Forest Fires Reduction using Enterprise Architecture

for

Master of Science

Software Design and Programming

ICT-4010 Enterprise Architecture

Brian Dobony

University of Denver University College

October 27, 2019

Professor: Dr. Steve Else, PH.D

Table of Contents

Executive Summary

This paper lays out an enterprise architecture project for the USDA to work as a joint collaboration organization with state and local governments in order to reduce wildfires and the damage they cause to communities. This has become an increasing problem that is able to be mitigated.

With the progress already made in the government with enterprise architecture, some aspects such as technology are already well organized, but just needs a new direction with new business strategies.

In analyzing the issue, judicial boundaries create the largest problem for success. This paper will show how the current methods can bring forth more benefit within a year, while other solutions will bring forth benefits in steps. Also addressed is the aspect of how the government can work together to prevent creating solutions that cause problems in other places. In this way, the solutions that are brought forth can be improved.

These solutions are to form a central budget for fire prevention and fighting of wildfires. It will also add a focus of business strategy to fight dry conditions rather than prevention of ignition. In this aspect it will address the issues of policies that are counterproductive. This will also create an added benefit of increased water supply during drought conditions, a common condition that creates these high-risk areas.

Background

When dealing with wildfires, there are multiple government agencies involved. These agencies are the local and state governments, and the United States Department of Agriculture (USDA). These government agencies, hereinafter referred to as the government, have somewhat different roles, however, actions of one agency directly affect another. The Federal Emergency Management Agency (FEMA) also gets involved, especially when fires sweep through communities.

The government has been experiencing increased costs and damages to communities due to wildfires. The increase in cost is mainly due to the increasing size of wildfires, even though the overall number of wildfires has decreased (Brusentsev and Vroman 2017, 154). The size itself is costly in controlling fires but is only part of the cost. When a fire involves areas that have been developed, costs grow exponentially. This is troublesome because development is occurring in wildfire-prone areas (Cleetus and Mulik 2014).

Wildfires are different from other natural disasters. For the most part, human effort cannot prevent or control natural disasters. Wildfires are different. Although some wildfires occur due to natural causes, such as lightning, many fires are caused by the actions of people (Brusentsev and Vroman 2017, 154). In response to this, the government works to manage conditions through various methods to reduce the risk of a wildfire and the conditions that could cause it to spread quickly. This management mainly only happens on federal land due to the separation of funding (McDowell 2003, 56). Unfortunately, the hazards are growing faster than the mitigation (McDowell 2003, 56).

The agencies that handle each wildfire are based on the location and the severity of the fire. This creates different processes depending on the fire, including which agencies will absorb the costs. FEMA, for example, is an agency that steps in after a presidential disaster declaration, which happens after a disaster overwhelms the local and state government's ability to respond effectively (GAO 2019).

When it comes to fires starting and spreading quickly, dryness is a large problem, even within residential areas. California, the state with the most wildfires, deals with this along with a combined problem of common droughts. This has led to water consumption regulations for activities such as watering lawns (Scauzillo 2018). These restrictions increase the conditions for a quick-spreading fire. In some cases, the dryness has been so bad that just sparks from a lawnmower have started wildfires (Bulwa 2008).

When it comes to data for fires, the USDA monitors conditions like dryness through a predictive services team. Working together with weather services and specialized equipment, this team analyzes the data to determine high-risk areas for fires (Predictive Services n.d.). The various agencies of the government then use this data to ensure resources are available to those high-risk areas ensuring a quick response time. These data and technology aspects are well organized due to government EA mandates.

When it comes to change, the government is very used to it. Much of this change is brought about through the introduction of newly elected officials. Other changes are brought about by policies created due to those changes. Some policies will remain, while others get removed or altered.

Recovery is another area that has a great cost, especially if the size of the fire gets to a point that FEMA is involved. Each agency has its own administration costs, with the same details collected by each. When it comes to FEMA, there has been a unique problem of the collection of duplicate benefits. Collecting back those payments has resulted in heavy administrative burden and collection issues (GAO 2019).

The main success factor is the reduction of wildfires, especially wildfires that sweep though communities. This is due to the lives that are lost and the great cost to those communities. The other factor is reduction of government costs associated with wildfires, or ways to deflect that cost for added benefit to the communities. In this aspect, efficiency is the key. Although recovery is an aspect, prevention from having to recover from a wildfire is ideal.

Identification of Major Architecture Issues

Organizational / Financial issues

- The government's agencies cross jurisdictional boundaries, creating challenges in fighting fires, regulating development, finding money, and creating a common knowledge base (McDowell 2003, 45).
- The government is heavily bureaucratic and multileveled, taking a twentieth-century organizational structure (Kotter 1996, 172).
- The government is subject to lots of changes of direction.

Data Issues

- The government has data useful for solutions (another project's waste is another project's treasure aspect) spread throughout its agencies.
- FEMA lacks the real-time data on insurance coverages that result in a double benefit.

Technology / Water Infrastructure Issues

- Technology is city focused, with each city having its own water distribution setup.

Policy Issues

- Local and state governments create policies that increase the risk of fire.
- Policies prevent major federal funding until the disaster comes to a level in which state and local governments are no longer able to respond or recover effectively (GAO 2019).
- There is a conflict of interest with special interest groups and government programs.

Analysis of Wildfires and the Major Enterprise Architecture Issues

Organizational / Financial Analysis

Business Case

The aspect of jurisdictional boundaries presents multiple challenges. When analyzing this area, much of the problem shows up through the separation of budgets. Budget separation is the cause of limiting programs that reduce hazardous fuels and support prescribed burning mainly to federal lands (McDowell 2003, 56). Without these programs, fires end up becoming much larger in size due to the inability to control them. In many cases, the damage is so large that FEMA ends up paying for recovery aspects. If the recovery budget was available to fund the programs, it could have reduced or eliminated the recovery costs FEMA incurred. In the end, the overall cost would be lower and less devastating to the people. There has also been a need for FEMA's budget to decrease, which places even more burden on state and local governments (Strategic Foresight Initiative 2011). This makes it necessary to reorganize funds not only to save costs but even to maintain the current operating levels.

The lack of centralized funding also has other cost aspects. It introduces a critical management practice issue that hinders the implementation of enterprise-wide standards (Ross, Weill and Robertson 2006, 105). This leads to silo processes when it comes to how local governments handle a fire as well as a different process if another agency takes over.

Another problem that jurisdictional boundaries cause is increased administration costs. Each agency has its own administration and has many similar tasks, yet they operate as

separate units with different processes. This creates a strongly multileveled structure that when also mixed with the bureaucratic structure of the government, shows signs of a twentieth-century organization that is slow to make decisions and more reluctant to take risks (Kotter 1996, 172). Although these qualities can help to maintain the status quo, it is more resistant to progress. This is because progress comes with risk.

When it comes to jurisdictional boundaries and separation of budgets, the root runs deep. Constitutional and legal boundaries keep state and federal agencies separate. This, however, is not the case between different federal agencies. Local and state agencies are also separate, but it is not as much an issue as between federal and state agencies. It would be possible for complete funding from a federal level but would present a heavier burden on states that do not have a wildfire risk but have other high-risk areas that are not covered by the federal government. The other complication to this would be the determination of what is considered a wildfire and what is considered just a fire.

The other concern with architecture is that the leadership changes often. This presents a problem of keeping an EA functioning well. This falls under the eighth stage of major change, and that is anchoring new approaches in the culture. This is very similar to the Aerospace situation of when the GM left, and everything went back to the way things were (Kotter 1996, 146-147). This shows how important it is to ensure changes get anchored so that it can stay functioning when new leaders come.

Base Architecture

Each agency of the government has its own budget and operates separately. The local governments, state governments, and federal government agencies have judicial boundaries

between them. Local and state governments have the least budget but carry the bulk of the administration costs. FEMA has an overall budget that covers all disasters but is being asked to be decreased. FEMA's budget mainly pays for recovery but includes some costs for management. USDA has a budget that manages only federal land.

Target Architecture

The ideal architecture would be to have an EA shared budget among the government agencies. This budget would reside over a joint EA among these agencies, except for FEMA as its scope is much different than the others. FEMA would be outside this scope of EA and into another category that would be limited only to recovery, coming more inline with FEMA's purpose. Each agency would have shareholders in this EA. This would ensure that each agency is represented in the distribution of this budget.

Gap Analysis

Currently, the different agencies are not part of a joint EA. They do collaborate when fighting fires and recovery, but not for prevention. Another aspect found was that strategies of the federal government and state governments were different. Due to budget constraints, state and local governments did not prioritize prevention programs (McDowell 2003, 56). These are focuses that will need to be resolved within a joint EA.

When it comes to FEMA, it runs much differently than the other organizations. It takes an emergency declaration by the president for large funding (GAO 2019). To change this, it would take Congress and the President of the United States to approve changes to how this organization works for wildfires. Due to this aspect, the target architecture drops FEMA. To

make up for the reduced work that FEMA would be involved in, some funding will need to be deverted from FEMA for the actions that will be moved to the USDA. This will still require getting approval from Congress.

When it comes to culture, the federal government has already been working to come under an EA structure. The aspect of working along with state and local governments can present challenges as this EA initiative only affects the federal government (Office of Personnel Management n.d.). This will mean that the changes to a joint EA will be new for many stakeholders. This will require that preparation is taken in stages to prepare for major change. An example of this would be the eight-stage process of creating major change by Kotter.

Data Architecture Analysis

Business Case

When it comes to getting information about fire conditions, the fire data is centralized and analyzed by a program under the USDA called Predictive services (Predictive Services n.d.). Although this team includes weather data, it is limited to conditions for a fire. For coming up with solutions, water is a major aspect in both prevention and in fighting fires. It is also getting more expensive for water to fight fires as firefighters in drought areas are having to go farther distances to get water (Ghose 2015). This adds costs in two ways. One, the time lost in fighting the fire whilst getting water. And two, the transportation cost of getting that water. These aspects of how to provide fresh water should be connected with analyzing fire prevention and firefighting. This is because dryness is a leading factor in a wildfire. Flood data, sea water, and water tables are all vital information that could open up capabilities. In some ways, it could even tackle two to three issues at once.

Base Architecture

The data that pertains to risk factors is centralized within the USDA through the predictive services. This data is available to the government and the public. Data is structually organized and contains information related to fire resources, conditions, type of landscape (burnables), and forecasts. The data systems are also connected to applications that use a WOA style architecture, making its data very useable for other applications.

Target Architecture

The system set up by predictive services is sufficient, but does need to be expanded. Another system similar to it should be set up with water table, flood data, and sea water data. This data should include the aspects of treatment information (costs to make water usable), along with distances to high risk areas.

Gap Analysis

Since data is only being added to a system, this area does not require a lot of change. It will require some new methods to anaylize the data in order to come up with the best solutions. It may even be that a mix of solutions will be needed.

Technology / Water Infrastructure Analysis

Business Case

With droughts, a high-risk condition for fires, water supply is limited, not only for lowering high-risk conditions but also for fighting fires when fires do break out. With the farther distances that firefighters have to go to get water, time is lost in fighting fires creating larger costs and larger fires. An abundance of water in high-risk areas would greatly reduce risk conditions for fires. Tackling this problem also adds other benefits. One is that it supports policy improvement by removing the need for some of them.

With each city being on its own water system, another problem is presented. Using too much water in one city could lead to the running out of water in that city. Since water is a vital resource, running out would create an emergency situation for the city. In reality, the issue is not a water shortage problem, it is a water distribution and treatment problem. There are places in other locations that have no shortage of water. And in some cases have an overabundance of water causing flooding. Other aspects are a rising ocean that has plenty of water, but requires desalination.

Base Architecture

Water resources are controlled mainly through water conservation policies. The current infrastructure for water is that each city has its own water infrastructure. If this were an IT infrastructure, it would resemble an extremely siloed architecture.

Each state comes up with its own ways of trying to deal with the situation. Some throw money at increasing precipitation through seeding clouds. There is debate of whether this

technology works. Even if it does work, however, seeding clouds with silver iodide is only effective if there are already rain clouds and has not been determined if it truly is successful (Breslin 2016).

The main aspect is that a joint strategy is not driving solutions. In many cases, technological ideas are what is driving strategy. This is not an ideal practice in EA. Since government jurisdictions are working separately, they do not have the efficiency to drive the direction but are instead into trying out the next new thing sometimes with no matrix to know if the solutions are helping.

Target Architecture

Ideally, the strategy should be decided first. Technology should be a consideration in the strategy, but it should not drive it. The strategy should be decided as a whole so that direction can be moved in a single focus instead of in every direction. Moving in every direction is very expensive. Automated processes should be considered over manual processes.

The other aspect is that technologies should be measurable, and working methods should not be reduced at the expense of known working technology solutions. Currently, as stated earlier, state and local governments have not been active in fire management programs, but yet have invested in technologies such as cloud seeding which has not been validated to work.

Gap Analysis

Focus is the main hindrance to reach the target architecture. This lack of focus is further hindered by jurisdictional boundaries. A successful guiding coalition is important in bringing efficiency in this area. There is great potential in this area to make technology an asset rather than a liability.

In the area of choosing solutions to move forward on, it would be good to use application rationalization. Although the system might not be an IT system, rationalization will still help in determining its value and whether it is worth going in that direction, and whether other solutions may be a better approach.

Policy Analysis

Business Case

When working with the government, there are lots of policies. Although these policies are usually there for a reason, when it comes to wildfires, these policies can be counterintuitive. Water consumption policies are one of them. As drought conditions get worse, lawn irrigation that could prevent fires becomes banned (Port City Daily Staff 2019). In this case, water supply issues are traded for increased fire risk. Although burn bans are also put in place with these policies, that does not prevent the high-risk conditions. Instead, it creates perfect conditions for a fire to spread throughout an entire community.

The next aspect of policies is that they are not always followed. This was the case with the lawnmower fire that devastated 86 homes causing the largest community fire in the state that year (Bulwa 2008). Policies need more collaboration so that risks are reduced even if there

are cases that the policies are not followed. Solving problems, in this case, is better than managing them.

Some policies are not direct causes, but instead cause other bad policies. A good example would be California's Permit policy for desalination plants. Due to policies, permitting and other related expenses can cost up to about 4 times the cost when compared to other states (Mishra 2018). These are hinderances to solutions for water shortage and creates water restriction mandates that create high-risk fire conditions.

Another large area of conflict in policies is when it comes to fire hazard mitigation in forested areas. These areas are of special interest to environmental groups and so it is common for hazard mitigation to be delayed and face court battles (McDowell 2003, 60). This adds cost to mitigation, and increased risk during the delay.

The main problems in policy creation is that policies are not aligned with an overall strategy, and that strategies are created from an agencies perspective. This is shown in figure 1 in the Apendix. Having an overall stategy can spark innovation and lead to better capabilities.

Base Architecture

Policies are created from too low of a perspective. This perspective tends to produce low quality (Bente, Bombosch and Langade 2012, 17). This is shown in water usage policies created for droughts. Policies prevent or limit watering lawns to reduce water consumption, and although these policies also add other policies that help prevent a fire, they can still create a perfect environment for rapid spread fires. The part that is not thought about in these

situations is the water that will be needed if a fire is created, which has been the case many times.

FEMA has a very unified way with policies, in that it uses the same type of policy for all the disasters. It does not take the uniqueness of wildfires compared to other natural disasters into consideration. The policies are in line with the overall strategy but do not meet the more direct needs of wildfires.

When it comes to special interest groups and fire prevention programs, there are perceived conflicts of interest. Although both groups in a way want the same thing, controlled burns have been considered as the destruction of wildlife. With this, stakeholders of these special interest groups are not involved in any of these policy decisions and prevent progress.

Target Architecture

Policy creation needs to take into consideration the event of a fire, especially if policies that are proposed would increase the conditions for one. This will mean that policy creation will need to get an overview of the problem to get the big picture, as well as understanding the problem closer up.

For wildfires, FEMA should only focus on recovery, as it is in line with its strategy. Because there can be a state emergency side of the actual fighting of a fire, that aspect of FEMA should be passed on to the USDA. This will allow FEMA to stay separate and more focused on its strategy. In return, some of the funding that was set apart in that budget should be moved to the USDA, to become part of the EA.

Gap Analysis

The way policies are created creates a problem. Each agency is working more like a silo in policy creation which is created by the democratic type system. That makes politics heavily involved in the process. In order for policies to change and take consideration of the overall picture, they need to come through the oversight of the EA. This will need to take place by overarching policies through higher level (federal) policies of the EA. Having these come through the EA will also give local and state governments a voice into these policies.

Overarching policies, however, need to be approached carefully. Overly rigid approaches can lead to these policies not being adhered to (Bente, Bombosch and Langade 2012, 19). An example of this would be how recently some states made marijuana legal. Federal law still prohibits it, but states are now not enforcing it.

On the aspect of special interest groups, courts are an obstruction to policies. Although involving special interest groups will lower the risk of court battles, courts still taking up these cases complicate the issue and create extra expenses. This will need to be bridged by collaboration with special interest groups. It would be very unlikely to prevent court situations in our current society, even if it is a sure win. All cases are considered a loss as it results in a loss of time and money.

Recommended Solutions

Organizational / Financial Solutions

Organizational and Financial areas are the most critical part of the EA. Other areas such as Technology have already had a boost due to EA mandates, but juristictional aspects of the value streams have largely not been dealt with. In order to move in any direction, changes would need to be made in the area of budgeting and responsibility. These two areas alone could create large change. With the current standing and goals, two options were considered. The first would be to have a joint EA that includes FEMA, local and state governments, and USDA. The second option would be to leave FEMA out of the EA and limit FEMA to only after fire response. The second option is the recommended option for two main reasons. First, FEMA's strategy is better served for recovery. This is the focus it has on other disasters. Keeping it separate will allow it to keep the value chain that it already has.

The second main reason it was decided to keep FEMA separate is due to how FEMA is funded. For major funding through FEMA, an emergency declaration is required (GAO 2019). This is fine for recovery but is unreliable in prevention efforts. To change the policies on this for wildfires does not work well for the whole. Reducing FEMA's scope does.

After putting together the recommendation of the organizational structure for the EA, the financial aspect needed to be dealt with. First, with the reduced scope for FEMA, an analysis should be done to determine the lowered risk cost for FEMA and migrate those finances for the use of the EA. For options on how to address a centralized budget, three options were considered.

Option 1 - Have states negotiate the method that will be used for their share of the budget.

Option 2 - Have the federal government completely handle the budget.

Option 3 - Have only states that are medium to high risk required to contribute to the budget. This would also limit stakeholders to those states.

In the case of a centralized budget, it does matter too much about which option should be chosen. The main aspect would be that an agreement could be made on how this is achieved. I would lean toward recommending options 1 or 2 though, as it would allow better efficiency by using a unification operating model. If option number 3 was chosen, I would recommend using the replication model. The unification operating model would give the best cost savings due to economies of scale, but the replication model would allow states to run more separated, but yet replicate best practices (Ross, Weill and Robertson 2006).

Data Solutions

In the issue with FEMA and insurance collections, there are two options for solutions that were considered.

Option 1 - Have insurance companies be required to provide coverage details for customers that have exposure for any aspect that FEMA covers (temporary housing, debris removal,…).

Option 2 - During emergency declarations, insurance payouts for FEMA covered expenses should be sent to FEMA instead of the customer. FEMA would then handle the payouts.

Considering these two options, the recommendation I would make would be both of them. This is because of working with businesses outside. It is better, in this case, to prevent hardship on the companies on procedure changes. This will give insurance companies two different ways that they could comply with the policy.

Technology / Water Infrastructure Recommendation

For FEMA and the recommended actions for insurance companies, I would recommend a software system that will check insurance records when entered for payout. The system would process these payments while preventing payouts for amounts that are covered under insurance policies. There would have also been another option of not changing this if all covered insurance benefits were instead sent to FEMA, but that was not the recommended action chosen.

On the aspect of technology, there needs to be a shift to support the new strategy of water. Water is a way that all sides are protected. In looking at the direction of technology, three options were looked at. The first is ocean water. Ocean water is the closest water source for high-risk areas. It is also in abundance, but the one caveat is that it is saltwater. Saltwater would need to be converted to freshwater to be able to be used for fires. This is not because it wouldn't put out fires, but because it would prevent many types of vegetation from growing. Unfortunately, saltwater is currently hard to convert in large quantities, although technologies have been improving (Gerbis n.d.).

The next option would be to get water from the central locations of the United States where flooding is common. This would be costly in creating pipelines, but it would be much

easier to purify. The logic behind this is that if enough water could be transferred, then flooding could be prevented or reduced. This would then lower costs associated with flooding.

This is an area that would take more research, but with the information known, the recommended option would be saltwater conversion. Since freshwater is a worldwide issue, technologies would be beneficial worldwide. It is also an industry that is researched throughout the world due to it being a worldwide issue. This allows operations to be improved as technology increases.

Along with this approach, I would recommend creating a grid-like system to allow cities to share water supplies. This will require each water source to have an SOA type interface where data can be collected about the water table. This water table data would be used to determine distribution routes so that water tables are able to recover. These systems would need to be routed through high-risk areas where water can be released to create fire barriers. These systems should be automatic based on the dryness of the area. These systems will also be made to handle high temperatures so they can be used in the event of a fire for suppression. They will also need to be able to shoot up large distances to ensure that fires are not spread from treetops.

To ensure these systems are available, and that data can be collected from them, there should be an SOA management solution used for them to notify performance issues and downtime. This will ensure quick recovery of these systems.

Policy Recommendation

Policies that discourage watering lawns should be eliminated. Other water conservation rules are okay. Keeping lawns watered should actually be encouraged. Systems set up to convert saltwater into freshwater should be used to increase the water supply for both the cities and the fire suppression systems that work to create fire barriers.

In policy creation, the EA should overview policies and ensure that created policies do not contradict the vision of the EA on wildfire prevention and suppression. It was considered to have all policies be required to go through the EA, but most policies created are not hindrances.

High-Level Roadmap

In order to successfully implement the changes, a plan should be followed. TOGAF provides an effective methodology for this called the TOGAF architecture development methodology (TOGAF ADM). This is the most significant component of the TOGAF framework (Bente, Bombosch and Langade 2012). Having a methodology will help guide the process in a step-by-step method.

The work packages and milestones in the following table are based on the TOGAF ADM.

Phase	Recommended Direction
Preliminary Phase	• Determine current architecture (Background) • Determine gaps (Issues Defined) • Determine an operating model (Unification or Replication model based on Organizational / Financial Issues) • Define EA structure (Joint EA between USDA and Local and State Governments) • Define budget requirements (Centralized EA budget)
Phase A Architecture Vision (government processes may prolong this phase)	• Define Scope of Organizations impacted (Organizational / Finacial Issues) • Define the problem (Background) • Overview of Vision / Capabilities (Technology / Water Infrastructure Recommendation) • Create an agile communication plan between Local and State governments, and USDA • Get all approvals by agencies needed to set up the EA as defined
Phase B Business Architecture	• Prepare a high-level description of the people involved with their functions, services, roles, and processes. • Gather locations involved (high-risk wildfire locations by Predictive Services). • Map Business Capabilites (Apendix Figure 2).
Phase C / D Information Systems / Technology Architecture	• Determine Data Integration components • Create Water Control Application Work Package • Create Water Pipeline Work packages • Create Suppression / Sprinkler Work Packages • Create Logic Controllers Work Package

	• Create Water Desalinizer Work Packages
Phase E Opportunities and Solutions	• Identifiy Existing Solutions for work packages. • Identify Solutions for Work Packages
Phase F Migration Planning	• Create Transition Plan • Stakeholder signoff for ROI for each Capability.
Phase G Implementation Governance	• Prepare Communities for implementation • Set up Service-Level Agreements
Phase H Change Management	• Set up Audits to ensure QoS

Work Item Order of Priority

1. Create Joint EA Structure
2. Establish Coordination Meetings
3. Establish Shared Budget
4. Delegate Prescribed Burns to USDA for state land (Eleveate lack of prescribed burns due to budget issues)
5. Eleviate Water Supply Issue
6. Remove Conflicting Policies
7. Establish Water Grid / Software Systems
8. Install Water Suppression / Sprinkler Systems (Addresses Special Intrest Group Area Conserns)

Conclusion

In conclusion, forming a joint EA will help to reduce wildfires by providing more capabilities and allowing different agencies of the government to work together. The change of strategy to focus on water will not only help fight fires, but also to help communities dealing with drought. An EA will help the government change the way it thinks about a problem and avoid creating other problems in the process of fixing one. Based on the EA and its capabilities it creates, water desalinization and grid like water distribution to connect cities will be a recommended direction to go.

Appendix

Figure 1: Motivational Map

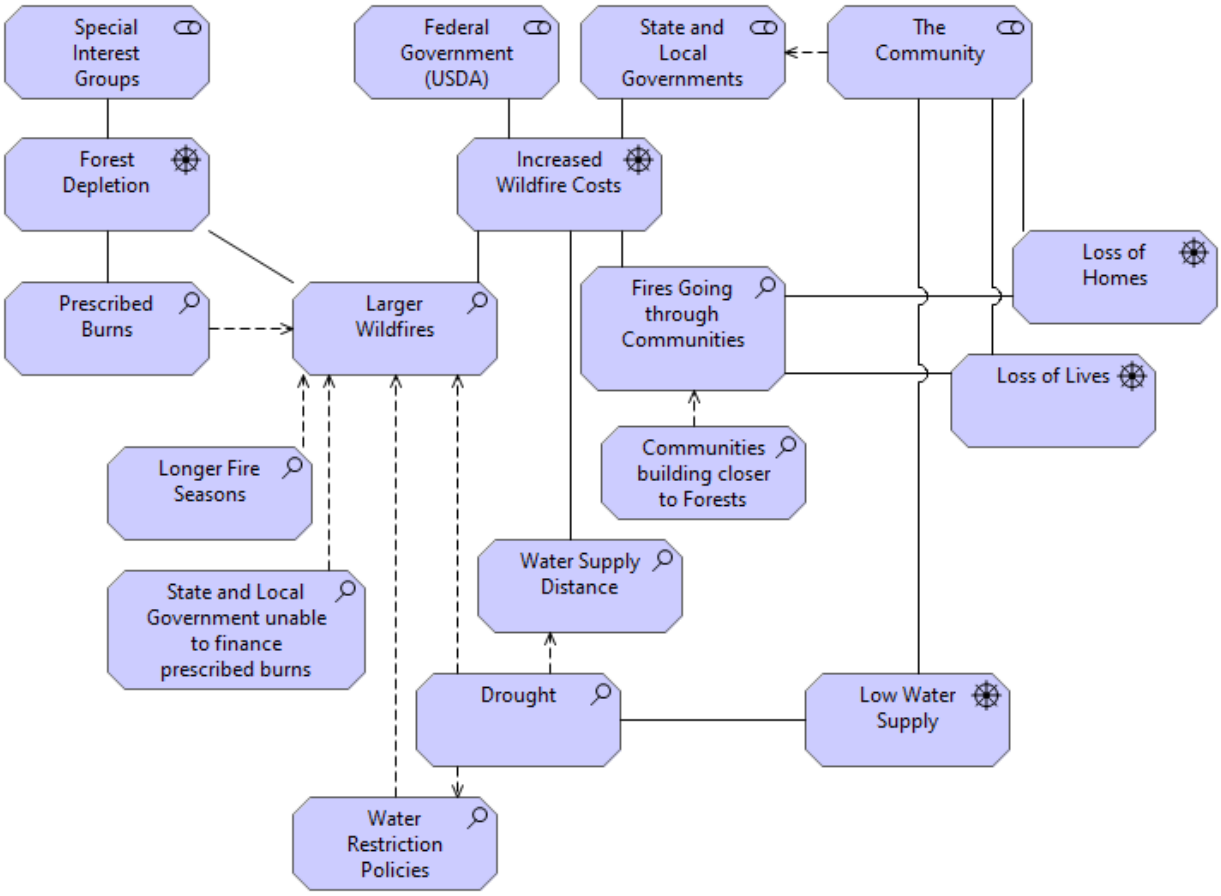

Figure 2: Before and After Capability Map

Figure 3: System Data Matrix

System Data Matrix (based on Predictive Service Program Overview (Predictive Services n.d.) and recommendations. Recommendations are in Orange.		
Application	Description	Data Entitity
Intelligence	Preparedness levels, fire situation, resources, mapping and satellite imagery, climatology, preparedness levels, resource availability, rotation schedules, and fire potential information.	Firefighter Data
Weather	Weather information pertaining to conditions of a high-risk for fire	Fire Risk
Fuels	Data pertaining to burnables	Burnable Matter
Fire Danger	Information on fire behavior and fire occurance statistics.	Fire Statistics
Water Table	Information on each city's current water table level	Ground Water Levels
Water Grid	Information on water routes for new water grid	Water Routes
Water Suppression / Sprinkler Information	Collection of data of when water suppression systems turn on and the conditions during it	Suppression / Sprinkler

Figure 4:Technology Comparison

	Cost				
Desalination Cost Aspects	**High**	**Medium**	**Low**	**Mitigated with EA**	**Mitigatable**
Energy Cost	X (Gerbis n.d.)				X
Transporting	X			X	
Startup	X				
Permits	X (California)		X	X	

	Cost				
Flood Water Aspects	**High**	**Medium**	**Low**	**Mitigatable with EA**	**Mitigatable**
Pipleline Costs	X				
Energy Costs	X				
Startup	X				
Permits		X			
Transporting (Pipeline)	X				

Figure 5: Responsibility Model

Base Responsibility Model

	Local Government	State Government	USDA	Special Intrest Groups
Fire Management (Federal Land)			RA!	
Fire Management (State Land)	RA!	RA!		
Local Policies	RA!			
State Policies	I	RA!		
Federal Policies	I	I	RA	
Fire Information Services	I	I	RA	
Fire Fighting	RA	RA	RA	

Recommended Target Responsibility Model

	Local Government	State Government	USDA	Special Intrest Groups
Fire Management (Federal Land)			RA	C
Fire Management (State Land)	I	I	RA	C
Local Policies	RA	C	C	
State Policies		RA	C	
Federal Policies		C	RA	
Fire Information Services	I	I	RA	
Water Distribution			RA	
Water Suppression		I	RA	
Desalination Systems	R	R	A	
Fire Fighting	R	R	RA	

Firemanagement includes:	Prescribed Burns
	Forest Thinning
	Other Methods

!	Issue Areas
R	Responsible
A	Accountable
C	Consulted

References

Strategic Foresight Initiative. *Government Budgets.* May 2011. https://www.fema.gov/pdf/about/programs/oppa/government_budgets_paper.pdf (accessed November 2, 2019).

Bente, Stefan, Uwe Bombosch, and Shailendra Langade. *Collaborative Enterprise Architecture.* Waltham: Elsevier, Inc., 2012.

Bernard, Scott A. *EA3, An Introduction to Enterprise Architecture.* 3rd Edition. Bloomington: AuthorHouse, 2012.

Breslin, Sean. *Clouds Seeded During Recent Rainfall in California.* March 10, 2016. https://weather.com/science/environment/news/california-cloud-seeding (accessed November 4, 2019).

Brusentsev, Vera, and Wayne Vroman. *Disasters in the United States.* 2017. http://www.jstor.org/stable/j.ctvh4zgjh.12.

Bulwa, Demian. *Accidental fire-starter furious at punishment.* August 10, 2008. https://www.sfgate.com/news/article/Accidental-fire-starter-furious-at-punishment-3200351.php (accessed October 31, 2019).

Cleetus, Rachel, and Kranti Mulik. *Playing with Fire: How Climate Change and Development Patterns Are Contributing to the Soaring Costs of Western Wildfires.* 2014. https://www-jstor-

org.du.idm.oclc.org/stable/resrep00039.9?refreqid=excelsior%3A3d4e8c1120eb5058396f050c73542afb&seq=1#metadata_info_tab_contents.

GAO. *Wildfire Disasters: FEMA Could Take Additional Actions to Address Unique Response and Recovery Challenges.* October 2019. https://www.gao.gov/assets/710/702013.pdf (accessed October 19, 2019).

Gerbis, Nicholas. *Why can't we convert salt water into drinking water?* n.d. https://adventure.howstuffworks.com/survival/wilderness/convert-salt-water.htm (accessed November 5, 2019).

Ghose, Tia. *Water Woes: Firefighters Get Creative to Douse Flames in California.* September 25, 2015. https://www.livescience.com/52302-alifornia-drought-reducing-water-firefighting.html (accessed November 3, 2019).

Kotter, John P. *Leading Change.* Boston: Harvard Business School Press, 1996.

McDowell, Bruce. "Wildfires Create New Intergovernmental Challenges." *Publius* 33, no. 3 (2003): 45-61.

Mishra, Dhananjay. *The Cost of Desalination.* February 15, 2018. https://www.advisian.com/en-us/global-perspectives/the-cost-of-desalination (accessed Novermber 7, 2019).

Office of Personnel Management. *HR Line Of Business.* n.d. https://www.opm.gov/services-for-agencies/hr-line-of-business/migration-planning-guidance/overview/ (accessed November 4, 2019).

Port City Daily Staff. *Drought update: Here's the latest on water restrictions and burn bans.* May 31, 2019. https://portcitydaily.com/local-news/2019/05/31/drought-update-heres-the-latest-on-water-restrictions-and-burn-bans/ (accessed November 2, 2019).

Predictive Services. *Predictive Services Program Overview.* n.d. https://www.predictiveservices.nifc.gov/predictive.htm (accessed October 31, 2019).

Ross, Jeanne W., Peter Weill, and David C. Robertson. *Enterprise Architecture as Strategy.* Massachusetts: Harvard Business School Publishing, 2006.

Scauzillo, Steve. *California's drought restrictions on wasteful water habits could be coming back - this time they'll be permanent.* February 12, 2018. https://www.sgvtribune.com/2018/02/12/californias-drought-restrictions-on-wasteful-water-habits-could-be-coming-back-this-time-theyll-be-permanent/ (accessed October 27, 2019).