Title: The Defense Logistics Agency (DLA) Enterprise GIS

Brian Kaley – 596B; Advisor, Justine Blanford

Abstract

The Defense Logistics Agency (DLA) is a component of the Department of Defense (DOD) that has acquired the responsibility to maintain Federal Government Real Property. These tasks include Engineering and Preventive Maintenance (PM) planning and scheduling, in addition to its logistics core competency. Unfortunately, DLA has not implemented a standard Geographic Information System (GIS) to perform these functions. Few standards have been directed by Headquarters, which drives each installation to decide unilaterally the process and software solutions to employ. This leads to different datasets and data types throughout the Enterprise as no data standard definitions have been established to ensure conformity. DLA should implement an Enterprise-wide GIS solution. With this Project, I plan to recommend a solution which will capture the required workflows and products necessary. I will arrive at a solution by following basic GIS Design Processes. I will show that one accurately defined and filled database will be able to replace the quantity of products currently being used, and will increase productivity. And I will also show that a proper GIS system can be selected even though the Federal Government assigns strict rules that at times seem to inhibit technological advances. This recommended GIS would standardize data across multiple installations. In fact, the Enterprise GIS solution would provide guidance, allow sharable information and improve communication. The proposed GIS system will increase functionality and efficiency between all units in DLA. And lastly, an Enterprise-wide GIS would save money by eliminating redundancies and saving time.

Introduction

The Defense Logistics' Agency (DLA) is the least well-known agency of the Department of Defense (DoD). But the agency's reach and responsibilities continually expand and evolve, as does the reliance on its critical Mission.

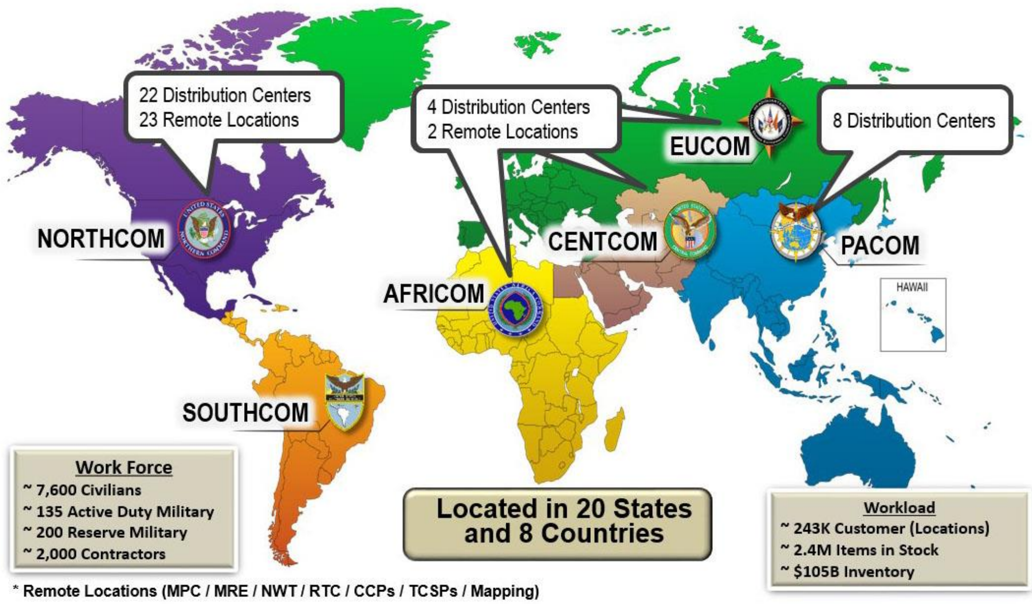

Figure 1: Map of DLA locations worldwide (DLA, n.d.)

DLA's roots are found in the necessity driven by World War 2. Due to the enormity of the scale and coordination necessary for the effort, the military tried to Centralize Military Logistics Management. But with the end of the war, the Service Branches resumed in-fighting for influence and each branch was granted "single manager" status depending on supply items needed. This resulted in each Single Manager having distinct requisition policies, requiring supply professionals to learn multiple requirements depending on need. In 1961, DoD consolidated all single managers into the Defense Supply Agency (DSA), and in 1977 DSA evolved into DLA. Finally, The Goldwater-Nichols Act of 1986 identified DLA as a combat support agency with primary logistical support for the DOD and its Service Components (Defense Logistics Agency (b), n.d.).

Photo 1: 1st Defense Supply Agency Director, Army Lt. General Andrew McNamara, February 1963. (Reilly, 2017)

DLA's current Mission is to serve as the DoD's primary logistics combat support agency. Because of the role it has, DLA agencies claim primary ownership of some installations and are located at multiple DoD host Bases of the Army, Navy, Air Force, Marines and Coast Guard. Mission support is provided to each of the Service Branches as well as some Foreign countries and Civilian Agencies, as approved (Defense Logistics Agency (a), n.d.).

Photo 2: National Guard transports essentials during Puerto Rico Hurricane Maria relief efforts. (Diaz-Ramos, 2017)

Part of DLA's evolving Mission encompasses installation support, similar to services provided by small municipalities. These services include traditional roles, such as safety, security, installation, and facilities management support services to all DLA organizations. The Headquarters (HQ) organization responsible for these tasks is Installation Support (DF) which is comprised of 11 sites across the United States and Europe *(Defense Logistics Agency, Installation Support, n.d.)*

Unfortunately, DLA has not evolved its support activities as quickly as its primary Mission activities. DF doesn't have any guidance on what systems should be in place or data minimum requirements, so Installations have a mixed mash-up of different products to fill gaps and accomplish the Mission. For example, at the New Cumberland Installation, infrastructure data is collected and provided on the AutoCAD Civil 3D platform. No standards were provided at the DF HQ level, which causes each installation level activity to decide on their own the process and software they will use. This leads to different data-sets and data types through-out all installations as no data standard definitions have been established to ensure conformity.

Due to the lack of standards, data duplication occurs and workflows are not efficient. For example, reproducing data for maps and cover sheets requires tedious cartographic manipulation. Since the data doesn't have dynamic labeling and symbology, each product requires the author to manipulate presentations based on scale until the presentation meets the "looks right" standard rather than utilizing a consistent standard template.

It is for all of these reasons that a Geographic Information System (GIS) enterprise-wide solution is being proposed and the purpose of this project. "A geographic information system (GIS) lets us visualize, question, analyze, and interpret data to understand relationships, patterns, and trends (ESRI, n.d.)." There is geographic information being used, but not efficiently or to its fullest potential and certainly not part of any cohesive system. An enterprise-wide GIS solution would simplify and standardize all of the installation's tasks. And since the New Cumberland depot has the largest and most varied DF Mission, a GIS solution considering all the available tasks at New Cumberland will more than likely fill the needs of those installations with less varied requirements.

At installation level, GIS is only used sporadically, and as an after-thought. It is currently used to create maps showing the condition of roofs, heat systems and other infrastructure items and highlights areas in need of maintenance. It is also used to occasionally show ownership of property and tenant maps to highlight buildings that are not owned by DLA. And local maintenance personnel are even less involved with GIS. There is zero capability, training or support for any repair or work scheduling at present.

An enterprise-wide GIS solution would establish data standards and requirements. Those standards and requirements could be passed on to contractors during new construction, allowing compatible deliverables after construction and enabling ease of maintaining current infrastructure as-builts. Additionally, maintenance personnel could use the GIS data to schedule preventive maintenance and recurring work more efficiently. Finally, all of the emergency response personnel could utilize GIS for planning, preparation and response.

To accomplish this requires developing an infrastructure that will enable for the storage of information as well as the retrieval of such information as it pertains to specific needs and workflows, as highlighted in the aforementioned examples. Ideally the infrastructure would replicate the example provided in Figure 2 and contain the following requirements:

- **Data Requirements:** Data would be stored in a centralized database for quality control and each Installation would be responsible for the maintenance of this database (Figure 2). The database could include several types of data such as environmental, maintenance, property, etc., depending on capability and requirements at each Installation. A local GIS Manager would have the responsibility to ensure the database data is quality checked prior to check-in. The system would need data check-out/check-in capabilities with the regional DB copy for survey/as-builts edits, and each GIS manager would need the ability to limit or grant user rights, from view or search to edit or create new data. Additionally, the centralized data location would require periodic data-checks prior to upload from each region, most likely weekly, but could decrease or increase depending on frequency of data edits.
- **Multiple Users:** The system will need to support multiple users at each Installation where users may be required to view or search for information as well as edit or create new data, which may occur simultaneously.
- **Functionality:** The system will need some customization depending on need. The software and hardware selected could allow for research, reports, analysis and other data outputs as identified and required.

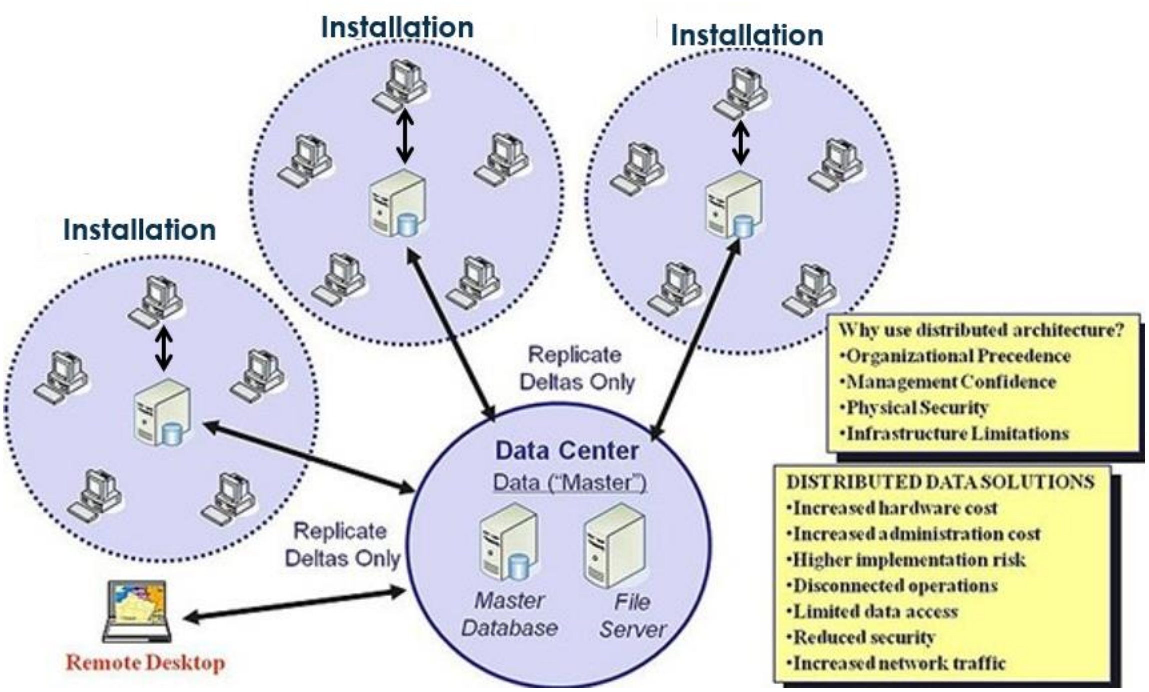

Figure 2: Sample of Ideal Scenario (Bacastow, n.d.)

However, several constraints exist. LIMFACS imposed by working on a Federal IT System are generally more severe than in the private sector. Any IT solution must receive Communications Network approval prior to purchase. These approval processes have been known to take months, if not longer. Any GIS data solution must conform to one of the Armed Forces component versions of The Spatial Data Standards for Facilities, Infrastructure, and Environment or SDSFIE; each branch of the DOD has an approved version that is scaled from the DOD approved SDSFIE. Each installation has limited on-site survey capability so any new data will require an investment of either time or a contract vehicle, which equals money. Lastly, no USB connections are allowed which severely limits mobile collection device utility and function. All of these limitations will impact the design decisions for this system.

Phasing Steps

Since the purpose of this system is to develop an enterprise system that will utilized by different users each with unique workflow requirements, this project was broken down into two phases. Phase 1 of the project identified current user needs and developed the system requirements, while Phase 2 used the information from this project and implemented and tested the enterprise system (see Megonnell, 2018 for details).

Design Process

All GIS design and evaluation processes follow the same basic formula and included several components: performing a needs assessment, concept development, prototyping and implementation (Figure 3). This is an iterative process with evaluations taking place throughout the entire process.

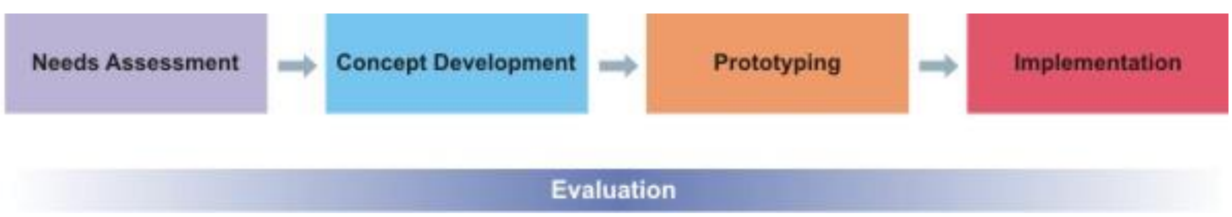

Figure 3: Basic system design and evaluation process (Robinson, n.d.)

The process was modified to fit the needs of this project (Figure 4) and are described next.

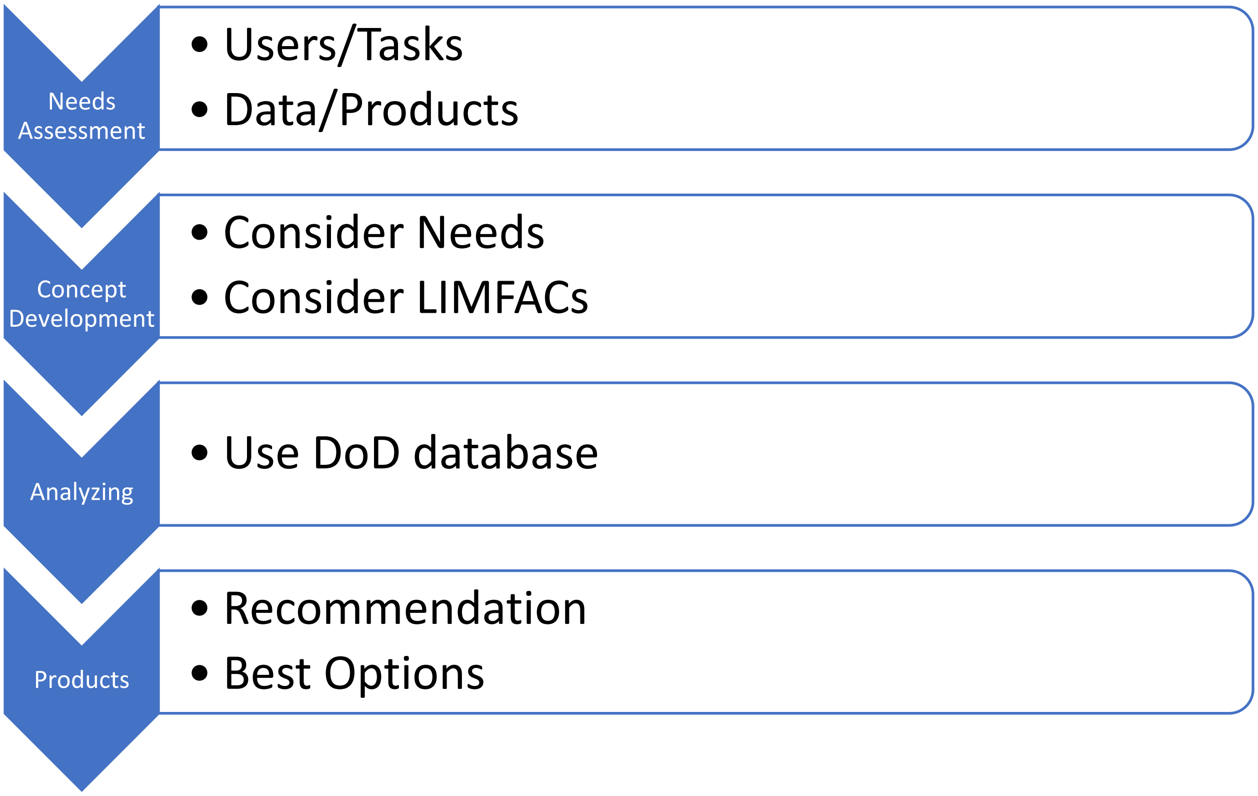

Figure 4: GIS design process.

NEEDS ASSESSMENT

This included identifying

(i) types of users and skill-levels,
(ii) tasks and functions that each user type is required to perform,
(iii) data required to complete each task and function and finally
(iv) needed products; In this case, products included outputs, reports, etc., at least initially.

The number of users varied by each of the 11 Regional Office. For example, New Cumberland, has two people assigned to perform GIS tasks with several more people who were familiar with GIS software. When Real Property, Emergency Services, Engineering and other specialties were included, the number of GIS users steadily increased. Overall between 100 to 200 users encompassing various spectrums of knowledge are likely users of the enterprise system.
The skillsets of users varied with experienced GIS professionals who were able to edit, collect and analysis data, while others were less experienced, unfamiliar with GIS as well as slightly intimidated by such new technology. Knowledge-level ranged from expert to less than novice. Therefore, to ensure that users will be capable of using such a system, training was identified as a critical component.

Data needs also varied based on workflow requirements, as shown in Figure 5, where imagery was used to calculate storm water retention, and Figure 6 where a hazardous plume analysis shows the extent of a projected hazardous substance path. Other examples include infrastructure inventory and maintenance, such as required by fire hydrants for scheduled preventive maintenance to very involved construction planning and any tasks in between.

Figure 5: Retention Pond (Maryland Department of Transportation, n.d.)

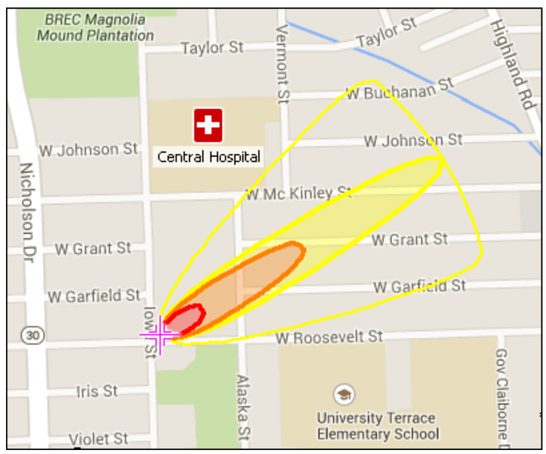

Figure 6: Hazardous Plume Plotting Example (United States Environmental Protection Agency (EPA), 2017)

To capture the varied uses and skill-levels needed, numerous techniques were utilized. Some information was obtained through personal interviews, questioning primary duty requirements and types of information needed. Other data users and task descriptions were obtained via informal group discussions and monthly Business Meeting briefings. And lastly, the greatest source for information was personal corporate knowledge available through personal experience and product use. A summary of these findings is captured in Table 1 where the requirements for 11 different users are shown. These include a brief description of what they need to do, type of functionality required, additional data needs, level of access and whether mobile access would be a critical component of their responsibilities.

DATA USERS	Description	Functionality: Systems required	Additional information/data	GIS/mapping what level of access?	Mobile access
Master Planner (similar to Community Planners)	Facility siting, space management	Funding priorities, space requests	Protected areas, Mission of requestors	GIS Desktop, GISPro,	Yes
Maintenance Personnel	Maintain facilities, roads, infrastructure, grounds maintenance	Work management system, database of warranties	Cartographic location of items to work on	Supervision would need access to GIS Desktop	Yes
Construction Project Managers	Manage multi discipline construction projects	Infrastructure locations, as-builts		Read access only, perhaps a portal	
Military Construction (MILCON) Coordinators	Coordinate large-scale projects, Congress level	High-priority, mission-driven short-falls	Project priority list	Read access only, perhaps a portal	
Environmental Specialists	Fauna and flora numbers, protected species habitats	Database of environmental compliance items	LIDAR surveys	GIS Desktop, GIS Pro, author-level access	Yes
Emergency Responders	Hazardous material locations	Database of trained personnel	Meteorological charts (wind), topography (run-off/storm-water)	GIS product to plot events, Chief or Command Post level	Yes
Public Safety (Police and Fire)	E-911 system	GPS, Base Map		Geo-coded addresses in Desktop, linked GPS, read-only	Yes
Logistics Operations	Optimize storage with highest volume movers (closest to the exit)	GPS? SMART Installation?	Tracking system, track “hot” inventory and locations	GIS system linked to inventory; key personnel need author-level access to update database	Yes

DATA USERS (con't.)	Description	Systems required	Additional information/data	GIS/mapping what level of access?	Mobile access
Headquarters and Primary Field Units	Enterprise-wide planning, both logistics and facilities	Review available storage space, review infrastructure condition codes, determine funding priorities		Searchable database (GIS portal), entire enterprise	
Real Property Management	Track Real Property, update square footage and layout.	Database of property, including geographic location	New construction paperwork, as-built paperwork	Portal access, but will require assistance to perform attribution and vector changes.	
Other interested Federal Agencies, upon specified need and request	Coordination, high-level, inter-agency data sharing		Could be anything	Searchable, portal-level access, read only	

Table 1: Potential DLA users, skill-levels and access requirements

New Cumberland was built in 1918, so multiple data types will need to be catalogued. Data is available in a variety of formats and include shapefiles, excel or text type datasets, CAD files as well as paper surveys and old non-georeferenced photos that will require digitalization and manual manipulation. Data comes from a variety of sources (Table 2) and includes contracted projects for on-going site-surveys or Facility Condition reports provided by the United States Army Corps of Engineers for various infrastructure items like roads and roofs.

Currently, the data is scattered throughout New Cumberland but obtainable, for the most part. Some data can be accessed via network share drives or various hard-copy and digital record storage locations.

DATA SOURCES	DATA PROVIDED	DATA FORMAT	DATA LOCATION	ADD'L INFORMATION
HDR, Inc. (Contracted Company)	Baseline Infrastructure	Shapefiles, SDE	Network Drive, Portal	
United States Army Corps of Engineers	Roofing, Paving, Facility Condition Index Survey	Digital Report (pdf?)	Network Drive	Not received yet

HDR, Inc (2nd Contracted Item)	Area Development Plan	Planning document	Network Drive	In-progress
CAD Files	CAD drawings	.dwg files	Network Drive	
As-built Deliverables	Depends on Statement of Work defined deliverables	Various (CAD, reports, Op Manuals, shape files, etc.	Network Drive, when submitted	Required for each project
In-house Surveys	Topo, boundaries, survey data	.csv files	Network Drive	As needed
Historical Data	Various	Various	Network Drive	
Project Deliverables	Reports, Plans, etc.	Various	Network Drive	As solicited
Building Information Modeling (BIM) data	Building life-cycle data	.dwg, .dxf, .ifc, .rvt, .nwd	Network Drive	Unknown if any currently available or on-hand
Civil 3D Data	Topo	.dwg files	Network Drive	As received
LIDAR Data	Elevation, vegetation, contours	.dem, .csv	Network Drive	
Historical, Multi-format Data	Various	All previously listed, plus .dgn (micro-station)	Network Drive	No Micro-station software available
TIFF & JPEG Files	Mostly old scanned as-builts	.tif, .jpg	Network Drive	
Historical, Hard-copy as-builts	Infrastructure As-builts	Hard-copy prints	File room	Will require scanning
Other Unknown Formats	TBD	TBD	Network Drive, physical location on-site	TBD while researching

Table 2: Preliminary list of data types, formats, providers and locations

Once the user and data needs assessments were completed, the next needs assessment involved determining work products. Work flow processes were used to determine various types of requirements, which were as varied as the highlighted examples discussed next.

- **Facility Renovation.** For facility renovation projects, project managers, architects, engineers and others require a variety of data throughout the design process. These can include as-built conditions and drawings are needed using current condition reports (attribution), utility locations (geography), capacity (attribution), etc. These tasks require read access during planning stage, but also edit access after completion to update both geography and attribution, or more specifically, footprint and capacity.
- **Roof Warranty and Maintenance considerations.**
  - *Roof Warranty:* The Real Property Manager handles warranty issues and needs tools to access information about a roof that include date installed, contractor, etc. as well as tools that allows them to produce reports and maps to visually show conditions or recommend future projects, such as 5-year plans.
  - *Roof Maintenance:* The Maintenance Foreman also needs roof data but for entirely different reasons. His requirements focus on materials and construction types. The Foreman will

need to produce periodic maintenance work schedules based on install dates and order repair materials based on construction types or materials used. The Foreman will also need a set of tools that will enable them to access information about the roof.

CONCEPT DEVELOPMENT

During the concept development phase, users and uses, software, hardware and limitations were assessed to provide recommendations and best options, considering all available factors as well as factoring in room for adjustments. The recommendations will be based on allowances from the LIMFACs but will also allow room for adjustments.

As previously discussed, the enterprise system being developed is within a DOD site with limitations which include severe LIMFACS imposed by Federal IT Systems with "secure" IT systems. Limitations include network approval, an approved DB version that is scaled from the DOD approved SDSFIE, limited on-site survey capability, no USB connections allowed and limited funding dollars.

Currently approved software consists of ESRI products (ArcMAP, ArcGIS PRO, centralized license manager, etc.), Autodesk (AutoCAD, assorted Autodesk Business suites, centralized license manager) and Leica Captivate survey software with a security work-around which requires off-line computer usage to scan data, save to CD and then load to network. Trimble survey products have been eliminated because their mobile application runs on a soon-to-be obsolete Windows 6.5 embedded platform which exposes several security flaws. New Cumberland currently uses Leica products and the HQ IT function is currently reviewing them to see if they are secure enough to attach to the DLA network.

ANALYZING

Having established the software capabilities, the next stage was to develop solutions that work within the secure environment as well as the DOD's SDSFIE standards.

According to the DOD SDSFIE website, "The Spatial Data Standards for Facilities, Infrastructure, and Environment are a family of IT standards (models, specifications) which define a DoD-wide set of semantics intended to maximize interoperability of geospatial information and services for installation, environment and civil works missions (Unknown, SDSFIE: The Spatial Data Standards for Facilities, Infrastructure, and Environment, n.d.). The SDSFIE standards aim to:

1. Advance and maintain SDSFIE in order to achieve interoperability for both data and systems, using accepted industry practices.
2. Promote implementation of SDSFIE DoD-wide.
3. Align SDSFIE with functional business mission requirements and the DoD Business Enterprise Architecture (BEA).
4. Maintain and sustain a coordinated SDSFIE program management process.
5. Educate, train, and support the implementation of SDSFIE within the user community." (Unknown, SDSFIE: The Spatial Data Standards for Facilities, Infrastructure, and Environment, n.d.)

And the approved standards are managed by The Army, Air Force, Marine Corps, Navy, Army Corps of Engineers and the Washington HQ Services. These versions will be the choices that are available to pick from. The following graphics represent the oversight offices for each Branch's GIO office.

Figures 7: Various DOD agencies responsible for component SDSFIE development.

During the analysis phase, we were able to participate in SDSFIE data set working groups, focusing on the Army's new 4.0 version. Every component command participated in similar efforts, employing multiple people at each location within their command.

PRODUCTS

To this day, no version of the SDSFIE has been officially selected. However, available software suites and higher headquarter direction determined the way forward. Working within the limits of the organization, the decision was made to incorporate existing ESRI products and expand the capability and scope of existing software. This included standing up a new live portal and filling in architecture with various ESRI software (Megonnell, 2018).

Assumptions versus Reality

Since the start of this project, the changes and expectations of the Enterprise GIS during Phase 1 have been substantial. The following few paragraphs summarize expectations versus reality and where we envision the system evolving in the future.

Project Phasing Steps

During Phase 1, specific user needs were captured with examples of personas that capture the diversity of the workflows of how the system is likely to be used. In the timeframe of this project, many needs and products were identified through interviews and development of personas (e.g. roof maintenance and warranty; facility renovation; additional information listed in Table 1), as well as using personal knowledge and work experience to anticipate requirements. However, there will be more users identified as this project continues to develop. The key is that these insights have provided the ability to develop a framework that enables for the implementation of an Enterprise GIS that is both scalable and adaptable to current and future needs where key resources such as data and tools will be centralized for easy maintenance and access from any device through a web-type interface, as illustrated in Figure 8.

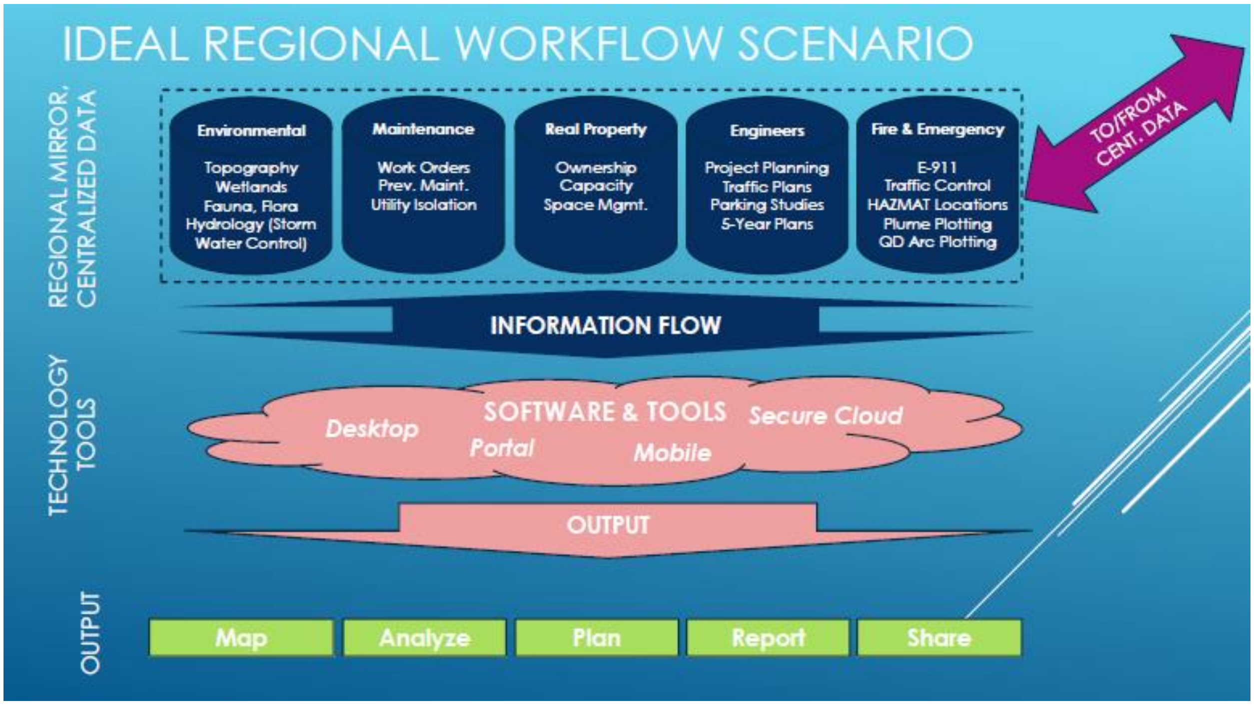

Figure 8: Concept of regional data access and workflow.

Design Process - Current State

Phase 1 started as anticipated however, as the project progressed it became apparent that additional data sources were omitted. This was an oversight due to the sources of the data, some of which were in progress of being collected and became available after the initial presentation. Although not anticipated, the cyclical nature of the design allowed seamless capture and integration of the data.

Progress on this effort has been surprisingly rapid due to a sudden influx of funds. Many software suites and types have been approved for use on the DLA network and have been organized into an initial architecture for DLA. The graph below compares our initial thought as to what the architecture would look like (Figure 2, this report) compared with the software approved and where it fits in the actual architecture today (Megonnell, 2018), figure 9 below.

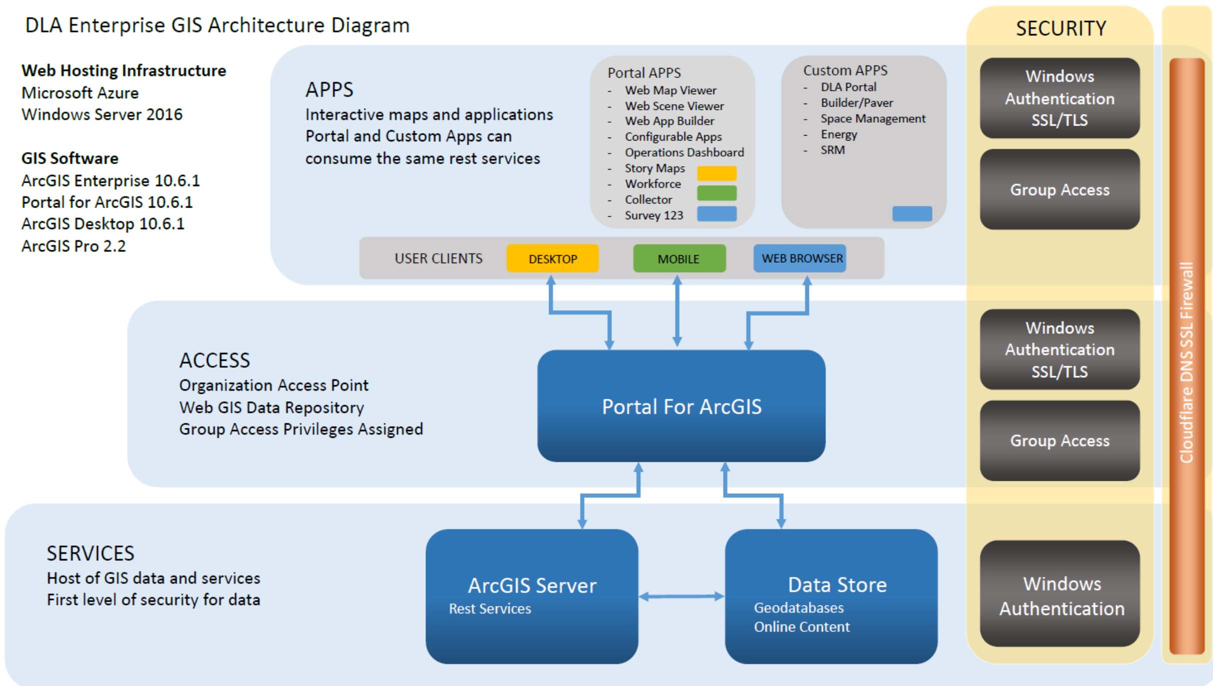

Figure 9: Sample of Ideal Scenario with DLA approved software (Megonnell, 2018)

The design process followed the four steps described above; Needs Assessment, Concept Development, Analyzing and Products. The four-step process is summarily compared below.

The Needs Assessment phase proceeded as anticipated enabling us to select both users and data sources and thus create select products to demonstrate the benefits of such a system and highlights how GIS can be used to improve productivity, determining products to be developed by consulting the work flow. The first step of the process was virtually "text book," and figure 10 below includes a logistics business process Megonnell (2018) was able to create to show timeline items where GIS could improve processes, to the point that every step could benefit.

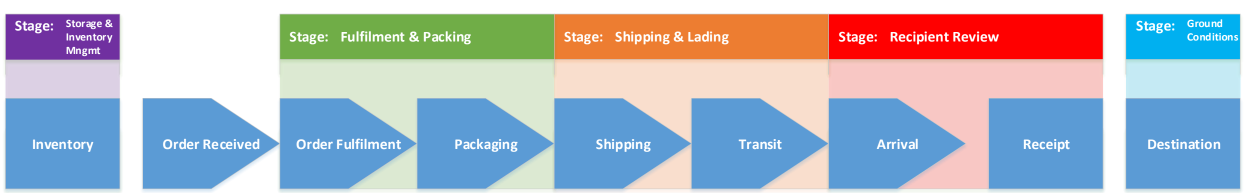

Figure 10: Logistics business process used to demonstrate GIS usefulness (Megonnell, 2018)

Figure 11 on the next page shows an additional tool that shows the uses of a well-designed GIS. In this case, a transit log tracking product delivery in virtual real-time (Megonnell, 2018).

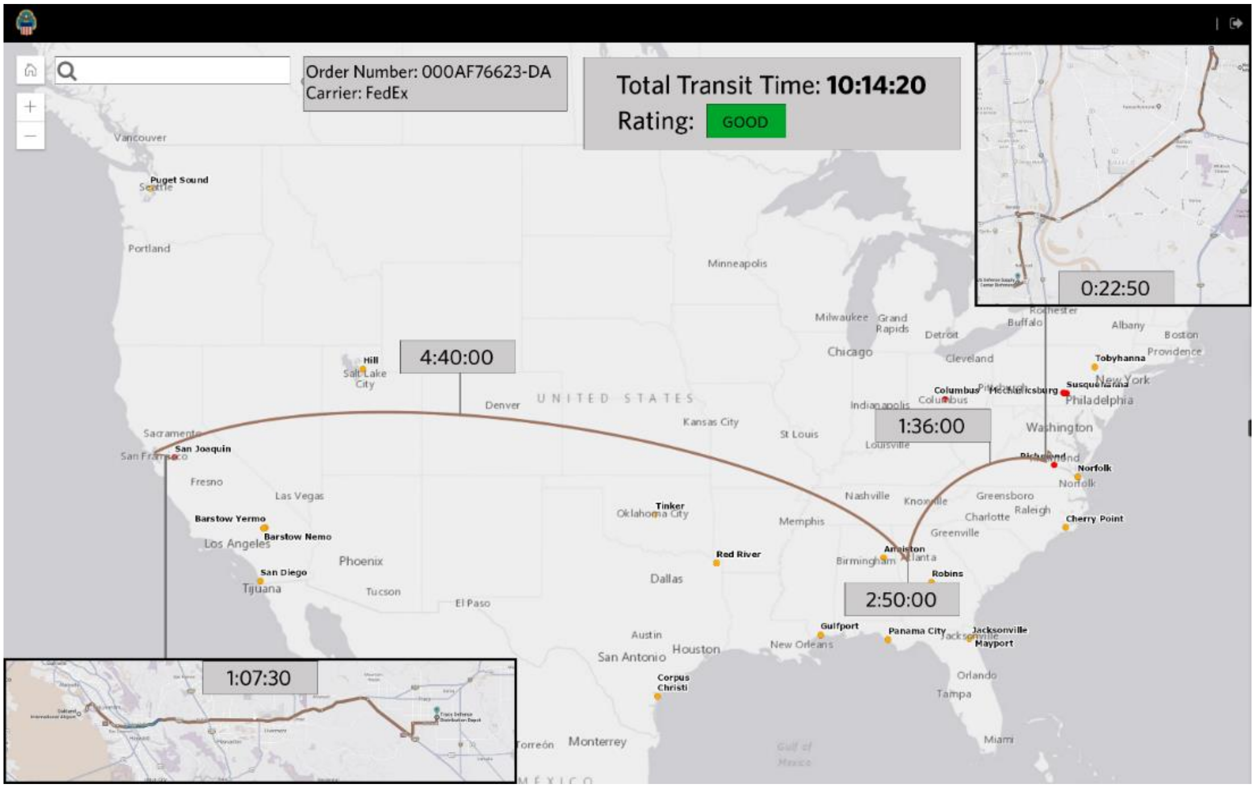

Figure 11: GIS product demonstrating transit log for logistics (Megonnell, 2018)

On the Concept Development design step, our fear was that the Federal bureaucracy would hinder the speed of the process. However, in this instance, the LIMFACs were less of an issue. The combination of increased will and available funding precipitated the expedited approval and acceptance of a variety of ESRI products. The downside is that the approvals were based on the prior approval of other ESRI software. The assumption is that ESRI will be able to meet DLA needs since they are the leading industry provider. Two of the Concept implemented are captured in the next two figures, the DLA GIS Portal and the recently activated DLA Geospatial Gateway (Megonnell, 2018).

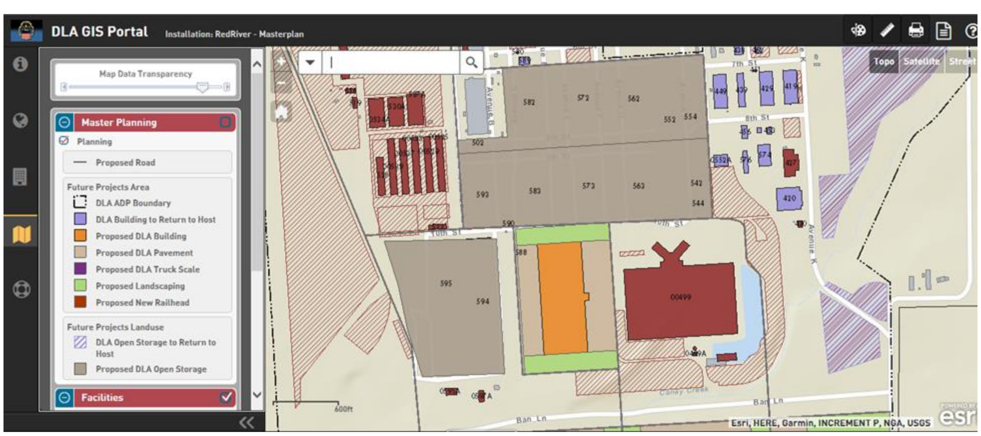

Figure 12: Screen shot of DLA GIS Portal (Megonnell, 2018)

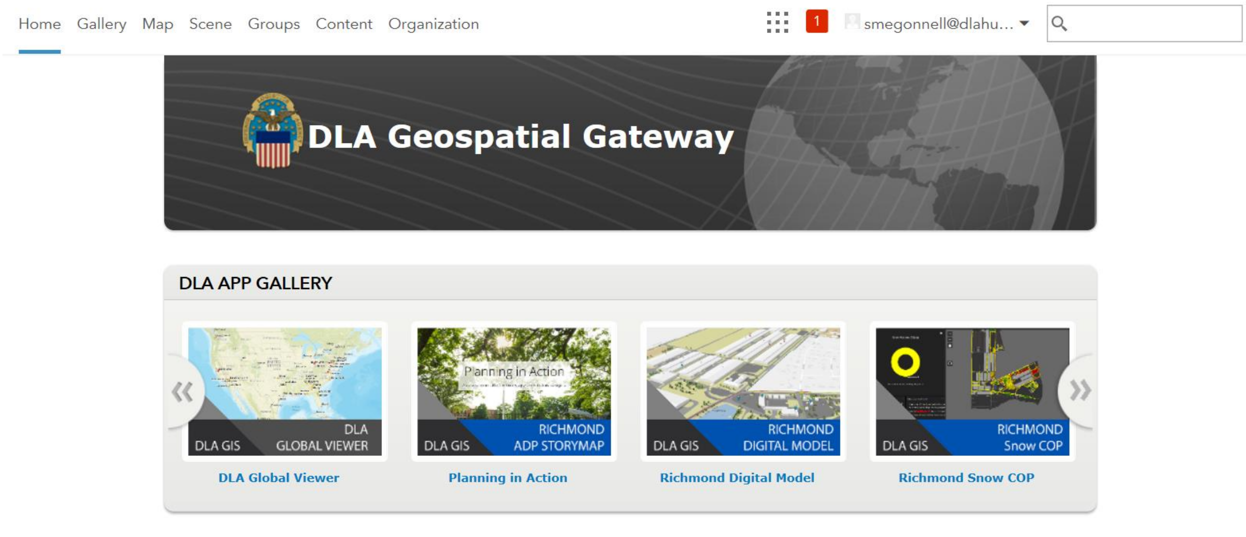

Figure 13: Screen shot of DLA Geospatial Gateway (Megonnell, 2018)

As previously mentioned, the speed with which the various solutions were accepted and implemented affected the Analysis and Product Recommendation steps the most. Due to the rapid launch, there was very little local involvement during analysis. The decision was made that although the design may not currently fit all situations, it was thought that the products currently available and approved are modifiable and that the implementation would be cyclical, with a basic foundation supporting a majority of the Enterprise situations. Additionally, the SDSFIE selection still hasn't been officially announced, although DLA is leaning towards the Army's adaptation. But any of the Armed Forces databases will be based on the DOD SDSFIE, and because all of the other branches use ESRI products, DLA is confident that they'll work for our organization, too.

Product Recommendation didn't occur at all as a direction of leveraging existing approved IT solutions facilitated rapid development and focused funds on data and solution development rather than market research (Megonnell, 2018). Those products were then acquired, approved and inserted into the design as previously shown in Figure 9.

Future Steps

The road ahead is fairly clear; continue advocating GIS solutions and socialize these solutions across the Enterprise. This will be necessary to navigate the ebb and flow of both will and funding priority. Continuing and sustainable education will be part of this process, not only to advocate use and familiarity at the worker level, but to encourage leaders so they may become champions of a sustainable system.

System champions will be crucial due to the cyclical nature of the design. Starts and stops may incur additional funding strains, and will require those capable of advocating and being heard to sustain momentum. While it is true that there is a system in place currently, this system is realistically a live "Beta" version which still requires work for full functionality. Much can go wrong between now and future state.

The fully-functional version of the system is close since the back-bone and architecture is in place. The final DLA SDSFIE component selection will enable a fuller database connection with appropriate attribution to provide a useful and dynamic system. Leadership now needs to select the SDSFIE so the system shows its utility. Otherwise, it will die due to limitations in the current data available. If we're unable to show why the system is useful, to both rank & file and executive leadership, DLA will see no need for an Enterprise GIS and will direct implementation dollars towards higher perceived necessities so selecting key examples that demonstrate the benefits of such as system is key.

ACKNOWLEDGEMENTS

Collaborative effort with Shaun Megonnell on “beta” portal use, feedback, and establishing final presentation. The results from this project and Megonnell, 2018 were combined and presented during a 1-hour presentation.

References

Bacastow, T. (n.d.). *Geospatial Systems Architecture*. Retrieved October 14, 2017, from SlidePlayer.com: http://slideplayer.com/slide/9106265/

Defense Logistics Agency (a). (n.d.). *About the Defense Logistics Agency*. (DEFENSE LOGISTICS AGENCY) Retrieved August 20, 2017, from http://www.dla.mil/AboutDLA/

Defense Logistics Agency (b). (n.d.). *History of DLA*. Retrieved August 20, 2017, from http://www.dla.mil/AboutDLA/History/

Defense Logistics Agency, Installation Support. (n.d.). (Unknown, Producer) Retrieved August 26, 2017, from DLA: http://www.dla.mil/HQ/InstallationSupport.aspx

Diaz-Ramos, J. (2017, September 27). *Defense Logistics Agency*. Retrieved September 30, 2017, from The Nation's Combat Logistics Support Agency: http://www.dla.mil/News/Images/igphoto/2001819506/

DLA. (n.d.). *Defense Logistics Agency*. (D. (DOD), Producer) Retrieved October 8, 2017, from DLA Distribution: http://www.dla.mil/Distribution/Locations.aspx

ESRI. (n.d.). *What is GIS?* Retrieved September 30, 2017, from ESRI What is GIS?: http://www.esri.com/what-is-gis

Maryland Department of Transportation. (n.d.). (M. A. , Producer, & Maryland Aviation Administration) Retrieved October 14, 2017, from Maryland Aviation Administration: http://marylandaviation.com/content/environmental/opes/index.html

Megonnell, S. (2018). *The Defense Logistics Agency (DLA) Enterprise GIS.*

Reilly, C. (Ed.). (2017, February 1). *"History of the Federal Catalog System"*. (D. D. Services, Producer, & DLA) Retrieved September 2017, 2017, from Defense Logistics Agency: http://www.dla.mil/News/Images/igphoto/2001705438/

Robinson, A. D. (n.d.). *GEOG 583 Geospatial System Analysis and Design Lesson 1: Design Basics*. (T. J.-E. Institute, Producer, & Penn State Licensing Office) Retrieved October 19, 2017, from Penn State College of Earth and Mineral Sciences, Department of Geography: https://www.e-education.psu.edu/geog583/node/20

United States Environmental Protection Agency (EPA). (2017, October 13 (Last Updated)). *MARPLOT Software*. (EPA, Editor, EPA, Producer, & EPA) Retrieved October 14, 2017, from https://www.epa.gov/cameo/marplot-software

Unknown. (n.d.). *SDSFIE: The Spatial Data Standards for Facilities, Infrastructure, and Environment*. (DOD, Editor) Retrieved September 16, 2017, from SDSFIE: The Spatial Data Standards for Facilities, Infrastructure, and Environment: https://www.sdsfieonline.org/Components/USA