year. System's performance and stability has been proven through extensive use in industry.
Support Personnel	2	Support availability/response time is based on the problem criticality. Customer support routes issue requests to the appropriate engineer, whose response time is between 1 hours (via remote call) or 3 days (in-person support). Support staff based in Atlanta, GA.
Interface	2	Kiosk and mobile interface capable. Cannot integrate some mobile interface or cloud functions due to PII concerns.
Remote Accessibility	2	User may remotely queue and monitor status via mobile application.
Communication	3	System communicates with the user via mobile device and text messages, with options for phone and live web feed.
Hardware Compatibility	2	Capable of utilizing some baseline components such as kiosk and ticket printer.
Network Compatibility	2	Local network compatible for queueing system. Remote network is incompatible with the DoD DISN.
Data Storage	3	Local server and cloud storage capable.
Security	2	Compliant with DoD security requirements by utilizing a separate closed network for PII.
Expertise & Training	3	Upgrade to the baseline system retains a similar look and feel, requiring minimal familiarization training.
Report Customization	2	Service facility staff must utilize pre-defined reports. Unique reporting requirements must be requested through the parent company.
Queue Cognizance	3	Users have full visibility to their progression through the queue with dynamic communication and finite service time.

3. Q-Flow

The Q-Flow system is evaluated against the evaluation criteria in Table 5.

Table 5. Q-Flow Evaluation

Q-Flow		
Criterion	**Score**	**Evaluation Justification**
Procurement Cost	2	Procurement of new hardware, software, and auxiliary systems necessitate an initial investment of $73.6K (Table C-2).
Sustainment Cost	2	Support services, hardware/software modifications, maintenance, training, and other services are estimated at $29.1K annually.
Upgradeability	3	System utilizes several system-unique components.
Maintainability	2	Company offers a limited warranty for system components for 1 year. System's performance and stability has been proven through extensive use in industry.
Support Personnel	2	Support availability/response time is based on the problem criticality. Customer support routes issue requests to the appropriate engineer, whose response time is between 1 hours (via remote call) or 3 days (in-person support). Support staff based in St. Louis, Missouri.
Interface	2	Kiosk and mobile interface capable. Cannot integrate some mobile interface or cloud functions due to PII concerns.
Remote Accessibility	2	User may remotely queue and monitor status via mobile application.
Communication	2	System communicates with the user via mobile device and text messages, with options for phone and passive web feed.
Hardware Compatibility	1	Incapable of utilizing baseline system components; must purchase new hardware.
Network Compatibility	1	Incompatible with local network; necessitates additional integration efforts. Remote network is incompatible with the DoD DISN.
Data Storage	3	Local server and cloud storage capable.
Security	2	Demonstrated security standards on DoD and industry systems.
Expertise & Training	2	Unique interface and system processes requires a paradigm shift, although new skills are minimal.
Report Customization	2	Service facility staff must utilize pre-defined reports. Unique reporting requirements must be requested through the parent company.
Queue Cognizance	2	Users have minimal visibility to their progression through the queue with a three-hour window of service time.

4. Government-Developed Solution

The Government-developed system is evaluated against the evaluation criteria in Table 6.

Table 6. Government-Developed Solution Evaluation

Government-Proposed Solution		
Criterion	**Score**	**Evaluation Justification**
Procurement Cost	1	Procurement of new hardware, software, and auxiliary systems necessitate an initial investment of $93K.
Sustainment Cost	2	Support services, hardware/software modifications, maintenance, training, and other services are estimated at $25K annually.
Upgradeability	4	A system tailored to service-specific requirement specifications that provides high physical and functional modularity and is designed with a goal of operational commonality. Modularity is of key importance.
Maintainability	3	Government owned software and hardware can be maintained internally, with hand-picked personnel to provide specialized maintenance. System can implement redundancies to reduce down time.
Support Personnel	3	Government ownership and selection of skilled support personnel. High availability due to co-location, all support rendered in-person.
Interface	3	Interface specifications and requirements defined and developed by the Government. May collect user feedback and implement continuous process improvement to streamline user interface.
Remote Accessibility	2	User may remotely queue and monitor status via mobile application and web, but may not transmit any PII.
Communication	2	System communicates with the user via mobile device and text messages. Implementation of web services would be costly and are thus infeasible to support.
Hardware Compatibility	2	Capable of utilizing some baseline components such as kiosk and ticket printer.
Network Compatibility	3	Local network compatible for queueing system. Remote network required commercial internet service rendering.
Data Storage	2	Local server capable; handling of remote PII data requires investment in separate storage.
Security	3	Demonstrated security standards on DoD and industry systems.
Expertise & Training	2	Unique interface and system processes requires a paradigm shift, although new skills are minimal.
Report Customization	3	Service facility staff may utilize pre-defined reports, define new report templates, and customize data output as needed.
Queue Cognizance	3	Users have full visibility to their progression through the queue with dynamic communication and finite service time.

5. Hybrid

The Hybrid system is evaluated against the evaluation criteria in Table 7.

Table 7. Hybrid Evaluation

Hybrid Solution		
Criterion	**Score**	**Evaluation Justification**
Procurement Cost	2	Procurement of new hardware, software, and auxiliary systems necessitate an initial investment of $75K.
Sustainment Cost	2	Support services, hardware/software modifications, maintenance, training, and other services are estimated at $28.75K annually.
Upgradeability	4	A system tailored to service-specific requirement specifications that provides high physical and functional modularity and is designed with a goal of operational commonality. Modularity is of key importance.
Maintainability	3	Government owned software and hardware can be maintained internally, with hand-picked personnel to provide specialized maintenance. System can implement redundancies to reduce down time.
Support Personnel	3	Government ownership and selection of skilled support personnel. High availability due to co-location, all support rendered in-person.
Interface	3	Interface specifications and requirements defined and developed by the Government. May collect user feedback and implement continuous process improvement to streamline user interface.
Remote Accessibility	3	User may remotely queue and monitor status via mobile application and web; Government/Hybrid system allows for queue remotely as well as physical queue, with capability to allow customer to depart after kiosk check-in.
Communication	4	System communicates with the user via mobile device and text messages, with options for phone and live web feed. Potential upgrade to implement 2-way communication with the user to accept pre-check in data.
Hardware Compatibility	3	Capable of utilizing baseline components such as kiosk, ticket printer, overhead displays, and queue advancement.
Network Compatibility	4	Local network compatible for queueing system. Remote network can be modified to DoD DISN standards.
Data Storage	4	Local server and cloud storage capable, with internal Government modification to handle PII on existing systems.
Security	3	Government owned security implementation plans and protocols. Low difficulty in obtaining a CoN.
Expertise & Training	2	A similar interface to the baseline system is utilized with the additional implementation of specific Government requirements. Minimal training/skill required to perform standard operations.
Report Customization	3	Service facility staff may utilize pre-defined reports, define new report templates, and customize data output as needed.
Queue Cognizance	3	Users have full visibility to their progression through the queue with dynamic communication and finite service time.

E. SENSITIVITY ANALYSIS

Trade study outcomes were reviewed with the service facility's management to determine if the evaluation criteria needed alteration. Engineering judgement and discussions with the service facility stakeholders was used to determine if the delta values between alternative scores were statistically significant and if minor variations in the raw scores and weighting would affect the selection (Federal Aviation Administration, 2006). A critical inspection of the weighted scores determined little sensitivity to variation of weights or scores.

F. SUMMARY OF RESULTS

After each alternative was evaluated independently, the evaluations are compared side-by-side in Table E-4 to display the summary of the evaluation results. These results represent the raw score for each alternative. To determine the best alternative solution, evaluation criteria weighting percentages must be applied to each alternative's raw score, producing a weighted ranking for each alternative as shown in Table E-5. Each alternative is ranked in two ways. The most suitable technical solution is ranked best (1) to worst (5) based on the alternative's operational utility function (OUF) score. OUF weighs the alternatives independently of procurement and sustainment costs associated with the system acquisition. The alternatives are also weighed using a cost effectiveness function (CEF) which is ranked best (1) to worst (5). The rankings for each alternative are summarized in Table 8.

Table 8. Summary of Alternative Rankings

	Alternatives				
Rankings	Baseline	Qmatic Upgrade	Q-Flow	Government Solution	Hybrid
OUF Ranking	5	3	4	2	1
CEF Ranking	1	3	4	5	2

Using the OUF and CEF rankings, the alternative evaluation matrix determines that the Hybrid solution is the most technically suitable solution, while the Baseline system is most cost effective (best value). For this study, the baseline solution is not considered a viable option going into the future as user demands and opportunity cost continue to rise. Consequently, the second most cost effective alternative, the Hybrid solution, also ranks highest as a technical solution, making it the self-evident preferred alternative for this trade study.

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V. CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The garrison tenant population has grown exponentially since the service facility opened in July 2012, thus causing longer delays and wait times for services rendered. However, the current queuing system in place only provides for in-facility notification. Under this JAP, engineers have devised a project plan and proof of concept to address and reduce the physical waiting room wait times at the service facility. In coordination with garrison leadership, engineers conducted a trade study analysis reviewing several industry commercial off-the-shelf solutions as well as the current in-place solution for queuing capabilities and remote notifications. Based on the results of the trade study conducted in this JAP, a Hybrid COTS and Government developed solution is presented as the best technical solution to replace the existing baseline system at the garrison service facility. This solution would allow the implementation of an internet presence to enhance and expand user notification.

As discussed in Chapter III, the customer wait times incurred by the current process result in an annual non-value added cost impact of roughly $2.29M. Assuming a reduction in NVA-R wait times by 50%, the cost impact to the garrison would be reduced by an estimated $1.15M. Employee morale and productivity would be improved by streamlining the process and allow support to continue to the DoD mission of serving the Warfighter.

B. RECOMMENDATIONS

Based on the conclusions of the trade study conducted as part of this Joint Applied Project, it is recommended that the garrison service facility execute a hybrid solution that combines the existing, commercial queuing capability of the upgraded Qmatic software (Orchestra Essentials 6 and Business Intelligence) with a Government Integrator and Technical Support team. This solution set combines the cost effectiveness and proven technical solution of an existing COTS product with the Government support needed to successfully tailor that product to meet any DoD application, security and cybersecurity requirements to ensure a successful end product to the end user.

A phased approach has been developed to implement this solution to include upgraded queuing application software hosted on a new server platform and current operating system. Acting as a system integrator, the garrison research facility must expand and extend the current physical network infrastructure into the service facility. Utilizing the HPCMP DREN as the network service provider, the new queuing system will have integrated Internet access for providing remote capabilities to include SMS text notifications and mobile ticket visual presentation status. The following sections provide a summarized list of activities recommended for each phase of the implementation plan.

1. Initial Implementation (Phase I)

a. Procurement/Planning

- Procure the upgraded Qmatic Orchestra 6 Essentials and Business Intelligence software component and services
- Select and procure SMS services
- Server Resources identified/procured to host the system elements
- Define and document a network schema addressing security and cybersecurity requirements based on operational system requirements
- Define workflow/queuing heuristics and requirements with garrison leadership for Qmatic analyst initial setup (queuing procedures, SMS text timeframe notifications, etc.)
- Develop a physical hardware installation plan for queuing system accessories (signage, monitors, kiosk, etc.)
- Develop and document a test plan

b. Implementation/Configuration

- The garrison research facility requests a work order with NEC for a fiber circuit to be created from the service facility building to the research headquarters

building. This provides a physical network connection between the two organizations

- Install a network managed switch
- Implement the network schema defined in planning phase. This includes the Access Control List (ACL's) implementation strategies to meet cybersecurity requirements and restrictive control measures
- Request domain name system registration for online presence
- Setup and Install server resources (operating systems, SQL)
- Request and install DoD server certificates
- Configure backup and restore procedures
- Setup and install Qmatic application software and accessories
- Coordinate with Qmatic SMEs to implement defined workflow heuristics
- Implement SMS texting alert notifications based on defined heuristics to ensure adequate time for customers to arrive back to the service facility for processing

c. Testing/Validation

- Test and validate network connectivity and SMS capabilities
- Check and ensure valid backup and restore operations
- Monitor system operations for proper operations

2. Sustainment (Phase II)

Upon initial implementation of Phase I, analyst must monitor, gather and review customer feedback and system data. Results will be analyzed and decisions will be made to determine if system adjustments or standard operating procedures need to be modified to enhance operational performance.

a. System Modifications

- Make system adjustments based on the analyzed results (if necessary)
- Develop plan and heuristics for mobile check-in capabilities (what services will be accepted, number of check-ins, timeframe available, etc.)
- Develop test plan for mobile check-in

b. Implementation/Configuration

- Coordinate with Qmatic SMEs to implement defined workflow heuristics for mobile check-in
- Implement Mobile check-in capabilities / Online appointment scheduling

c. Testing/Validation

- Execute test plan for mobile check-in
- Validate results

d. Transition

Establishing the proof of concept hosted via DREN fits within the network model for the research and development of systems to solve problems related to DoD organizations, military and industry applications, processes and programs. Once the proof of concept has been completed and operations go into a sustainment phase, efforts will begin to transition the garrison service facility queuing system off of the DREN and onto the service provider managed by NEC.

3. Additional Recommendations to Support the Preferred Solution

Prior to transitioning, a plan must be developed and documented between the organizations to ensure a smooth transition. The plan should examine all factors which are impacted due to the move to include the physical network schema changes required, domain name system transition, subscription services for SMS texting, and cybersecurity requirements on the new hosted network. Once all of the items have been documented and

addressed, system analysts should schedule and stage the transition to ensure system backups are adequate before executing the move.

C. FUTURE WORK

During the initial coordination of this study, the authors of this report received concurrence from the Federal research agency's Chief of Staff, Deputy Chief of Staff, Chief Information Officer, and Chief Technology Officer to support the garrison in program integration and hosting during the proof of concept phase of this effort.

It is recommended that the service facility coordinate with the program integration support provider and Chief Technology Officer to identify exit criteria for the proof of concept phase of this effort. Once that is established, the local Federal agency must coordinate a schedule and communicate sustainment resource requirements to the service facility. With standard support, the reoccurring annual program integration resource requirement is expected to be $34,000 (operations and maintenance type). The funding can be sent as a military interdepartmental purchase request (MIPR), direct cite for contract, to the local Federal agency on an annual basis. The service facility also needs to fund the software application vendor, Qmatic, for program upgrades, text messaging, and technical support on an annual reoccurring basis through their internal contract. With this type of standard support, it is expected that the annual sustainment resource requirement would be less than $25,000.

Upon successful demonstration of the proof of concept for the mobile queuing application, the program integration team will assist the garrison in transferring the application to be hosted on a non-developmental domain.

As with a standard LSS approach, sustaining the improvement in the control phase is a critical step to successful implementation. Once the waiting room wait times have improved, it is recommended that the service facility leaders ensure that the queueing enhancements maintain the gains of reducing the physical waiting room time of their customers.

1. Operational Improvements

a. Process Documentation

The service facility should work to update process maps, document new procedures and checklists, and create or update workflow diagrams. Documentation allows process participants to adopt the new way of doing things, and gives leverage for leadership to take ownership of changes and direct improvements.

b. Introduce and Propagate Best Practices

The service facility can continue to improve by adopting best practices from this and other improvement programs, and reaching out to other government facilities to gain an understanding of the best practices across a diverse service environment. Even if the software solution cannot be utilized across all areas, the lesson learned by its development and implementation can be passed to other operations or other commands to improve processes and inform decision making for the future.

c. Implement Continuous Process Improvements

The four LSS principles of value, flow, pull and perfection should be used to optimize the processes employed at the service facility. The service facility should work to obtain updated ICE comments, review social media posts, execute surveys, and identify and collect metrics to baseline and measure improvements. GoLeanSixSigma.com identifies the LSS principles:

- Value: The minimum steps needed to satisfy the customer
- Flow: Optimization of processes by removing waste
- Pull: Customer demand of services
- Perfection: Application of continuous improvements to seek “perfection” of the system (GoLeanSixSigma.com, n.d.)

d. Rebuild Customer Confidence

The service facility should promote the new queuing system in garrison newspapers, organization newsletters, all-hands staff meetings, and social media. The attempt to improve customer service and be respectful of the customer's personal time will be appreciated.

Additionally, customer climate surveys should be utilized to gauge customer impressions and satisfaction level with the new process. A Government stakeholder should be assigned to check back on the success of the new queueing system and processes, taking in to account the customer satisfaction. A method to handle and analyze this information should be retained by the service facility as a method for continually improving the customer experience.

e. Bolster Appointments

A complimentary improvement to the queueing system and process would be the expanded use of appointments. As discussed in this JAP, a mere 10 appointments are provisioned per day at a service facility that sees hundreds of customers daily. With the improvement in customer walk-in processing, the JAP team recommends increasing available appointments to 60 per day, with 10 appointments reserved for urgent circumstances. The increased use of appointments reduces the strain of walk-ins and, consequently, the number of turn away customers.

2. Possible Future Upgrades

a. Expand Customer Convenience

After the successful implementation of the improved queueing system and processes, as well as observed improvement in customer wait times, it is recommended that leadership focus shift to continuous process improvements. Expanding customer convenience can translate directly to improved customer satisfaction and process flow. Process improvements may encompass many options and should be evaluated independently based on operational need or user demand. The JAP team presents the following options as suggested future upgrades to analyze:

- Add additional check-in kiosks at remote locations, such as those with high employee populations
- Add more automation to the check-in process; explore options for saving and transmitting customer data through the mobile application
- Further improve communications to the customer through texts, calls, emails, and push notifications

b. Integration with the Garrison's Mobile Application

In December 2016, the garrison launched a mobile application to communicate public information with the installation and community. There was a lack of streamlined communication for safety and quality of life facets. A leadership team who served as the program management for developing and deploying this mobile application wanted to capitalize on the digital mindset of the current workforce. They developed a mobile application to connect the installation and community more effectively through safety and security notifications, quality of life initiatives, installation information, and other public websites. The mobile application met every single LOE on the senior commander's list (Figure 1) and connected many facets of the workforce and community as they marched towards becoming a Federal center of excellence.

In the event of an emergency, the installation did not have one single method of communication that had the capability to reach the entire workforce. Each individual organization had their own method of email, text messaging, or relying on personal phone calls from chain of command. The garrison has AtHoc (www.athoc.com/) and uses it for desktop notifications to communicate emergency information to the workforce. However, the mobile notification system is only obtained by providing the AtHoc service website with personal information (name, phone number, organization, etc.). Most individuals do not feel comfortable providing personal information to a non-Government source. Therefore, after a meeting with the Installation Emergency Office personnel, they confirmed that only 5% of the workforce had downloaded the AtHoc mobile application.

Without a Government owned mobile application, the installation was not effectively communicating with the workforce while they were away from their desk.

In 2017, the installation had a potential active shooter situation. The installation went into immediate lockdown and the emergency services (SWAT, FBI, security, police, emergency management, etc.) and protocols went into action. The garrison sent out a push notification on the mobile application to communicate the potential active shooter situation to the workforce and provide instructions to remain vigilant and safe.

As of April 2018, the mobile application has been downloaded more than 15,000 times, by users who did not have to type in their personal information. The mobile application is available on the Apple App Store and Google Play store as a free download, and is Defense Information Systems Agency (DISA) approved for use on Government devices.

The garrison's mobile application serves as a critical communication tool to the workforce and community. During times of base closure, inclement weather, major traffic delays, and emergency situations, the garrison has the capability to send push notifications to communicate information quickly. For quality of life information, the mobile application has a news feed and access to maps, resources on base, and contact information. Additionally, public websites are linked to organizational information.

It is expected that the mobile application could also serve as a common information tool that provides a link to a public, secure, Government owned website for walk-in appointment scheduling purposes. At this secure website, a customer can schedule a same day appointment to the human resources service facility mentioned in this study. Additionally, there can also be links to the RAPIDS appointment scheduler for those customers who can meet the 8–12-week lead time. The mobile application serves as an existing communication tool that will connect customers to the secure website to schedule appointments. It is expected that mobile application users will increase if there is a link to the service facility's mobile queuing website. As the workforce and surrounding community download the free mobile application, a secondary benefit to the senior

commander and installation commander is that they will be able to reach a wider network of personnel to communicate emergency information.

APPENDIX A. GARRISON ENDORSEMENT

Naval Post Graduate School (NPS)- Joint Applied Project (JAP)

Project Title: One Stop – Remote Waiting Room Analysis

Start Date: 1 November 2017

Completion Date: 23 August 2018

Team Members: Naval Postgraduate School – Program Management

Carolyn Farmer, Brittany Roop, Megan Shumate

Date Submitted to NPS for Approval: 9 November 2017

1. Problem Statement

One-stop walk-in customers experience extensive waiting room times.

Impacts:

- Quality of Life
- Security
- Resources (financial, time, personnel)
- Responsiveness, Resiliency & Productivity of the Workforce

2. Business Impact

One Stop Customers (Active Duty, Civilian, Retirees, Veterans, Dependents, Spouses, Contractors, Foreign Nationals, etc) are encountering extensive wait times for "walk in" service.

By providing a remote waiting room capability to the One-Stop, the customer is able to potentially increase their productivity while they wait for their service.

3. Goals

- Identify and research various technical capabilities that offer a remote waiting room experience to One-Stop customers.
- Conduct a trade study on technical solutions and provide a final recommendation to Garrison.
- Provide recommendations to enhance communications with One Stop customers (walk-ins and appointments)

4. Before (as is)

To Schedule an Appointment:

1. Online RAPIDS Appointment Scheduler. Owned by Defense Manpower Data Center (DMDC). Requires est 8-12 week lead time.
2. "Walk In" to pull a number through the Qmatic system onsite and physically wait in the One Stop waiting room for availability. Extensive wait times (hours to days).

5. After (to be)

Offer a third option to remotely schedule "walk in" appointments. Communicate status, information on service time, reminders, and cancellations to customers (walk-ins and appointments).

Connect mobile queuing system to sync with the onsite interface. Allow customers to "wait" anywhere and provide updates about the status of their wait. Allow the option to also use a web browser, as some organizations do not allow mobile devices inside their buildings.

6. Gap Analysis

1. **Remote Room Capability**: Research and identify a solution for walk-in customers that reduces the amount of time they have to physically sit in the lobby of the One-Stop.
2. **Communication**: Enhance real time communication to the customer to give them flexibility to "wait" anywhere and still monitor their place in a virtual line.

7. Action Plan

- **Oct 2017**: Coordinate with Garrison & One Stop
- **Nov 2017**: Complete JAP Proposal Plan with Final Signatures
- **Jan - March 2018**: Complete Data Collection
- **April – June 2018**: Complete Analysis and Research of Technologies
- **August 2018**: Complete JAP and submit to NPS Advisor, Command Advisor, Garrison, and stakeholders

8. Results

1. **Research** available technologies/programs that can be used to create a remote waiting room and mobile communication capability. Decrease the amount of time that the customer has to physically spend in the lobby of the One-stop.
2. **Provide a final report** to Commander, Redstone Arsenal – Garrison, that documents the technical solutions that were analyzed, the COAs that were explored and the final recommendation from the JAP team for Team Redstone One Stop Customers.

9. Approval

As the Command Sponsor, I accept the proposed academic research effort and allow the report to be used and published for academic purposes at the NPS. I will review the recommendations and determine if the Garrison or other organizations can utilize its contents to compliment existing processes. I understand there is no obligation to fund or sustain the recommendations provided in this analysis.

COL Thomas P. Holliday Jr./ Tom Holliday

Commander, Redstone Arsenal – Garrison (Command Sponsor) 1 Nov 17

Figure A-1. Command Endorsement

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APPENDIX B. DATA REPORTS

Table B-1. Baseline Card Transaction Summary Sample (November 2017)

DoD ID Card Report

REPORT SELECTION CRITERIA:
Begin Date: Nov 1, 2017 End Date: Nov 30, 2017
Site ID: 102080 - Redstone Arsenal

SITE: 102080 / Redstone Arsenal

CARD TRANSACTION SUMMARY

Cards Issued by Card Media Type

	Successful	Failed	Total
CAC / PIV:	1,249	69	1,318
USID:	674	25	699
Chipless:	47	10	57
CIF Request:	0	0	0
VOLAC:	0	0	0
Unknown:	N/A	0	0
Total:	1,970	104	2,074

Table B-2. Garrison Services Transactions

Service	Served	Average Transaction Time	Total Transaction Time	Average Wait Time	No Show
All	246,570	598	40938:23:00	2,504	21,235
Add or Remove Endorsements	293	495	40:16:34	8,857	40
Agent Shoppers Card	35	675	6:33:40	6,469	9
Badges Priority	2	1,167	0:38:54	1	
Boat Tag	600	729	121:30:06	1,160	12
Boat Test	26	490	3:32:30	6,123	7
Boat/Watercraft/Vessel Registration	73	764	15:30:00	389	1
CAC	68,424	644	12231:17:46	2,995	7,813
CAC (ISSUE REPLACEMENT) Civilian	10,419	828	2396:38:32	7,225	494
CAC ID Priority	11,150	616	1908:56:22	298	466
Casualty Room 112	39	717	7:46:06	1,783	186
Civilian	4,499	199	248:19:14	103	186
Civilian Pin Reset (CAC)	1,902	381	201:09:40	506	48
Contractor	3,955	210	231:04:56	112	215
DA Civilian Spouse Card (1602)	181	675	33:56:36	6,065	36
DEERS (Civilian)	758	642	135:16:06	5,574	71
DEERS UPDATE (Military In Uniform)	404	653	73:13:54	405	14
Drivers License or State ID	2,339	779	506:10:36	487	30
Handicap Placard	168	602	28:04:52	520	5
HHC	9	218	0:32:40	3,526	1
Hunting/Fishing License	427	685	81:13:56	883	2
ID Cards	47,806	570	7567:58:54	2,426	4,401
IN and OUT Processing Room 114	292	732	59:24:36	935	572
MILITARY	1,061	147	43:22:02	183	100
Military IN/OUT Processing	15	944	3:55:56	3,653	7
Military PRR/FRR/ORB/ERB UPDATE	10	9,523	26:27:08	3,820	3
Military Records Room 114	321	708	63:09:14	985	663
Military Retired ID	5,874	665	1085:34:54	6,393	719
Military Retirement	32	361	3:12:24	5,527	33
MILPO Priority		NaN		NaN	11
Mobile Home / RV Registration	5	482	0:40:12	685	2
Motorcycle Registration (Madison Country)	15	630	2:37:28	236	2
Motorcycle Test	241	530	35:30:36	10,130	25
New (First Time Issue) License or State ID	705	688	134:45:00	9,569	42
New Alabama License	3,440	622	594:47:34	9,805	318
Permit Test	1,028	593	169:27:02	10,245	99
PIN Reset	5,419	339	510:14:52	2,752	993
Removal of Corrected Lenses	51	560	7:55:36	8,075	7
Renew or Replace License	17,508	550	2675:05:36	840	507
Retirement Room 114 A and B	184	769	39:18:58	1,257	695
SFL-TAP	1	1,156	0:19:16	2,644	6
Star/Veteran ID	1,535	619	263:58:56	12,343	147
TAGS	7,899	546	1197:41:32	1,099	78
Titles	1,940	732	394:18:20	993	24
Transition DD-214	10	747	2:04:30	3,389	6
Transition Room 114 D	58	670	10:47:16	1,382	267
Update DEERS	6,570	506	924:04:10	2,269	1,635
Vehicle Registration	6,607	675	1238:46:58	534	18
Vehicle Tag	32,240	627	5611:11:00	1,074	219

APPENDIX C. COST ESTIMATES

Table C-1. Qmatic Cost Estimate

QMATIC

ver. 28.2f

Q-MATIC Corporation
2400 Commerce Ave., Building 1100, Suite 100
Duluth, GA 30096

Organization	US Army Garrison Military Personnel Division	**Date:**	August 25, 2017
		Expires On:	November 23, 2017
		Rep:	Ben Smith
		Phone:	205-847-8877
		Fax:	
		Email:	Ben.Smith@qmatic.com
		Branches	1
		Quote #:	BLS-RSA1STOP-08252017-v4

RE: System Upgrade of 30 user license with Mobile Ticket expansion & moves as described LOBBY: Change ticket issue process from self-service kiosk to Recptionist assisted utilizing two new Intro 5 printers, add enablement for two lobby monitors, move (2) 948s from current lobby location to small waiting area on North wall above TVs, uninstall Intro 17 kiosks, DEERS: install 1 additional DEERS station 924 and Keypad (installation & configuration only hardware owned), MPD: uninstall (4)924, (1) 948, (1) 972 LED, & (4) KT2595 keypads, install (5) 924 LEDs on other side of room (installation & configuration only hardware owned), In & Out: Install (1) 972 in middle of long hallway for directional information & (1) 924 over doorway (installation & configuration only hareware owned). oluton includes (3) rack mounted servers: Application, SQL Database, and WebServer for Mobile Ecosystem. Government to provide (2) HDMI enabled wall-mounted monitors in lobby.

QTY	*GP Part #*	*DESCRIPTION*	*LIST*	*PER UNIT*	*PRICE*
*	**ORCHESTRA 6**				
30	10115500	Orchestra 6 Essentials	$885.40	$0.00	$0.00
*	ORCHESTRA 6 OPTIONS				
30	10115511	Orchestra 6 Digital Communication playlist/context marketing tab	$174.20	$139.36	$4,180.80
30	10115512	Orchestra 6 Business Intelligence	$245.40	$0.00	$0.00
30	10115513	Orchestra 6 Mobile Ecosystem	$174.20	$139.36	$4,180.80
*	**HUB DEVICES**				
1	10216100	Qmatic Hub	$1,245.00	$747.00	$747.00
*	Qmatic HUB Firmware License				
1	10115401	Hub Network Gateway License	$425.00	$0.00	$0.00
1	10115510	Orchestra 6 Distributed Operations	$425.00	$340.00	$340.00
*	**COMPUTER HARDWARE (Manufacturer's Warranty)**				
2	99900341R	Open Market Item, Non GSA - Std Orchestra Application and BI Rack Server	$5,009.94	$5,009.94	$10,019.88
1	99900340R	Open Market Item, Non GSA - Std SQL Database Rack Server	$7,269.94	$7,269.94	$7,269.94
2	99900578	Intro 5 Reception (Includes Printer and Mounts/Pedestal)	$2,990.27	$1,935.00	$3,870.00
*	**HARDWARE**				
1	HW9024	Hardware, Signage and Cabling	$660.00	$594.00	$594.00
1	100932	Qmatic Power Supply PS5A	$210.00	$178.50	$178.50
1	99900013	Open Market Item, Non GSA - 4-Port Ethernet Switch	$80.00	$77.60	$77.60
*	**TELEVISION HARDWARE & ACCESSORIES (Manufacturer's Warranty)**				
1	99900575	Qmatic Digital Media Add-on	$590.00	$590.00	$590.00
*	**SERVICES**				
12	PM1001	Project Management Services Hourly	$158.00	$142.20	$1,706.40
22	SA1001	Systems Analyst Services Hourly	$165.00	$148.50	$3,267.00
15	TR9087	Trainer Level II Hourly(Web Ex)	$165.00	$148.50	$2,227.50
29	IN9090	Installation	$132.00	$118.80	$3,445.20
1	TR9090	Open Market Item, Non GSA - Travel Expenses		$2,000.00	$2,000.00
1	SH9090	Open Market Item, Non GSA - Shipping & Handling - UPS Ground		$366.48	$366.48
*	**MAINTENANCE**				
1	HW7000	Q-MATIC CARE+ (months 1-6 included, charges for months 7-12)		$428.39	$428.39
1	SW7000	Q-MATIC CARE Starts Day One		$6,015.06	$6,015.06
1	SMS1001	Qmatic SMS Messages Block - 100,000/yr		$2,000.00	$2,000.00

SOFTWARE SUBTOTAL	$8,701.60
HARDWARE SUBTOTAL	$23,346.91
SERVICES SUBTOTAL	$10,646.10
MAINTENANCE SUBTOTAL	$8,443.44
TRAVEL SUBTOTAL	$2,000.00
SHIPPING SUBTOTAL	$366.48
TAX SUBTOTAL	$0.00
GRAND TOTAL	$53,504.54

* If taxes are quoted they are subject to change at time of invoicing

Q-Matic reserves the right to bill multiple invoices for this order - See Terms & Conditions for a complete overview

Table C-2. Q-Flow Cost Estimate

ACF Technologies, Inc.							
Date: **2-Apr-18** Quote: **MJP4218a**		GSA: GS-03F-0191V EXP 9/15/19			Core Quote - Assumes Customer to provide and install all TVs with CAT6 cabling; assumes workstation access through network for users. As quoted, without options, assumes on-network with customer providing servers		
Product Code	**Product Description**	**Unit of Measure**	**Qty**	**Commercial Price**	**GSA Disc**	**GSA Price with IFF**	**TOTAL**
u	**Software – Server Level -** Single Centralized Server						
QC-03	Small Branch Server Software	Global	1	$1,100	4.00%	$1,063.92	$1,063.92
QC-23	Calendar for Small Branch Server Soft	Global	1	$1,100	4.00%	$1,063.92	$1,056.00
QC-43	Enhanced Herald for Small Branch Server, including Test Messaging	Global	1	$1,100	4.00%	$1,063.92	$1,056.00
QC-90	ACF API for Small Branch Server - Mobile Framework	Global	1	$2,500	4.00%	$2,418.00	$2,400.00
QC-72	QFlow Workflow Server License (scope includes Online Appt Booking related Calendar templates)	Global	1	$9,500	4.00%	$9,188.40	$9,120.00
	Software – Client Access Lic						
QA-20	Agent – Premium License (Required for Appt templates)	Per User	8	$745	4.00%	$720.56	$5,764.48
QA-50	Manager License	Per User	1	$1,095	4.00%	$1,059.08	$1,059.08
QA-60	Administrator License	Per User	1	$1,250	4.00%	$1,209.00	$1,209.00
	Software – Equip Operation						
QL-35	Audio Channel License	Per Channel	1	$590	4.00%	$570.64	$570.64
QL-41	Ticket Printer License	Per Printer	1	$340	4.00%	$328.84	$328.84
QL-46	Info Page License	Per Display	1	$620	4.00%	$599.66	$599.66
QS-25	Multipage Kiosk License	Per Kiosk	1	$1,360	4.00%	$1,315.39	$1,315.39
	Hardware – Recept & Ticketing						
RK-12	Table Top Self-Serve Kiosk (w/printer and color touch screen)	Per Device	1	$3,895	4.50%	$3,747.62	$3,747.62
FS-01	Stand for Self-Serve Kiosk (RK-12)	Per Device	1	$725	4.50%	$697.56	$697.56
BC-02	Kiosk Barcode Reader (2D) and Shelf Fits FS-01 Kiosk	Per Device	1	$990	4.50%	$952.54	$952.54
TX-01	Case of 50 Thermal Ticket Rolls	Per Printer	1	$149	4.50%	$143.36	$143.36
	Hardware – TV *ADV MEDIA*						
MP-30	ACF Media Player	Per Device	1	$945	4.50%	$909.24	$909.24
MP-33	For KIOSK PC ACF Media Player - MiniPC with Storage (posting of call-forward data, advertisements, promotions and information)	Per Device	1	$1,175	4.50%	$1,130.54	$1,130.54
HD-19	HDMI to CAT-6 Accessory Kit For TV's	Per TV	1	$399	4.50%	$383.90	$383.90
MP-25	ACF Media TV Tuner (For Live TV Feed)	Per Device	1	$289	4.50%	$278.06	$278.06
	Installation/Configuration						
IN-01	Q-Flow Server Software Configuration	Per Unit	1	$1,590	4.00%	$1,537.84	$1,537.84
IN-05	Hardware Installation	Per Device	2	$200	4.00%	$193.44	$386.88
IN-06	Software Configuration	Per Wrkst	10	$100	4.00%	$96.72	$967.20
CO-01	On-Site Training, consultation, install	Per Day	6	$1,000	4.00%	$967.20	$5,803.20
PM-15	Project Management	Per Hour	40	$85	4.00%	$82.21	$3,288.40
SHW-01	Combined Core Global Maintenance and Support (annual impact)	18% of combined HW and SW value	1	$8,475	2.00%	$8,367.55	$8,367.55
CO-02	System Customization & Data Analysis (for use with block time report customization)	Per Hour	40	$155	4.00%	$149.92	$5,952.00
	Additional Software						
HOST-01	Annual Hosting via Gov Cloud with Gateway	Monthly	12	$1,000	non-gsa	non-GSA	$12,000.00
		TOTAL			$73,588.90		

APPENDIX D. PROPOSED GOVERNMENT/HYBRID SOLUTION INTERFACE

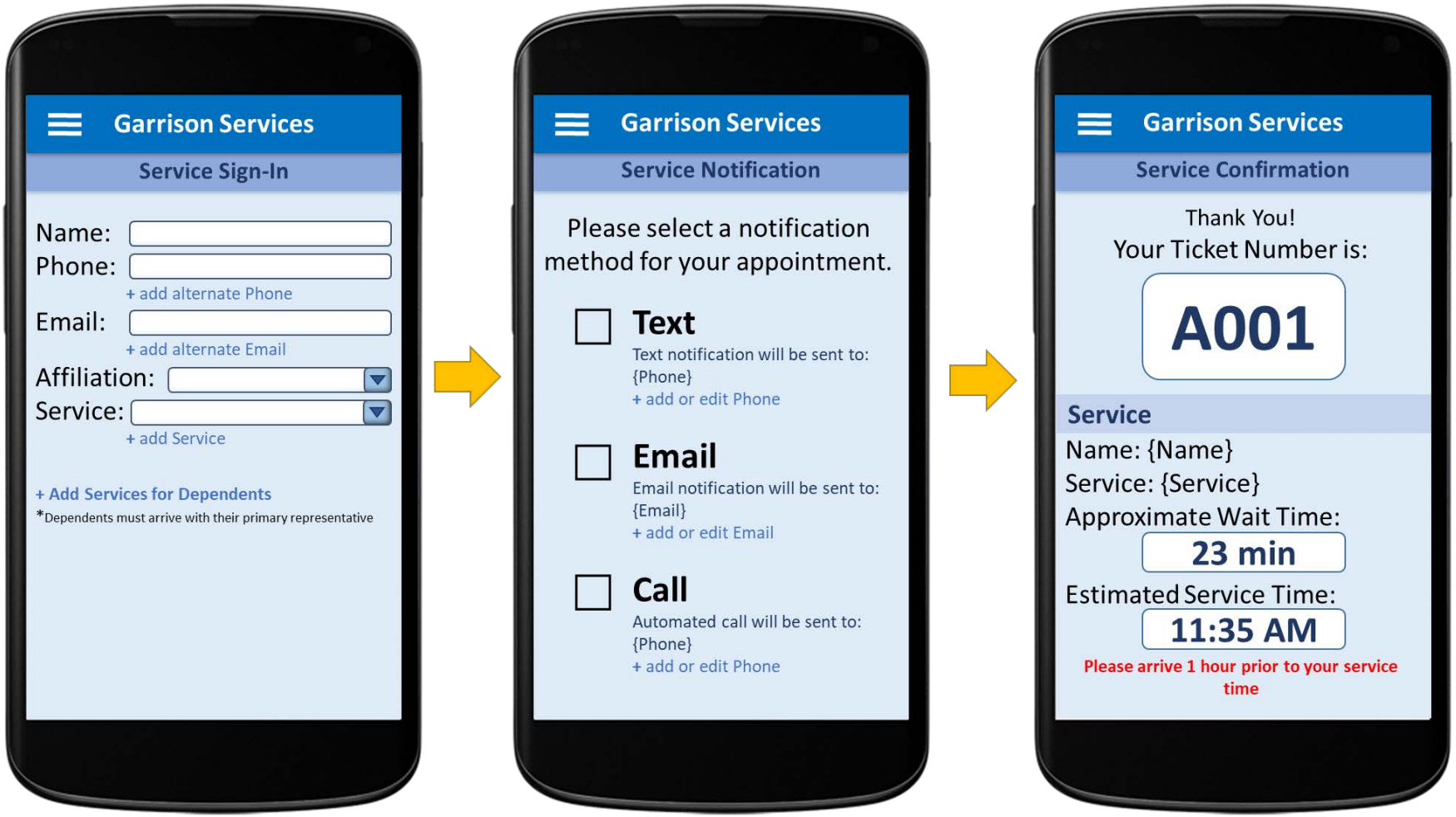

Figure D-1 Government Proposed Solution Mobile Application Mock-Up

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APPENDIX E. TRADE STUDY TABLES

Table E-1. Evaluation Criteria Weighting

	Procurement Cost	Sustainment Cost	Upgradeability	Maintainability	Support Personnel	Interface	Remote Accessibility	Communication	Hardware Compatibility	Network Compatibility	Data Storage	Security	Expertise and Training	Report Customization	Queue Cognizance
Procurement Cost		1	0	1	1	0	2	2	0	0	0	1	1	0	1
Sustainment Cost	1		1	1	1	1	2	2	0	0	0	1	1	2	2
Upgradeability	2	1		1	1	2	2	2	1	1	2	2	1	1	1
Maintainability	1	1	1		1	2	1	0	0	0	1	1	2	1	1
Support Personnel	2	2	1	1		2	2	2	1	1	2	2	1	1	1
Interface	2	0	0	1	1		1	1	1	1	1	1	1	1	1
Remote Accessibility	1	1	1	1	1	1		1	0	0	0	1	1	1	1
Communication	1	1	0	0	1	1	1		0	0	1	1	0	1	1
Hardware Compatibility	2	2	1	1	1	2	2	2		1	1	2	2	2	2
Network Compatibility	2	2	2	2	1	2	2	2	1		2	2	1	1	2
Data Storage	1	1	1	1	1	1	2	1	0	0		2	1	1	0
Security	1	1	0	0	1	0	0	0	1	1	1		0	0	0
Expertise	1	1	1	1	1	1	2	0	1	1	1	2		2	0
Report Customization	1	2	2	1	1	2	1	1	1	1	1	2	1		1
Queue Cognizance	2	2	2	2	2	2	1	1	2	2	2	2	2	2	
Weighting:	20	18	13	14	15	19	21	17	9	9	15	22	15	16	14
W (out of 100):	**8.44%**	**7.59%**	**5.49%**	**5.91%**	**6.33%**	**8.02%**	**8.86%**	**7.17%**	**3.80%**	**3.80%**	**6.33%**	**9.28%**	**6.33%**	**6.75%**	**5.91%**
Ranking:	**3**	**5**	**13**	**11**	**8**	**4**	**2**	**6**	**14**	**14**	**8**	**1**	**8**	**7**	**11**

Weighted Readings

Score	Definition
2	Column is more important than Row
1	Column and Row are Equally important
0	Row is more important than Column

Table E-2. Weighting Rationale

Criteria	Weight (%)	Scoring Rationale
Cost		
↳Procurement Cost	8.44%	Total cost of hardware, software, and network that would be required to obtain and use the system.
↳Sustainment Cost	7.59%	Cost to sustain the system in future years.
Reliability, Maintainability, and Supportability		
↳Upgradeability	5.49%	Ease of upgrading the system (with new software, hardware, or auxiliary systems) " *How modular or easy is it to upgrade when needed?*
↳Maintainability	5.91%	Ease of maintaining the system. " *Timeliness: How fast can service/support be rendered? Resolution Time?*
↳Support Personnel	6.33%	Support personnel from the proposed solution's parent company. " *Is* support *expertise readily available?*
Customer Experience		
↳Interface	8.02%	Ease of user interaction with queuing system. " *Is the UI user friendly and intuitive? Capable of user feedback?*
↳Remote Accessibility	8.86%	User ability to access the system (in person, web, mobile device) and queue virtually from a remote location. " *Can (from a capability perspective) the customer enter the que virtually?*
↳Communication	7.17%	Communication from the system to the user (text, email) " *Can it send a text or email to the user to communicate that it's time to head to their appointment?* " *Can it notify the user that the system is down for the day (i.e. don't come in for your appointment)?*
System Integration		
↳Hardware Compatibility	3.80%	Ability to integrate with existing hardware. " *Is the product (as-is) compatible with existing hardware available at the service facility?*
↳Network Compatibility	3.80%	Ability to integrate with existing network. " *Is the product (as-is) able tie into the current network?*
↳Data storage	6.33%	Server requirements for the system. " *Servers on site, remote, or combination?*
↳Security	9.28%	Compatibility with DoD security requirements " *Can (from a security perspective) the customer enter the que virtually? *If Qmatic or* QFlow *have virtual capability, can the government use is?*
↳Expertise and Training	6.33%	Ability for service facility staff to use the system with current skill set. " *Does it require a government integrator to implement the solution? Does it require additional training?*
Reporting		
↳Report Customization	6.75%	Ability for service facility staff to customize reports. " *Feedback/Metrics: Can the system be designed to output customized metrics?*
↳Queue Statusing	5.91%	Ability to push updates to users via web or mobile (live, incremental) " *Can they give the user an approximate time upfront on when their service will be rendered that day once they are in the cue?* " *Can system calculate current wait time such that it notifies the customer 1 hr ahead of appointment?* " *Can the user access a web or app solution to determine status in que ("live feed" for average wait time and que number)?*

Table E-3. Evaluation Criteria Score Definitions

Attribute	Score				
Procurement Cost	Measured in dollars	1	2	3	4
	Best: 4 [Lowest Cost] Worst: 1 [Highest Cost]	>$90K	>$60K ≤ $90K	>$30K ≤ $60K	$0 ≤ $30K
Sustainment Cost	Measured in dollars	1	2	3	4
	Best: 4 [Lowest Cost] Worst: 1 [Highest Cost]	>$30K	>$20K ≤ $30K	>$10K ≤ $20K	$0 ≤ $10K
Upgradeability	Measured by ease to perform upgrades	1	2	3	4
	Best: 4 [Easiest to Upgrade] Worst: 1 [Hardest to Upgrade]	None	Low	Moderate	High
Maintainability	Measured by ease of maintenance	1	2	3	4
	Best: 4 [Most Maintainable] Worst: 1 [Least Maintainable]	None	Low	Moderate	High
Support Personnel	Measured by support effectiveness	1	2	3	4
	Best: 4 [Most Effective] Worst: 1 [Least Effective]	None	Low	Moderate	High
Interface	Measured by ease of use	1	2	3	4
	Best: 3 [Most Intuitive] Worst: 1 [Least Intuitive]	Low	Moderate	High	
Remote Accessibility	Measured by ease of access	1	2	3	4
	Best: 4 [Most accessible] Worst: 1 [Least accessible]	None	Web-Only Access	Mobile/App-Only Access	Full Accessibility
Communication	Measured by level of communication	1	2	3	4
	Best: 4 [Most communication] Worst: 1 [Least communication]	None	Web/Mobile	Text/Phone	All
Hardware Compatibility	Measured in compatibility	1	2	3	4
	Best: 4 [Most compatible] Worst: 1 [Least compatible]	None	Low	Moderate	High
Network Compatibility	Measured in compatibility	1	2	3	4
	Best: 4 [Most compatible] Worst: 1 [Least compatible]	None	Low	Moderate	High
Data Storage	Measured in compatibility	1	2	3	4
	Best: 4 [Most compatible] Worst: 1 [Least compatible]	None	Low	Moderate	High
Security	Measured by conformance to DoD security	1	2	3	4
	Best: 3 [Most secure] Worst: 1 [Least secure]	Non-Compliant	Compliant	DoD CoN in place	
Expertise & Training	Measured by ease of use	1	2	3	4
	Best: 3 [Most Intuitive] Worst: 1 [Least Intuitive]	Low	Moderate	High	
Report Customization	Measured by ease of customization	1	2	3	4
	Best: 4 [Most Customizable] Worst: 1 [Least Customizable]	None	Low	Moderate	High
Queue Statusing	Measured by statusing	1	2	3	4
	Best: 3 [Most timely] Worst: 1 [Least timely]	None	Passive Statusing	Live Statusing	

Table E-4a. Alternative Scores

Attributes		Alternatives: Baseline	Qmatic +	Q-Flow	Government Solution	Hybrid
Procurement Cost	Score:	4	3	2	1	2
	Notes:	$0	$53.5K NRE	$73.6K NRE	$93K NRE	$75K NRE
Sustainment Cost	Score:	4	1	2	2	2
	Notes:	$0	$33.77K	$29.1K	$25K	$28.75K
Upgradeability	Score:	1	3	3	4	4
	Notes:	No functional modularity	Use of system-unique components	Use of system-unique components	High Physical and Functional Modulatiry, operational commonality	High Physical and Functional Modulatiry, operational commonality
Maintainability	Score:	1	2	2	3	3
	Notes:	Parent company repair capability low for system failures (aged system)	Company offers warranty; Software quality/stability proven in industry.	Company offers warranty; Software quality/stability proven in industry.	Government owned software easier to maintain internally; speed depends on workload	Government owned software easier to maintain internally; speed depends on workload
Support Personnel	Score:	1	2	2	3	3
	Notes:	Parent company unable to provide any significant support for aged system	Customer support assigned to appropriate engineer; response time 1-3 days	Customer support assigned to appropriate engineer; response time 1-3 days	Government ownership of support. Rapid response to critical errors.	Government ownership of support. Rapid response to critical errors.
Interface	Score:	1	2	2	3	3
	Notes:	Physical kiosk at facility only. No web/mobile interface.	Kiosk and Mobile interface. Unable to utilize many mobile functions due to PII security.	Kiosk and Mobile interface. Unable to utilize many mobile functions due to PII security.	Customized government interface; may continually improve and adjust internally.	Customized government interface; may continually improve and adjust internally.
Remote Accessibility	Score:	1	2	2	2	3
	Notes:	No remote accessibility.	Customer remote queue and status monitoring capable.	Customer remote queue and status monitoring capable.	Customer remote queue and status monitoring capable.	Remote status monitoring capable. Customizable to more finite timeframes.

Table E-4b. Alternative Scores (cont.)

Attributes		Alternatives: Baseline	Qmatic +	Q-Flow	Government Solution	Hybrid
Communication	**Score:**	**1**	**3**	**2**	**2**	**4**
	Notes:	No communication capability; physical displays only.	Text, phone, and web live feed capable.	Text capability. No live feed capability.	Text capable. Live feed capability not feasible.	Text, phone, and web live feed capable. Capable of two-way communication from user.
Hardware Compatibility	**Score:**	**4**	**2**	**1**	**2**	**3**
	Notes:	Status quo hardware utilized.	Capable of utilizing most baseline components.	Incapable of utilizing baseline components.	Capable of utilizing most baseline components.	Utilizes baseline components.
Network Compatibility	**Score:**	**4**	**2**	**1**	**3**	**4**
	Notes:	Status quo network utilized.	Not compatible with private Government network.	Not compatible with baseline or private Government network.	Utilize Government owned network, but requires commercial internet.	Government owned network used with baseline.
Data Storage	**Score:**	**2**	**3**	**3**	**2**	**4**
	Notes:	Local storage only, on site.	Local and cloud storage.	Local and cloud storage.	New PII storage must be developed.	Utilize existing and COTS servers for local and cloud storage.
Security	**Score:**	**2**	**2**	**2**	**3**	**3**
	Notes:	Security compliant by use of closed network for PII.	Demonstrated security on other DoD systems.	Demonstrated security on other DoD systems.	CoN and security integration effort identified.	CoN and security integration effort identified.
Expertise & Training	**Score:**	**4**	**3**	**2**	**2**	**2**
	Notes:	Baseline system currently in use; no new training/skills required.	Upgrade to baseline system with similar look/feel requires minimal training.	Unique interface and system.	Unique interface and system.	Similar interface to baseline with additional features; requires minimal training.
Report Customization	**Score:**	**1**	**2**	**2**	**3**	**3**
	Notes:	Little ability to retrieve system data.	Must utilize pre-defined reports or request tailoring.	Must utilize pre-defined reports or request tailoring.	Ability to fully customize and define new report templates.	Ability to fully customize and define new report templates.
Queue Cognizance	**Score:**	**1**	**3**	**2**	**3**	**3**
	Notes:	No status.	Live status capable.	No live status; updates only within 3 hours.	Live status capable.	Live status capable.

Table E-5. Alternative Summary Chart

				Baseline		Qmatic Upgrade		Q-Flow		Government Solution		Hybrid	
Criteria	**Weight**	**Best**	**Worst**	**Raw Score**	**Weighted Score**	**Raw Score**	**Weighted Score**	**Raw Score**	**Weighted Score**	**Raw Score**	**Weighted Score**	**Raw Score**	**Weighted Score**
Procurement Cost	20	4	1	4	80	3	60	2	40	1	20	2	40
Sustainment Cost	18	4	1	4	72	1	18	2	36	2	36	2	36
Upgradeability	13	4	1	1	13	3	39	3	39	4	52	4	52
Maintainability	14	4	1	1	14	2	28	2	28	3	42	3	42
Support Personnel	15	4	1	1	15	2	30	2	30	3	45	3	45
Interface	19	3	1	1	19	2	38	2	38	3	57	3	57
Remote Accessibility	21	4	1	1	21	2	42	2	42	2	42	3	63
Communication	17	4	1	1	17	3	51	2	34	2	34	4	68
Hardware Compatibility	9	4	1	4	36	2	18	1	9	2	18	3	27
Network Compatibility	9	4	1	4	36	2	18	1	9	3	27	4	36
Data Storage	15	4	1	2	30	3	45	3	45	2	30	4	60
Security	22	3	1	2	44	2	44	2	44	3	66	3	66
Expertise	15	3	1	4	60	3	45	2	30	2	30	2	30
Report Customization	16	4	1	1	16	2	32	2	32	3	48	3	48
Queue Statusing	14	3	1	1	14	3	42	2	28	3	42	3	42
OUF Totals:		48	13		**335**		**472**		**408**		**533**		**636**
CEF Totals:		8	2		**25460**		**18408**		**15504**		**14924**		**24168**
OUF Ranking: (In numerical order Best [1] to Worst [5])				**5**		**3**		**4**		**2**		**1**	
CEF Ranking: (In numerical order Best [1] to Worst [5])				**1**		**3**		**4**		**5**		**2**	

APPENDIX F. PERSONAL ACCOUNT OF THE BADGE RENEWAL PROCESS

Time to renew CAC card. I checked online and earliest appointment was 18 April. My card expires 6 February. I tried calling an alternate location and got their answering machine which assured me that if I left my name and number that they would get back to me. I called for the next three days. No returned calls. Guess I'll have to bite the bullet and head to the dreaded garrison human resources service facility.

Attempt 1: 26 January 2018 *I thought that since it was a Friday that there would not be a lot of people there. I was wrong. I arrived at 7:05. It was around 33 degrees. After waiting in line, the doors opened and I was #43.*
I settled in with my book and waited. At 9:00 they announced that they were having problems issuing CAC cards (system was extremely slow, averaging 1 an hour) but that all other services were still up. At 9:30 they stated that all systems had gone down. They hoped to have them back up soon but the 1 server (?) was in California and would need to be rebooted. They said that the system was down world-wide and that nothing was being issued anywhere. ! ? I waited until 10:00 and then left. Before leaving I asked for the front desk number so I could call and check to see if it had come back up. It never did that day. By the time I got to work I had already wasted 3.5 hrs.
The following Monday morning I called at 7:45. They stated that the system was up but that they had already issued all the available tickets for that day. (I later found out that the system went down again, came back up for 15 minutes, then crashed for the rest of the day.)

Attempt 2: 30 January *I was determined to get that CAC card. I arrived at the service facility at 6:50 and again stood in a long line. Doors opened, line curled down interior hallway. I was lucky #40 this time. Settled in with coffee, biscuit, books and positive thoughts. By 8:00, 85 tickets had been given out. Time to get comfortable. Watched countless people come in just to be turned away. A coworker was in the line at 6:00 am behind people who came prepared with lawn chairs. Said coworker's lottery number was 19. (6:00 am and still ends up being #19) Personnel said that the system was up but working slowly. [At approx 9:00, an elderly retired military couple came in. They were in their 70s. He walked with a cane, she shuffled steadily beside him. They requested a number. "We've given out all the numbers that we can today. You will have to come back another time. Our doors open tomorrow at 7:30." He told them that they had driven over from Guntersville and that it was a long, hard drive for them. No exceptions or sympathy "You are welcome to wait but we cannot put you before any of these people." They sat to rest by me, determined to wait. After 30 minutes he asked if she would be willing to come back the next morning. She agreed. I suggested that they arrive early so that they might get a good place*

in line. He thanked me and left. Around 10:30, personnel announced that the system was down. "You are welcome to wait or come back later or call to see if system is back up." At 11:00 the system was working but processing more slowly. Personnel announced to the waiting hostages that if you left, you could return that day with your ticket. If they had already called your number, you went to the back of the line. If they hadn't called your number, you slid back in where you would have been. Half of the room departed; I was determined, so I waited. At 12:30, the wizard gave them a brain: They went around the room marking each present person's number on the admittance sheet and stated skipping missing numbers. It rolled faster…about 4 an hour. Finally, #40 was called and I yelled "Come on down!" feeling like I had just won the lottery. I triumphantly left with my golden ticket CAC card at 2:30.

Total time to get CAC was 11 hours.

MTA, Inc. Contractor

LIST OF REFERENCES

Air Force Systems Command. (1969, July 17). *Systems engineering management* (Military Standard MIL-STD-499). Retrieved from https://www.product-lifecycle-management.com/download/MIL-STD-499A.pdf

Department of the Army. (2007). *Environmental Protection and Enhancement (Army regulation 200-1)*. Retrieved from https://www.dodnaturalresources.net/AR200-1_2007.pdf

Federal Aviation Administration. (2006, October 11). *System engineering manual*. Retrieved from http://www.acqnotes.com/Attachments/NAS%20SYSTEM%20ENGINEERING%20MANUAL.pdf

GoLeanSixSigma.com. (n.d.). Control- phase 5 (of 5) of Lean Six Sigma. Retrieved July 7, 2018, from https://goleansixsigma.com/control-phase-5-of-5-of-lean-six-sigma/

Heinse, T. (2017, July 24). Re: ID/CAC Card Processing [Online comment]. Retrieved from https://www.military.com/base-guide/redstone-arsenal/contact/idcac-card-processing/4728

Interactive Customer Evaluation (ICE). (n.d.). Service provider summary for Redstone Arsenal. Retrieved November 28 2017, from https://ice.disa.mil/reports/index.cfm?fa=service_provider_summary_report_cust&site_id=513&dep=*DoD

Jeans, R. (2018, February 28). Re: ID/CAC Card Processing [Online comment]. Retrieved from https://www.military.com/base-guide/redstone-arsenal/contact/idcac-card-processing/4728

Military Advantage. (n.d.a). Military base guide. Retrieved September 4, 2018, from https://www.military.com/base-guide

Military Advantage. (n.d.b). Defense enrollment eligibility reporting system (DEERS). Retrieved September 4, 2018, from https://www.military.com/benefits/tricare/defense-enrollment-eligibility-reporting-system-deers.html

Murtagh, R. (2014, July 8). Mobile now exceeds PC: The biggest shift since the internet began. Retrieved from https://searchenginewatch.com/sew/opinion/2353616/mobile-now-exceeds-pc-the-biggest-shift-since-the-internet-began

My Base Guide. (2015, October 15). Redstone Arsenal: Team Redstone overview. http://www.mybaseguide.com/army/124-2781/redstone_arsenal_team_redstone_overview

My Base Guide. (2018, March 19). Redstone Arsenal: Our military. Retrieved from http://www.mybaseguide.com/army/124-3546/redstone_arsenal_our_military

Qmatic. (n.d.a). Orchestra Journey manager. Retrieved August 7, 2018, from https://www.qmatic.com/products/orchestra/

Qmatic. (n.d.b). Queue management. Retrieved August 7, 2018, from https://www.qmatic.com/solutions/queue-management/

Q-nomy Solutions. (n.d.). Q-Flow customer experience management and optimization. Retrieved August 7, 2018, from https://www.qnomy.com/q-flow

RAPIDS Appointment Scheduler. (n.d.). Retrieved October 11, 2018, from https://rapids-appointments.dmdc.osd.mil/appointment/

Reese, Glen. (2009). *Lean Six Sigma report: USAG-Red in-processing* [PowerPoint slides]. Redstone Arsenal, AL.

U.S. Army Aviation and Missile Research Development and Engineering Center. (n.d.). Software engineering. Retrieved May 7, 2018, from https://www.amrdec.army.mil/amrdec/SED.html

U.S. Army War College. (2011). *How the Army runs:A senior leader reference handbook*. Retrieved from www.dtic.mil/docs/citations/AD1001713

U.S. Department of Commerce. (2018). *National Institute of Standards and Technology (NIST): Protecting controlled unclassified information in nonfederal systems and organizations* (Special publication 800-171). Retrieved from https://doi.org/10.6028/NIST.SP.800-171r1

U.S. Department of Defense. (2018, July 17). Military installation overview. Retrieved from http://www.militaryinstallations.dod.mil/

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