Enterprise Architecture Solutions for an International Engineering

Services Company

Erin Culp

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Instructor: Dr. Steve Else, Ph.D.

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Executive Summary

The subject of this paper is one of the world's largest and most diverse international providers of technical, professional, and construction services with offices located in North America, South America, Europe, the Middle East, India, Australia, Africa, and Asia. The major focus of their business is based on building long-term relationships with clients within the industrial, commercial, and government sectors.

There are three major benefits of enterprise architecture:

- Cost reduction and the standardization of technology across the organization A subset
 of cost savings are the subcategories that focus on standardization of technology and
 efficiencies, along with being able to leverage skills and the retirement of aging highcost systems. The key stakeholder for cost reduction is usually the IT organization.
- Process improvement Contained areas can be re-architected to achieve optimal process improvement. Examples of this could be retirement of multiple systems with the same functions, improvement of workflow, ease of use, single points of entry. The stakeholders are the business owners.
- Strategic differentiation These efforts are centered around being able to respond to or better anticipate new business drivers, industry upheaval, and competitive pressures.
 The key stakeholders for this benefit are corporate and strategic stakeholders.



Although they are currently working toward establishing an enterprise architecture, the company is not fully aware of how do this. This paper focuses on the various enterprise architecture components based on the TOGAF^{®1} framework architecture development method (ADM) principles. The company currently has issues with its business processes, knowledge management, and data security.

¹ TOGAF is a registered trademark of The Open Group.

General Background

The organization is the top leader in the global professional services sector delivering solutions for a more connected, sustainable world. It provides a full spectrum of services including scientific, technical, professional and construction and program-management for business, industrial, commercial, government and infrastructure sectors. The company works with clients to resolve some of the most critical issues today: energy, mobility, intelligence, infrastructure, water, and exploration. The company has a presence in over 40 countries with approximately 77,000 employees across the world. They also have a total of \$15 billion in annual revenue.

In December 2017, the company acquired another engineering firm. Over the past nine months, the parent company has worked hard to develop a system on integration planning focusing on harmonizing both companies' process procedures and systems. The main focus of the company during this time was on governance and sales. By focusing on governance, the company released organizational charts from corporate structure to line of business structure all the way to the business units. It has used those organizational charts to understand their local operations and to help in the merger of the two companies in a methodical way. This governance can help both companies to operate as one organization in the future. The other focus is sales. Sales is the force multiplier gaining hearts and minds of people and showing clients and the world the combined value proposition they can bring to their client's business. The merger allowed the parent company to gain the ability to grow and win work that it could not have done on its own. However, running a successful business is difficult to do when operating without a successfully implemented enterprise architecture.

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The organization has four core values: profitable growth is an imperative, people are the heart of our business, performance excellence is our commitment, and clients are our valued partners. All four values stand on a foundation of safety and integrity. These core values are used as decision making tools for the company to produce solutions for their clients (**Appendix: Figure 1**).

Because they are such a large company, with so many employees across the world, it can be difficult to implement these core values and business strategy across all business lines without an implemented enterprise architecture. They currently operate under three lines of business: Aerospace, Technology, and Nuclear, Buildings, Infrastructure & Advanced Facilities (BIAF), and Energy, Chemicals & Resources (ECR). However, as of late October 2018 the company sold its ECR group to another energy and resources company in order to place their focus on building the BIAF group. Placing their focus on a single business line will make it easier to implement a successful enterprise architecture throughout the company.

A high-level view of the current BIAF operating model is based on overall line of business strategy to invest in growth markets and growth geographies. These geographical areas include the Americas, Europe, and Asia Pacific and Middle East with a focus on water, advanced facilities, transportation, built environment, and aviation. The company is hoping that through the merger, they can become an interconnected interdependent organization delivering unparalleled and differentiated value to the client. Since the acquisition, they have altered their business strategy so that it is delivered through solutions and technology, leading with innovation at the forefront of developing the value they bring to their clients. This value should be delivered to their clients through their growth and sales engine with execution delivery serving as the quality management platform working on tools, systems, and protocols, as well as providing strong project guidance and support through execution platforms around the world (Appendix: Figure 2).

Current Architecture Issues

Enterprise architecture is a blueprint that basically shows the operations of an organization and helps organizations to align their business strategies with their IT systems. When it comes to enterprise architecture maturity, the company currently falls under stage 2: Solution Technology. This means that it has adopted a standard platform for all technologies, including the same type of hardware and operating system across all business units. They also believe that the business needs should drive the technology. They look at the technology they currently have and provide solutions based on that technology (not the other way around). The company's IT group is seen as a group that only helps with technical issues and doesn't seem to be a part of the business strategy. In order for the company to establish a successful EA, all groups in every business line need to be involved. Also, they are currently operating on two different systems and two platforms: the parent company's system and the acquired company's system. This is due to the fact that the parent company did not have a successfully implemented enterprise architecture system in place before the merger.

Current Issues with Business Processes:

- Lack of a formal information management process.
- Not everyone is included in the business process, especially the ones involved in the day-to-day execution of the business.
- A formal business process model is not currently set up, which can cause consistency issues with deliverables to clients.
- The cost of training is too high. This reduces the number of important

training/conferences that employees are allowed to attend, which can cause these employees to become disgruntled.

 Poor organization of data causes consistency issues when different groups are using different data for the same deliverables to the same clients.

Current Issues with Knowledge Management:

- Lack of trust within the company causes issues with knowledge management.
- There is no formal documentation of knowledge which could cause an issue if certain employees should leave the company.

Current Issues with Data Security:

- Everyone in the company has access to important files and data allowing disgruntled employees to possibly damage accounts.
- Internet of Things (IoT): an idea that everything is connected which can leave the company open to more security breaches in the future.

An established enterprise architecture is important for any organization because it can help to create consistency in delivering solutions to the client, can offer a connection between business units within the organization and allows for collaboration across all business lines within the company. It can also help to alleviate the current issues with business processes, data management, and data security. Because the company didn't have a successful established enterprise architecture, especially during the time of the acquisition, the company's business strategy lacked organization which lead to conflict amongst groups within the enterprise. The following ideas on implementing an enterprise architecture are based on the TOGAF 9 Foundation Framework structure and the Architecture Development Method (ADM) (Appendix Figure 3).

Analysis of the Issues with Business Processes

The company lacks a formal information management process. This can lead to issues with processing, storing, protecting, and even analyzing data for day-to-day business processes. Having an information management system in place will allow the employees to use and store this important data for easy access, which will increase the shareability of the data as well. This will in turn allow for better decision making and an understanding about the customers and other business processes across the company.

Most employees are not included in the business processes that involve important decision making, especially the ones involved in the day-to-day execution of the business. Keeping these employees in the dark can cause some major trust issues between management and the employees. Also, when more employees are involved, it allows for the collaboration of different perspectives which can help in the decision-making process.

A formal business process model is not currently set up, which can cause consistency issues with deliverables to clients. The clients then get frustrated and confused because each deliverable is handled differently.

The cost of important training is too high. This reduces the number of important trainings/conferences that employees are allowed to attend, which can cause these employees to become disgruntled. If the company had a better way of keeping track of budget, they can give the opportunity of training to more of its employees.

Poor organization of data causes consistency issues when different groups are using different data for the same deliverables to the same clients. With a better system, they can identify issues and make better decisions within the company.

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Analysis of Issues with Knowledge Management and Data Security

"Knowledge is the organizational asset that enables sustainable competitive advantage in hypercompetitive environments" (Alavi). Lack of trust within a company can cause issues with knowledge management. Since the company doesn't have a formal system to document knowledge, that could cause an issue if certain employees should leave. Without this type of system, employees are more likely to keep what they know to themselves, so they can have ownership of this knowledge and remain valuable within the company.

The company currently does not have a system to track who has access to data or where this data is stored. This can cause a major issue with keeping this data secure. They should also have a way of classifying data on its level of importance, so it can focus on keeping the most vital data secure. The company is also headed toward an "everything is connected" world, which can leave it open to more security breaches in the future. Without a proper firewall in place, unwanted people can remotely access the system. The company doesn't have the IT staff with the knowledge of enterprise architecture to help design a system with resilience and recovery planning in mind.

Gap Analysis

A gap analysis is a great technique used to understand the difference between the two states of architecture: current and target. The following are the gaps that were identified between the actual (current) architecture, and the potential target architecture:

- Current IT functions could save money on additional automation opportunities
- There are areas for possible security breaches. These could be addressed in the target enterprise architecture.

Architectural Visions for the Organization

Architecture Vision is Phase A of TOGAF and it involves defining the scope, identifying stakeholders, creating the architecture vision, and obtaining approvals (Harrison). During this phase, the company will determine the potential outcome of the enterprise architecture. This will help the IT staff within the company understand the business goals of the organization and help them to focus on the important steps in creating a feasible architecture. It will also allow the company to establish communication with important stakeholders by giving the stakeholders a summary of what the architecture will look like when it is complete. The engagement of stakeholders is the process of involving people and organizations who are interested in/affected by a decision or activity, or who may influence the implementation of decisions or activities. Stakeholders should be informed about and involved in decisions which may affect them and have the chance to contribute to the decision-making process. Figure 4 of the Appendix shows a Stakeholder Matrix.

Business Architecture

A business process is any process that does not physically manipulate one or more tangible objects to produce a product or service that someone will pay for. In other words, a business process is any process that does not directly manufacture a tangible product or deliver a tangible service. Necessary business processes include design, purchasing, receiving, shipping, payroll, etc. In fact, most of the business processes the company uses are probably necessary at some level. However, there are some processes not necessary and these are called waste.

The first step would be to eliminate the waste by creating an accurate process map that actually identifies waste. Once those processes are eliminated, improvement in the remaining business processes can occur and changes can be made. However, some people in the company or in any organization have a vested interest in the status quo and will, therefore, actively resist changes that threaten their interests. People can also fear losing their jobs as processes become more efficient, a fear that is often well founded because real business process improvement can reduce the need for resources. However, these resources can be used somewhere else within other business units. **Figure 5** in the Appendix shows a Business Interaction Matrix, which depicts the relationship interactions between organizations and business functions across the organization (The Open Group^{®2}).

Data and Application Architecture

Data architecture refers to the structure of an organization's logical and physical data assets and data management resources (TOGAF). Currently, the company is lacking a system or structure of managing data. Considerations that need to be taken before setting up an application for data management are:

- Defining application components
- Defining any company-wide standards
- Understanding the level of complexity of data transformations

Management of Existing Data

The data the company currently has should be reviewed for completeness and usability before this data is used in any project. This data will also need to undergo a data migration to the new application. The following concepts will need to be taken into consideration: data quality, data access, data integration, and data governance. Any data received during a project will be managed under incoming data.

² The Open Group is a registered trademark of The Open Group.

Management of Incoming Data

During the design and construction stages of any project, new data is likely to be collected from new investigations, and ongoing monitoring conditions, which can contribute to the need for a proper data management system. Any of this new data should also be required to undergo quality assurance assessments prior to use in any project. This should resolve any issues with duplication of data as well. The person assigned to perform the quality assurance assessment should follow a specific documentation technique for every data set:

- Date and time of receipt
- Sender name and contact details
- Filename
- Format
- Data type
- Directory link where the data is located

These should be recorded in a spreadsheet type application (Excel, Access, etc) due to the ease of use. The data should then be uploaded to a shared network so other business lines are using the correct, most up-to-date data for their projects as well. **Figure 6** in the Appendix shows an example of the data process methodology for a specific engineering project and the roles of the relevant parties.

Technology Architecture

Technology architecture involves organizing the IT systems in an organization. Before the acquisition, the company's IT systems was solely there to perform day-to-day IT solutions. Since the acquisition, the organization has developed a group called Solutions and Technology

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(S&T).

The S&T group should be the leaders in strategy, growth, quality/project delivery excellence, and staff development. The plan is for this group to be organized with the highestlevel areas of focus referred to as "solutions." Each of these areas will be led by a Global Solutions leader. Furthermore, the IT team will have additional S&T leaders embedded in each Business Unit to further strengthen the team and ensure a robust organization that achieves the company's goals around growth, delivery, and people. **Figure 7** in Appendix shows the Missions of the Solutions and Technology Group.

The company is also working toward updating their technology architecture by recently acquiring another company. This a major step toward to aligning IT with the rest of the organization. The target company's mission is to bring their clients success by providing them with solutions and services that bridge the gap between IT and business strategy.

Enterprise Architecture Roadmap

What makes an enterprise roadmap distinct and differentiated is that it:

- Is an abstraction that depicts a conceptual view to provide context for the changes to high level business capabilities over time.
- Tracks highest level business outcomes that are directly linked to business KPIs.
- Indicates change across the enterprise (business and technology), not just one program, business unit and/or technology.

Example of a high-level roadmap for the organization:

| | 10 | May 14, 2018 | Q3 20 | 18 | Q4 2018 | | Q1 2019 | l | Q2 2019 | JULY 2019 | AUGUST 2015 | SEP 2019 | N OCT 2019 | ov 29, 2019 NOV 2019 |
|----------|------------------|--------------|-------|----|---------|-----------------|-------------------------|----------------|-------------------------|-----------|-------------|-------------|----------------|-------------------------|
| AAP | DEADLINES | | | | | | | | | | | | | _ |
| le roadi | ACHIEVEMENTS | | | | Establi | sh EA team | | | | | | | | regen |
| ITECTUR | BUSINESS DRIVER: | | | | | Di | velopment Planned | | EA Processes integrated | | | | | |
| SE ARCH | | | | | | Initial Technic | al Deliverables Planned | itakeholders a | sware of EA | | EA Proc | ess impleme | ented to align | with IT and |
| ENTERPRI | | | | | | | Initial | deliverables c | reated | | | | | |
| | | | | | | | EA team Trai | ned | | | | | | |
| | | | | | | | | | | | | | | |

Conclusion

The first step in implementing an enterprise architecture would be to establish a team dedicated to building and maintaining the EA. The next step would be to train the current IT staff on EA implementation. This will allow the current employees who know the business processes of the company to learn the various EA components. It may also highlight top level risks and disruptors.

Since acquiring the two new companies, the organization has announced its intention to streamline its operating model to three lines of business. This simplification will make it easier for them to keep everyone accountable and focused on the business strategy. As of last year, the company also established something called the Connected Enterprise (CE) which provides the clients the ability to connect and analyze the operational systems and data. This connectivity allows the organization to digitally collect and exchange data with the clients through wireless networks and the cloud. "Combining the acquired technology enabled solutions with the Connected Enterprise will accelerate client adoption around automation, analytics and innovation in commercial, civilian and national security markets" (Schwartz). This acquisition is great because it will allow the company to build on their current enterprise architecture using the TOGAF guidelines mentioned previously, bring on enterprise architecture experts to help alleviate the current issues with the business processes/data management and ultimately work toward their biggest business goal: serving the client.

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Appendix (Figures)

Figure 1: Business Core Values

- Profitable growth is an imperative
- People are the heart of our business
 - Clients are our valued partners
- Performance excellence is our commitment
 - Our values stand on a foundation of:

Safety, Inclusion,

Diversity, and

Inclusion.

Source: Engineering Services Company

Figure 2: High-Level BIAF Operating Model



Source: Engineering Services Company



| Stakeholder Name | Impact | Influence | What is important to the Stakeholder? | Strategy for engaging the Stakeholder? |
|----------------------------------|--------|-----------|---|--|
| Client | High | High | Receiving project deliverables on time with accuracy. | Constantly check-in with the client and continue to evaluate client satisfaction. |
| Central and Local Government | Medium | High | Following specific standards and principles | Educating officials about the issues important to the business and educating the governmental leaders about potential consequences of legislation. |
| Local Communities/Individuals | High | Medium | Potential impact of project on property | Public meetings/hearings |

Figure 5: Business Interaction Matrix

| | Providing Business Services | | | | | | | | |
|--------------------------------|---|-----------------------------------|---|---|---------------------------|--|--|--|--|
| Consuming Business Services | Engineering | HR/Customer Service | Environmental | Architecture | Inside Sales | | | | |
| Engineering | | Onboarding new team members | Providing the potential impacts based on the proposed schematic | | Contract for pursuits | | | | |
| HR/Customer Service | | | | | Onboarding new clients | | | | |
| Environmental | Providing the schematic for impact analysis | Onboarding new team members | | Providing the schematic for impact analysis | Contract for pursuits | | | | |
| Architecture | | Onboarding new team members | Providing the potential impacts based on the proposed schematic | | Contract for pursuits | | | | |
| Inside Sales | | | | | | | | | |

Figure 6: Data Process Methodology



Figure 7: Solutions and Technology Mission Elements



TALENT MANAGEMENT

Principal advocate for the Technology career path within BIAF – a talent 'force multiplier' to attract, retain, develop, and deploy

STRATEGY & GROWTH

Thought leadership driving market leadership through technical differentiation and packaging of solutions

CONNECTIVITY

Through robust global networking and Communities of Practice connect staff across all of BIAF to truly become a global LOB

DRIVE INNOVATION

By understanding client's challenges and fostering a culture of entrepreneurship we will provide customer-driven innovation to enhance value to clients and profitability to shareholders

PROJECT DELIVERY EXCELLENCE

Enhance technical expertise to ensure repeatable quality and reliability of projects and efficiency of project delivery

Source: Engineering Services Company