THE REEMERGANCE OF A GEOTECHNICAL, SPECIAL INSPECTION, AND CONSTRUCTION MATERIAL TESTING FIRM

A Record of Study

by

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DOCTOR OF ENGINEERING

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ABSTRACT

The following record of study documents the leadership and management efforts to re-vitalize a geotechnical, special inspection, and construction materials testing firm in Southern California. Starting in January 2020, the engineering manager assumed responsibility of a branch with recurring years of poor financial performance and struggling to remain purposeful and viable. A lack of leadership and management created an underperforming team that lacked direction, organization, structure, and accountability. Over the course of two years, performance was turned around. New leadership established guidance and direction. New management provided organization and structure. Management controls aligned employee behavior with organizational goals and objectives and established accountability. As the team began the ascent into the norming stage, a business strategy set a road map to success. A balance score card paired with an operational dashboard established a means to measure strategic progress and to accelerate decision making. Implementing process improvement and lean principles increased operational efficiency and organizational capacity. The development of training programs and investment in human capital set the conditions for long-term stability and success. Two years later, the branch rediscovered its purpose, established viability, and experienced financial success. In the search for future success, the branch continues to reaffirm its purpose and to uphold its viability.

DEDICATION

I would like to dedicate this achievement to my Marine Corps brothers, Major Allen B. Rowe, First Lieutenant Ronald B. Winchester, Lance Corporal Drew M. Uhles, and Private First-Class Julio C. Cisneros Alvarez. They made the ultimate sacrifice for us to maintain our freedom. I will continue to make the most of every day to honor their sacrifice.

I would like to dedicate this achievement to my family. First, to my father for leaving behind his family and native country for the opportunity for me to pursue a better life. Who knew that a two-year-old entering California in the trunk of a Cadillac would one day earn a doctorate? Second, I would like to thank my mother. She has always enthusiastically supported my interests and endeavors. She ensured I made it to all my baseball games and practices, and all my medical appointments and interviews required for admission to West Point. She studied and became an American Citizen, so that I could attend West Point. Still, today, she continues to take care of our family.

I would like to thank all my former commanding officers, Staff and Non-commissioned Officers, Marines, baseball coaches, teachers, and college professors. I have learned more about leadership through your everyday actions and constant mentoring. To my former teachers and professors, you have continued to ignite my desire to learn. Thank you, and I am still not finished learning.

CONTRIBUTORS AND FUNDING SOURCES

Contributors

This work was supervised by a graduate committee consisting of Professor Charles M. Wolf (advisor), Professor James Brumbelow, and Professor Timothy Jacobs of the Department of Multidisciplinary Engineering, and Professor Donald Smith of the Department of Industrial and Systems Engineering.

Mr. Trent Anderson (Regional Vice President – Professional Services Industries. Inc.) provided coaching and mentorship throughout the internship period.

Ms. Angie Dunn provided valuable support and assistance during the program's administrative process.

All other work conducted for the record of study was completed by the student independently.

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CHAPTER I

INTRODUCTION

Professional Services Industries, Inc.

Professional Services Industries, Inc. (PSI), is a nationally recognized firm that provides quality assurance for customers in the construction industry. Originating in the 1970's, the firm has 100 offices nationwide, and it is consistently ranked as one of the largest firms of its type by *Engineering News Record (ENR).* PSI offers services in Environmental Consulting, Geotechnical Engineering, and Construction Materials Testing and Special Inspections. In November of 2015, PSI was acquired by Intertek for $330 million. Intertek is an industry leader in the testing, inspection, and certification market. Intertek offers building commissioning services from: whole building air leakage testing to on-site forensics evaluations. Additional testing services include fire, thermal, acoustic, air, water, structural, and large-scale mock-up testing. Intertek employs over 46,000 people, operates over 1,000 testing labs, and occupies offices in over 100 countries.

The Santa Fe Springs branch is located within forty minutes of Los Angeles, CA. The office is centrally located in Southern California with operational access to Los Angeles, San Diego, Orange, Riverside, and San Bernardino Counties. At the start of 2020, the office consisted of thirteen employees. The Santa Fe Springs branch's three primary service lines are: Geotechnical Engineering, Construction Services, and Environmental Services. Geotechnical Engineering services consists of foundation design, site investigations, and pavement evaluations. Construction services consist of Construction Materials testing and Special inspections. Environmental services consist of Phase I Environmental Site Assessments and Industrial Hygiene Services. The generation of work consist of walk-in clients (20%) and work generated through the National Client Group (NCG) (80%). The NCG serves as an internal

group of brokers with well-established business relationships. National clients include Walmart, Olive Garden, Amazon, FedEx Ground, Floor and Décor, Public Storage, and Darden Restaurants.

Branch Manager Promotion

In the Fall 2019, I started graduate studies at Texas A&M University. At that time, I was employed by Wilson & Company, Engineers, and Architects. I worked as a construction manager supporting railroad construction for the Union Pacific Railroad. At the end of 2019, I was approached by PSI to fill the vacant branch manager role for the Santa Fe Springs, CA branch. There had been no branch manager, high employee turnover, and poor financial performance in the prior year. The branch's performance, quality, and staff engagement were not up to PSI's standards. Operating within a large market in Southern California, spanning the Central, Inland, and Southern Valleys, something needed to be done for the branch to remain viable.

Figure 1.1 below displays the organizational structure of the branch in January 2020.

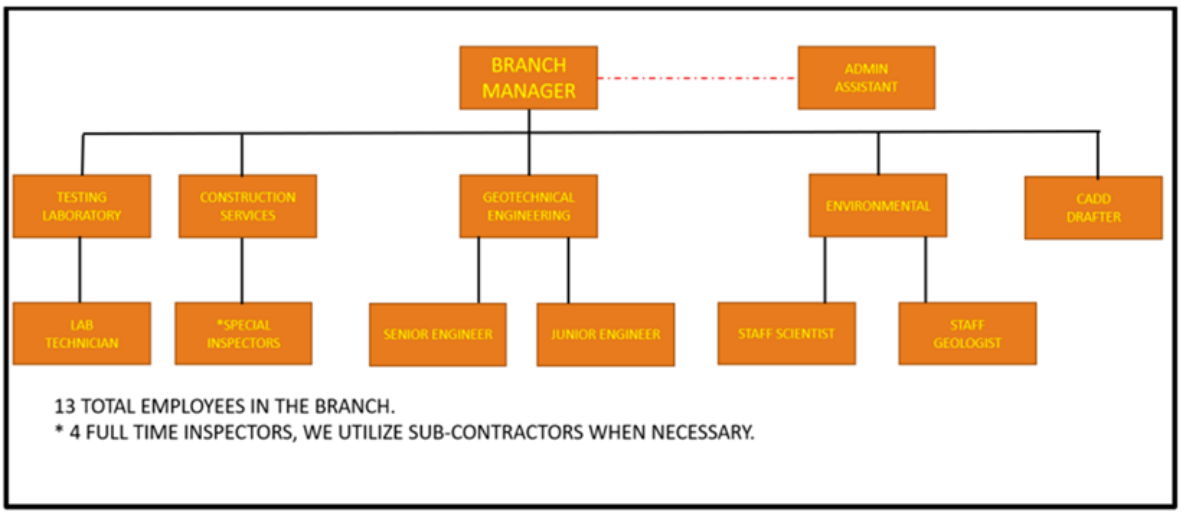

Figure 1.1: Jan 2020 Santa Fe Springs Organizational Chart

Figures 1.2 and 1.3 below display the branch's financial performance in 2018 and 2019.

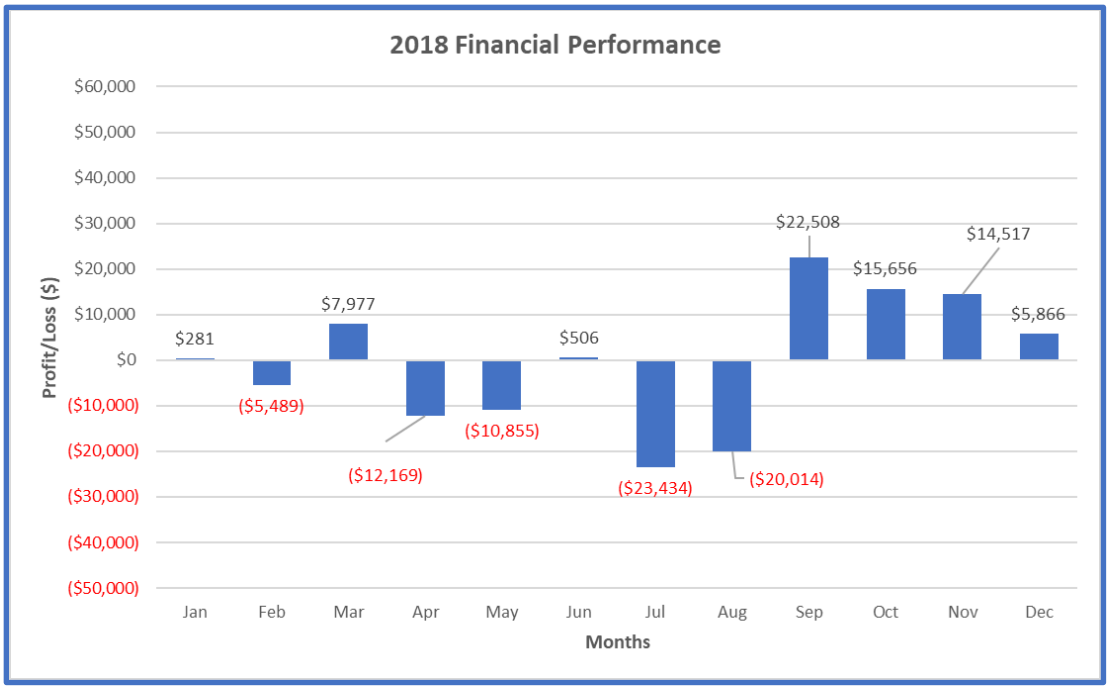

Figure 1.2: 2018 Branch Financial Performance (Profit/Loss)

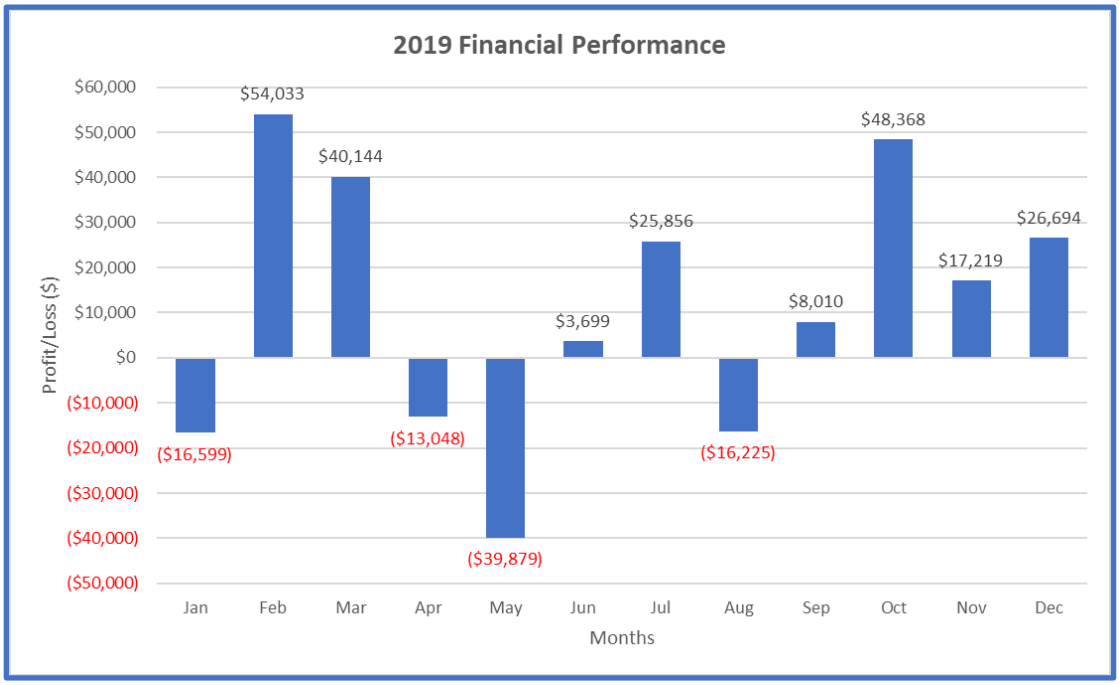

Figure 1.3: 2019 Branch Financial Performance (Profit/Loss)

On January 10, 2020, I assumed the duties and responsibilities of branch manager for the Santa Fe Springs, California branch. The position elevated me to a role with a higher level of responsibility, and serious challenges. Employee behavior was unregulated, losses exceeded profits, and control of labor costs was non-existent. The quality of services was descending rapidly. A spirit of teamwork and unity was absent. The branch and its employees were fortunate to still be open and operating.

As the branch manager, I would be responsible for financial performance of the branch measured in profit and loss and profit growth. I was responsible for management of staff and field personnel. I was responsible for generating revenue through business development and customer relationship management. I was responsible for preparing and issuing proposals and request for qualifications. I was responsible for project management. I was responsible for management and supervision of special inspectors, laboratory technicians, and field technicians. I was responsible for maintaining laboratory third party accreditations. I was responsible for training and development of all branch personnel.

Internship Objectives

While concurrently serving as the branch manager and participating in the professional internship, there were four primary objectives that I wanted to achieve. The first objective was to design and implement management control systems to align employee behavior with organizational goals and objectives. The second objective was to develop, effectively communicate, and implement a business strategy to achieve profit growth. The third objective was to review, analyze, and re-engineer core processes through process improvement to optimize operational efficiency. The fourth objective was to develop an effective and manageable training

plan to establish professional growth within the organization and to retain talent. The fifth objective was adjusting the existing organizational design to optimize performance.

CHAPTER II

MANAGEMENT CONTROLS

The design and implementation of management controls took place from Spring through the fall of 2020. These efforts were not undertaken during the official professional internship period, but greatly contributed to the overall accomplishment and success of the internship objectives. Therefore, it was critical to present and discuss the results within this record of study.

The First Thirty Days

My initial plan of action was simple. I observed the daily operation for thirty days, and I intervened only if serious issues arose. I focused on learning how the branch operated, how the employees interacted individually and amongst themselves, and how business was conducted. Concurrently, I learned my responsibilities, became familiar with our work, and our customers, and met face to face individually with the entire team.

The first thirty days were very challenging. It took a lot of discipline to sit back, silently observe, and do nothing with activities I felt needed adjustments immediately. The major problematic areas identified were a lack of leadership and management, a lack of discipline and accountability, a lack of guidance and direction, and lack of teamwork and unity of effort. The organization's purpose was unclear and organizational goals and objectives were missing.

A five-step plan was drafted and implemented to achieve a solution for the problems mentioned above. Part I of the plan was to identify the organizational issues, needs, and requirements through a system engineering approach (Shishko et al., 2018). Part II was the design of management controls to address employee behavior. Part III was the implementation of the management controls. Part IV consisted of measuring the effectiveness of the management controls. Part V consisted of stepping back and reassessing the state of the branch and continuing

to improve the organization. The overarching goal was to reinstate the organization's purpose and reestablish its viability.

Part I: Issues, Needs, Requirements

Table 2.1 below, presents the ten major issued observed and identified within the first thirty days.

Issues

Table 2.1: Organizational Issues

Issues	
Issue No.	**Description**
I-1:	High percentage of indirect hours and overtime hours.
I-2:	Uncontrolled spending (New Equipment/Office Supplies)
I-3:	Inefficient billing process (> $60k not billed).
I-4:	Lack of structure, accountability, discipline, direction.
I-5:	Lack of Initiative
I-6:	Lack of Quality
I-7:	Lack of Quality through to high reliance on subcontractors.
I-8:	Poor bids/poor estimating due to lack of experience and training
I-9:	Lack of Unity of Effort and Synchronization of Efforts.
I-10:	Unbalanced workloads/Over Utilization of Key Personnel.

I-1: Labor Hours: There was no control or oversight of hours charged by employees. The salaried staff was working minimal hours and the hourly staff was recording a high volume of unbillable overtime hours. This led to a high cost of indirect hours. In cases where the excess hours were billed to projects, project budgets were easily overrun. Failure to control project budgets led to low customer satisfaction.

I-2: Lack of Financial Discipline: Employee spending was unregulated. Equipment was either lost, damaged, or forgotten. New equipment and office supplies were purchased at will with no consideration of the financial position of the branch.

I-3: Inefficient Billing Process: Billing was a process that took over forty hours to complete. Cost codes were disorganized and used improperly. Laboratory work was improperly coded and recorded leading to missed billing. Budget control of projects was in disarray. At one point $60,000 was discovered in missed billing.

I-4: Lack of Structure: The established hours of operation for the branch were from 8am to 5pm. Customers expected to be able to call starting at 8am to schedule inspections, ask for proposals, or to coordinate work. Employee compliance with this policy was irregular. Employees arrived early, others late, and few arrived on time. This inefficiency made it difficult to perform work as a team and to synchronize efforts.

I-5: Lack of Initiative: There was minimal effort made to pursue and to generate additional work besides what was generated through the NCG. The success or failure of the branch was left up to NCG. The success of NCG was reliant on the construction initiatives and activities of our national clients.

I-6: Sub-Standard Reports: Review, approval, and distribution of inspection reports was sub-standard. Reports were not being submitted within the required twenty-four hours. Reports were poorly written, missing key information, and minimal effort was placed towards improvement. In extreme cases, reports failed to be distributed.

I-7: Subcontractor Quality: As the branch workload increased, it was an established practice to utilize sub-contractors. In Southern California, most inspectors were independent contractors gaining work individually through small firms serving as brokers. The quality amongst independent inspectors varied greatly. Self-interest outranked the desire to achieve the quality standards required by PSI. Customer demand needed to be met, even if it placed the branch in an unfavorable position.

I-8: Proposal Quality: Past proposals were incomplete and poorly developed. Customers had been given false budgets to work from. With multiple projects already in progress, proposals could not be fixed. Change orders were consistently required, and customer dissatisfaction increased. The root cause was a lack of training and experience.

I-9: Lack of Unity of Effort and Synchronization of Efforts: Unity of effort was non-existent. Employees restricted themselves to their individual business lines. Minimal effort was made to work as a team. This led to inefficiency in the operation, lack of consistency, and difficulty in achieve organizational objectives.

I-10: Employee overload: The branch was operating on a bare bones structure. This was partially due to recent turn over in personnel. There was only (1) licensed professional engineer, (1) laboratory supervisor, and (1) staff engineer. As work spiked, these individuals quickly become overwhelmed. This led to a decrease in operational efficiency and productivity. Proposals, final reports, and customer requests were consistently behind schedule.

Needs

Following the observation and identification of organizational issues, the following needs were identified as listed in table 2.2 below.

Table 2.2: Organizational Needs

Needs	
Need No.	**Description**
N-1:	Labor costs need to be controlled.
N-2:	Spending approval process needs to be designed and implemented.
N-3:	The billing process needs to be re-evaluated.
N-4:	The team needs to be transformed into a strong cohesive team.
N-5:	The office needs to generate a larger percentage of work.
N-6:	The office needs to adhere to its established standards for report distribution.
N-7:	Subcontractors need to be supervised and held accountable.
N-8:	The office needs training in proposal development and estimating.
N-9:	Duties and responsibilities of team members need to be re-balanced.
N-10:	Field personnel need training to be able to make decisions in the field.

Requirements

Following the identification of organizational needs, the following requirements were developed as listed in table 2.3 below.

Table 2.3: Organizational Requirements

Requirements	
Req#	**Description**
R-1	Labor cost needs to be controlled to be < 50% of net revenue.
R-2	Overtime hours must be approved in advance and billable.
R-3	Spending must be approved by branch manager.
R-4	A business development plan must be established to generate work.
R-5	Reports need to be completed within the established 24-hour period and on the jobsite.
R-6	A training plan needs to be developed for field employees.
R-7	Billable work must be billed on time, accurately, and all work must be accounted for.
R-8	Existing cost codes must be correctly incorporated into the existing billing system.
R-9	Project management tool required to identify project overruns in a timely manner.
R-10	Indirect hours must be minimized and only used when necessary.

Part II: Design of Management Controls

Cultural
- Birthday Celebrations
- Achievement Celebrations (EIT, PE, ICC)
- Initiation Program
- Turkey Give Away
- Toys for Tots
- Branch Manager Guidance
- Corrections – Personal Time

Administrative/Behavioral
- Time Clock
- Overtime Approval Policy
- Job Description
- Weekly Meetings
- Performance Evaluations
- Disciplinary Action

Symbols
- Public Posting of Profit/Loss Report
- Public Posting of Revenue/Service Line
- Public Posting of Revenue Goal Achievement
- Public Posting of Production Boards

Planning
- Training/Cross-training Plan
- Hiring Plan
- Internship Program

Cybernetic
- Revenue > $200k/Month
- Labor < 50% of Net Fees
- Days Sales Outstanding < 60 Days
- 100% billing

Performance
- Star Award ($500 to $1,000)
- $.75/Hour increase ACI certification
- $1.50/hour increase ICC Certification
- $5,000 - $10,000 EIT/PE

Figure 2.1: Management Controls

Figure 2.1 list various management controls that were designed and implemented. Table 2.4 associates the management control type and the requirements that each control addressed.

Table 2.4: Management Controls and Requirements

Requirements Satisfied	
Control Type	**Requirement Satisfied**
Cultural	I-9, I-10, N-4 N-5, N-6, N-9, N-10
Administrative/Behavioral	I-1, I-2, I-4, I-5, I-6, I-10, N-1, N-2, N-5, N-6, N-9, N-10
Symbols	I-5, I-8, I-9, I-10, N-4, N-5, N-8, N-9, N-10
Planning	I-7, I-8, I-9, I-10, N-4, N-5, N-8, N-9, N-10
Cybernetic	N-1, N-5, N-7
Performance	I-4, I-5, I-6, I-7, I-8, I-9, N-4, N-8, N-9, N-10

Part III: Implementation of Management Controls

Different types of management controls were designed and implemented to address the organizational issues, needs, and requirements. Cultural controls were established to unify the organization, prove that management was invested in the organization, and to establish individual commitment to the organization and to fellow employees. Symbols were implemented to establish accountability within the organization. Cybernetic controls were implemented to establish quantitative measures by which to measure success. Administrative and behavioral controls were established to regulate employee behavior. Planning controls were implemented to improve operational efficiency. Performance controls were established to motivate the organization to achieve additional certifications and licenses.

Part IV: Effectiveness of Management Controls

Change within an organization is never easy. For branch personnel change was seen as problematic and futile as mangers had come and go. Initial resistance was overcome through committed and invested leadership, follow through on promises, and the execution of disciplinary action when needed. The organization transitioned out of the survival stage and moved through the forming and storming stages of team development into the initial ascent of the norming stage. A year later, the branch experienced financial success, rediscovered its purpose, prepared to defend its viability, and exited the survival stage.

Figure 2.2 below displays the financial performance of the branch over the course of the 2020.[1]

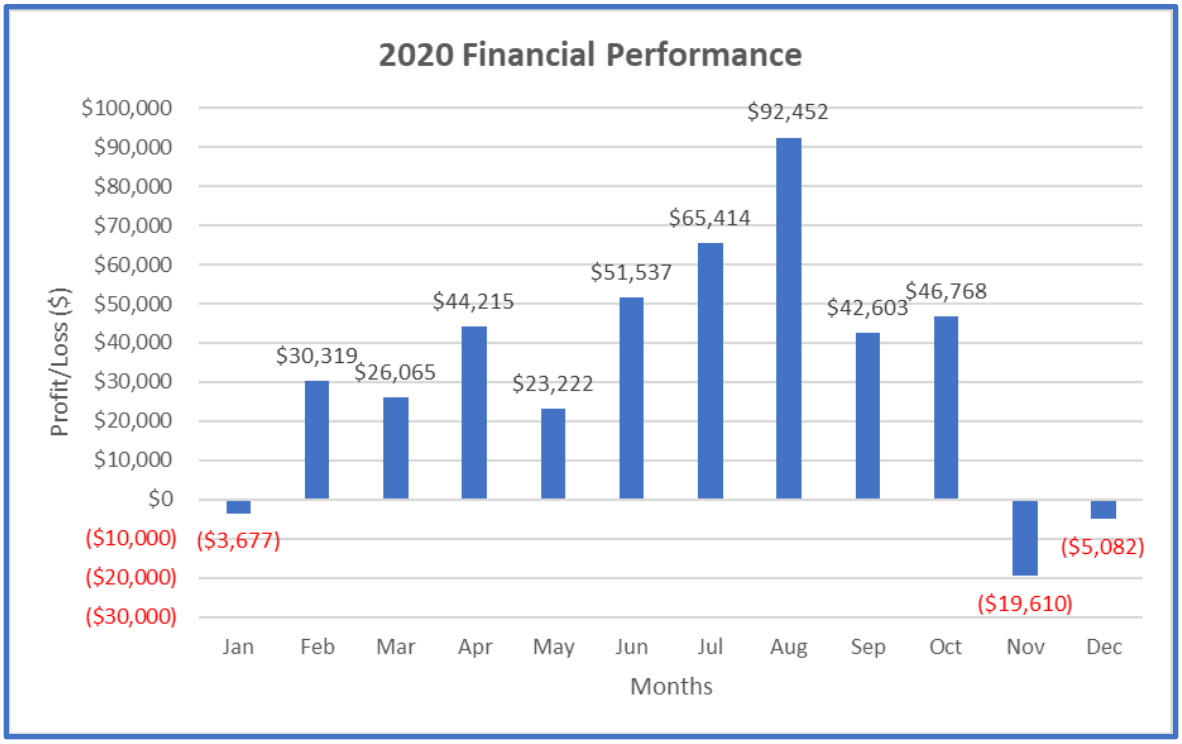

Figure 2.2: 2020 Branch Financial Performance (Profit/Loss)

[1] The losses in November and December 2020 were due to missed inter-office billing and not due to branch performance.

Part V: Evaluation of Management Controls

Management controls enable an organization to align employee behavior with the goals and objectives of the organization (Merchant et al., 2017). The goals and objectives are established to satisfy customer needs, and value can only be defined by the customer. Customers establish the purpose and organizational goals, and objectives achieve viability. Given guidance and direction, employees will be productive and successful. However, complete congruence between individual and organizational goals and objectives is not always possible. Performance incentives are only effective to a certain point. The achievement of purpose and viability is a continuous cycle.

CHAPTER III

FINANCIAL GROWTH

The current State

The spring 2021 semester marked the start of the professional internship. The design and implementation of management controls had been successful. It was now time to develop a business strategy. At the start of 2021, there had been some key changes within the organization. Two employees were dismissed for failing to align with the organizational goals and objectives. A second Geotechnical Engineer was hired to assist with generating more geotechnical work, and the branch's new internship program was underway. The branch was reorganized to better meet customer needs. 2020 was a financially successful year. The branch was minimally impacted by COVID. The structured, organized, and aligned team was now ready for a business strategy to pursue financial growth.

Objectives

The primary objective for the organization was to develop a business strategy (Kaplan et al., 2014) aimed at profit growth through an increase in revenue and decrease in operational costs. An increase in revenue would be achieved through entrance into new markets. The new markets being education, rail, and public works. A decrease in operational costs would be achieved through improvement in operational efficiency. The second objective was effectively communicating the business strategy and continuing to reaffirm its goals and objectives. The third objective was to identify key performance measures and metrics to measure strategic progress (Brown, 2009). The fourth objective was to design a balance score card that would measure strategic progress and provide actionable data for decision making to achieve strategic goals and objectives (Kaplan et al., 1996).

Business Strategy

Customer Value

Prior to drafting any strategy, it was first important to understand and define the customer, what they value, and what their conditions of satisfaction are (Simons, 2014). Once these three questions have been answered, true progress can be made towards creating and implementing a successful strategy. To gather and analyze information about the customer, surveys were conducted, net promotor scores were analyzed, and complaint logs were reviewed. Success factors associated with loyal customers and factors associated with terminated business relationships were investigated. The above actions helped to paint a complete picture of the customer.

Post analysis revealed that the organization had two types of customers, external and internal. The organization's primary and internal customers were real estate developers and construction professionals in need of consulting, design, and quality assurance services. The organization's secondary and external customers were municipal authorities responsible for enforcing safe building practices and ensuring adherence to the building code. Additionally, the organization's key stake holders are the everyday citizens who entrust the construction and engineering industry with the building of safe and habitable structures.

Figure 3.1 below summarized what the organization determined was important to the customer.

PSI customers value:

- Customers expect PSI to be the single source solution for coordination and execution of required services (Environmental, Geotechnical, Special Inspections, Construction Material Testing).
- Customers want to be able to trust that PSI will perform the contracted services by employing personnel with the required qualifications, experience, and sound morals and ethics.
- Customers expect to a fair price based on the complexity of the scope of work.
- Customers expect complete project and total quality management.
- Customers expect PSI to provide timely services and a quick response when urgent matters arise.
- Customers expect open and clear communication. They expect immediate communication when things go wrong.
- Customers expect for PSI to be the primary source of expertise in the building code and regulations associated with the local jurisdiction and to help guide them through the process.
- Customers expect for PSI to always act in the customer's best interest.

Figure 3.1: Customer Value

Theme

In developing the strategy map, the theme pursued was profit growth. Profit growth could be achieved through an increase in revenue combined with reduction in operational costs. Increase in revenue could be obtained by entrance into new markets. Target markets were on-call municipal work, class I freight rail work, and education work. Cost reduction could be obtained by improving operational efficiency through analyzation of internal processes. The timeline target for achieving the strategic objectives was a year, as the branch was still growing.

Financial Perspective

The main objective for the financial perspective was an increase in revenue. A financial perspective score was created with associated metrics. Four metrics were analyzed. The first was the branch's progress towards reaching the annual profit target established by corporate and the Regional Vice President. The second was the branch's average profit margin and its relation to

the 18% margin required to meet end of year targets. The third was the balance of branch generated work versus work generated by our National Client Group in Atlanta, Georgia. The final metric was the win rate in the pursuit of new projects in the on-call municipal, rail, and education markets. Key initiatives in the financial perspective were our branch re-organization and providing focus of effort amongst the team. The second was a recruiting/hiring plan to start staffing the organization with the people possessing the correct qualifications and culture. Figure 3.2 below displays the scoring system for the financial perspective.

Financial Perspective			
Category	**Score**	**Weight**	**Total**
Financial Target %	0.92	0.2	0.18
Profit Margin	0.97	0.4	0.39
NCG-Local Ratio	0.72	0.1	0.07
On-Call Municipal	0	0.1	0.00
DSA	0	0.1	0.00
Rail	0.5	0.1	0.05
		Score	**0.69**

Figure 3.2: Financial Perspective

Customer Perspective

The main objective for the customer perspective was retaining customer loyalty, gaining new customers, and minimizing bad customers. Bad customers consisting of customers who failed to pay for services or who placed the branch in high-risk position from a liability standpoint. A customer perspective score was created with associated metrics. The four metrics analyzed were the repeat business win rate, new customer win rate, bad debt, and net promoter score. The net promoter score is a product of corporate issued customer satisfaction surveys, and scores range between 0 – 10, with 10 being the highest. The primary initiative for the customer perspective was a business development plan outlining how to improve our customer relationship

management and ability to win work. Figure 3.3 below displays the scoring system for the customer perspective.

Customer Perspective			
Category	**Score**	**Weight**	**Total**
Repeat Business Win Rate	0.71	0.25	0.18
New Customer Win Rate	0.25	0.25	0.06
Bad Debt	0.95	0.25	0.24
Net Promoter Score	0.99	0.25	0.25
		Score	**0.55**

Figure 3.3: Customer Perspective

Internal Process Perspective

The main objective of the internal process perspective was increasing operational efficiency and reducing labor costs. An internal process perspective was created. Five metrics were analyzed. The first was geotechnical efficiency, evaluating how successful the branch was on delivering geotechnical projects on schedule. The second was laboratory efficiency, evaluating how successful the laboratory was in completing testing on schedule. The third was labor efficiency, with the target of restricting labor cost to no more than 50% of net fees. The fourth was subcontractor utilization with the target of not exceeding 10% of revenue in subcontractor costs. The fifth was our accounts receivable collection efficiency. In order to grow and invest, the working capital needed to be constant and sufficient. The initiatives for the internal process perspective were a formal training plan, implementation of lean principles, enforcing accountability through job design and performance evaluations, and the employment of business process models to help identify deficiencies, reduce waste, and increase value. Figure 3.4 below displays the scoring system for the internal process perspective.

Internal Process Perspective			
Category	Score	Weight	Total
Geotechnical Efficiency	0.75	0.2	0.15
Laboratory Efficiency	0.70	0.2	0.14
Labor Efficiency	0.99	0.2	0.20
Subcontractor Utilization	1.00	0.2	0.20
Collection Efficiency	0.80	0.2	0.16
		Score	0.85

Figure 3.4: Internal Process Perspective

Learning and Growth Perspective

The main objective of the learning and growth perspective was increasing operational capacity. Operational capacity meaning assessing whether or not the firm possessed the required personnel with the correct qualifications and sufficient experience necessary to perform the target work outlined in the strategy objectives. A learning and growth score was created. Four metrics were analyzed. The first was laboratory growth, the second special inspections growth, the third geotechnical growth, and the fourth project management growth. The primary initiative was the formal training plan. Figure 3.5 below displays the scoring system for the learning and growth perspective.

Learning and Growth Perspective			
Category	Score	Weight	Total
Laboratory	0.45	0.3	0.14
Special Inspections	0.44	0.3	0.13
Geotechnical	0.14	0.3	0.04
Project Management	0.5	0.1	0.05
		Score	0.36

Figure 3.5: Learning and Growth Perspective

Quality Perspective

The traditional strategy map and balance score card normally include the four perspectives discussed above. However, it was important to add two additional perspectives. Those perspectives were the quality and safety perspectives. The primary objective of the quality perspective was a complete buy in to the organizational quality culture and compliance with external regulations that govern the organization's accreditations and certifications. A quality perspective score was developed. Four metrics were analyzed. The first was the status of our accreditations. Current organization accreditations and certifications consisted of the Concrete and Cement Reference Laboratory (CCRL), American Association of Transportation and Highway Officials (ASSHTO), California Division of the State Architect (DSA), City of Los Angeles, and City of San Diego. The second metric was field audit scores. The third metric was the non-conformance score, tabulated from customer complaints entered into our non-compliance log. The fourth was a report review score, tabulated from daily review of inspection and lab testing reports. The primary initiative was the development of a branch standard operating procedure. Figure 3.6 below displays the scoring system for the quality perspective.

Quality Perspective			
Category	**Score**	**Weight**	**Total**
Accreditations	1.00	0.40	0.40
Field Audit Score	0.75	0.25	0.19
Non-Conformance Score	0.60	0.10	0.06
Report Review Score	0.75	0.25	0.19
		Score	0.84

Figure 3.6: Quality Perspective

Safety Perspective

The primary objective of the safety perspective was a revitalization of the branch safety culture and to communicate to customers that safety was of the upmost priority within the organization. A safety perspective score was developed. Four metrics were analyzed. The first was a safety incident score, with a zero tolerance for safety incidents. The second was a recordable injury score. The third was a safety certification score. The fourth was a safety training score. The primary initiative for the safety perspective was a formal safety training plan. Figure 3.7 below displays the scoring system for the safety perspective.

Safety Perspective			
Category	**Score**	**Weight**	**Total**
Safety Incidents	1.00	0.35	0.35
Recordable Injury	1.00	0.35	0.35
Certifications	0.04	0.15	0.01
Training	1.00	0.15	0.15
		Score	**0.86**

Figure 3.7: Safety Perspective

Figure 3.8 below summarizes the business strategy, strategy map, and balance scorecard.

0066: Santa Fe Springs Branch Strategy Map - Balance Score Card Spring 2021 (1 Year Target)					
Theme	***Profit Growth Through Diversification, Cost Reduction, and Becoming a Market Leader***				
	Objective	**Measure**	**Metric**	**Target**	**Initiatives**
FINANCIAL PERSPECTIVE	Increase in Revenue	Financial Perspective Score	(1) Financial Target %	On-schedule with corporate target	(1) Re-Organization
			(2) Profit Margin	18%	(2) Recruting/Hiring Plan
			(3) NCG-Local Ratio	50% - 50%	
			(4) On-Call Municipal Projects Win Rate	50%	
			(5) Education Projects Won Win Rate	50%	
			(6) Rail Projects Win Rate	50%	
CUSTOMER PERSPECTIVE	Retain Customer Loyalty	Customer Perspective Score	(1) Repeat Business Win Rate	> 90%	(1) Business Development Plan
	Gain New Customers		(2) New Customer Proposal Win Rate	> 70%	
	Minimize Bad Customers		(3) Bad Debt	< 10% of Annual Revenue	
			(4) Net Promoter Score	> 9	
INTERNAL PROCESS PERSPECTIVE	Increased Operational Efficiency	Internal Process Perspective Score	(1) Geotechnical Efficiency Score	90%	(1) Training Plan
	Labor Cost Reduction		(2) Laboratory Efficiency Score	90%	(2) LEAN Training Plan
			(3) Labor Efficiency	< 50% of Net Fees	(3) Accountability
			(4) Subcontractor Utilization	< 10% of Revenue	(4) CONOP Models
			(5) Collection Efficiency	Average 60 Days in Collection	
LEARNING AND GROWTH PERSPECTIVE	Increased Operational Capacity	Learing and Growth Perspective Score	(1) Laboratory Growth Score	100% by end of 2021	(1) Training Plan
			(2) Special Inspections Growth Score	80% by end of 2021	
			(3) Geotechnical Growth Score	80% by end of 2021	
			(4) Project Management Growth Score	100% by end of 2021	
QUALITY PERSPECTIVE	100% buy in to Quality	Quality Perspective Score	(1) Status of Accreditations	100%	(1) System Engineering Management Plan
			(2) Field Audit Scores	> 90%	
			(3) Non-Comformance Score	> 90%	
			(4) Report Review Score	> 90%	
SAFETY PERSPECTIVE	100% buy in to Safety	Safety Perspective Score	(1) Safety Incidents	Zero Tolerance	(1) Safety Program
			(2) Recordable Injuries	Goal is 0	
			(3) Safety Certifications	100% by end of 2021	
			(4) Training Sessions	1 per month	

Figure 3.8: Strategy Map – Balance Score Card

Operational Dashboard

Based on the strategic objectives and actions required to meet those objectives an operational dashboard was created. The dashboard allowed for real time data entry, a means to measure strategic progress, an actionable data for decision making (Person, 2013). After communicating the strategy to all team members, a printed copy of the dashboard at the end of every month was distributed and posted publicly along with the financial reports. Success was celebrated, and short comings were investigated, and required processes were reengineered. Figure 3.9 on the following page displays the operational dashboard that was developed.

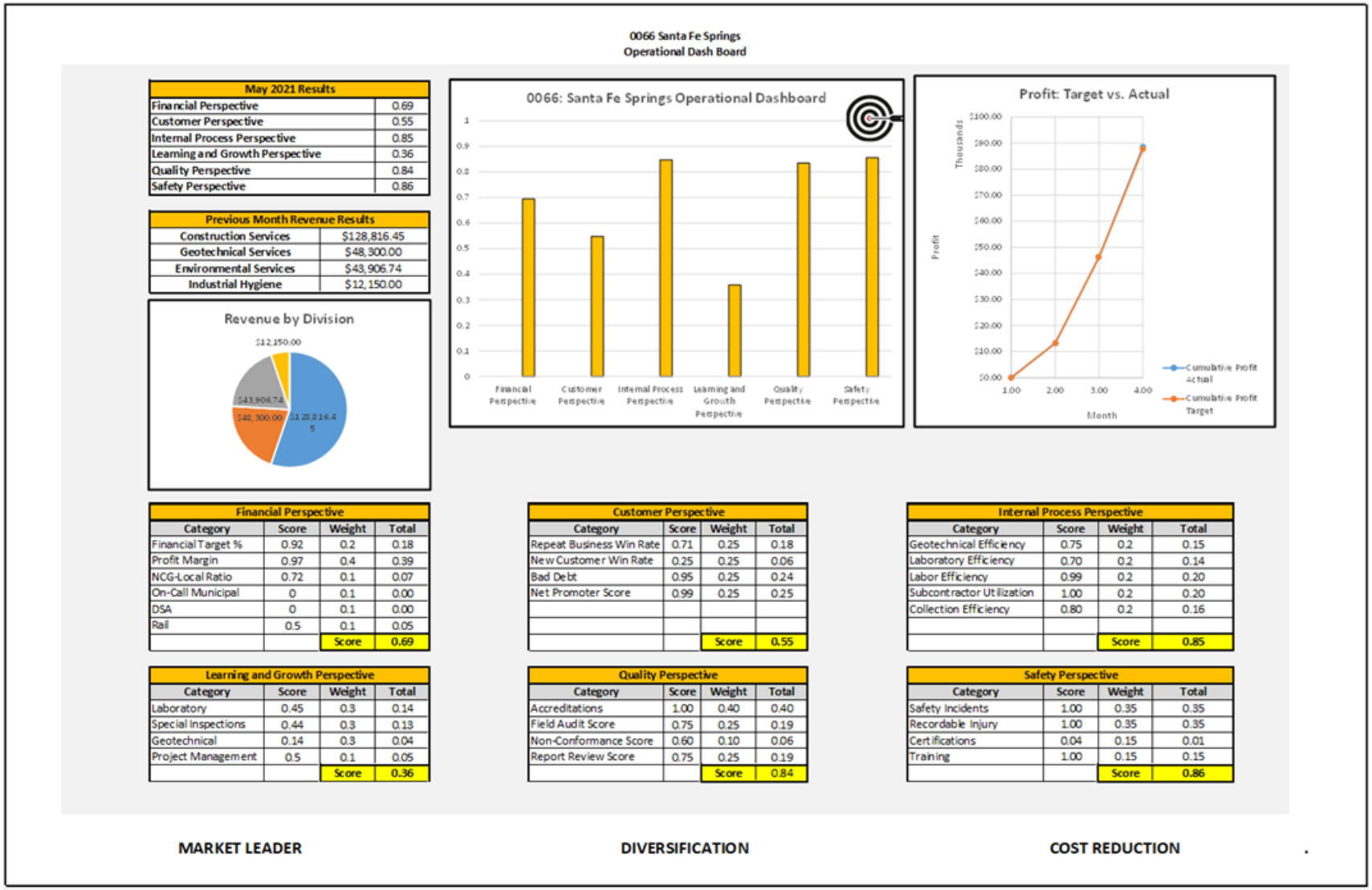

Figure 3.9: Operational Dashboard

Discussion

The business strategy provides a road map for success. Prior to its development the needs of external and internal customers must be taking into consideration. Customer needs must be satisfied. Organizational gaps and weaknesses must be remedied. The balance score card provides a means to measure success beyond quantitative financial values. Metrics are user defined and established by the organization. The operational dashboard provides a tool to track, measure, and evaluate progress towards the attainment of organizational goals and objectives. Data collection must be efficient and not impose additional burden on management. For true organization success to occur, the strategy must be effectively communicated and complete buy in from the organization is a must.

The operational dashboard was effective and a valuable tool for decision making. For the financial perspective the score increased, but there were some categories that became static. The branch was unsuccessful winning public works and education projects. The branch was uncompetitive due to inexperience and missing project experience. However, the branch was successful in winning rail projects and became the main geotechnical provider for 3 different companies. For the customer perspective, the overall score continued to increase. The bad debt category score was greatly improved. It was discovered that the branch needed to improve its project set up process to reduce miscommunication in collecting payments from clients. For the internal process perspective and learning and growth perspective, the scores improved over time. As a result, a special inspector was promoted to laboratory manager, and a field technician was promoted to assistant project manager. The quality perspective score continued to increase as a direct result of increases in the learning and growth perspective and internal process perspective. The safety perspective score improved with only minimal speeding incidents reoccurring.

CHAPTER IV

PROCESS IMPROVEMENT

Process improvement efforts began during the summer 2021 semester. At this point in time, the business strategy had been launched and new measures and initiatives had been implemented. However, successful accomplishment and achievement of strategic objectives would lead to an increase in workload for the branch. An increase in workload would mean that the branch would have to increase capacity and production. Furthermore, capacity and production needed to be sustained for the short term, as approval of new hires would not be approved until growth increased and became consistent.

The branch faced three main challenges. First, there was a constant change in roles and responsibilities. Due to the branch's small size, a fire hose[2] approach was undertaken to meet customer demands. Second, there was a lack of standardization. Although projects and customers changed, the core work performed by the branch remained consistent. Third, mistakes amongst the staff and personnel continued to occur. While problematic, these problems focused management attention away from more important areas.

To address the above-mentioned challenges, processes improvement needed to be implemented. New and existing processes needed to be reviewed, analyzed, improved, and standardized. Waste needed to be minimized. Dysfunction needed to be minimized. A team approach was essential for success. The tools implemented to achieve a solution were the Integration Definition for Process Modeling (IDEFO) methodology, utilization of simulation software, and application of lean principles and methodologies.

[2] A "fire hose" approach is when a team stops what it is currently doing to solve the current problem at hand leading to disruption and delays in completing other tasks.

IDEF0 Modeling

Profit growth was the primary aim of the drafted business strategy. A secondary aim was cost reduction through an increase in operational efficiency. The IDEF0 functional modeling process allowed the organization to map out activities, identify deficiencies, identify waste, and to engineer needed improvements to optimize efficiency (Feldman, 1998). Models were built for administrative, technical, and field work procedures. Once drafted, the models were tested, and adjustments were made. Once the models were finalized, they were stored in the branch standard operating procedure manual.

While multiple models were developed, the example below highlights the special inspection report process. Although a fairly easy and straight forward process, it was not without its problems. The reports were completed at the end of the day. Fatigue, time constraints, and conflicts of interest contributed to reports being rushed and incomplete. The IDEF0 model assisted in improving this process. As a result, time was saved, there was a reduction in re-work, increase in quality, and increase in return on management.

Special Inspection Report Process

Figure 4.1 below displays the complete special inspection report process.

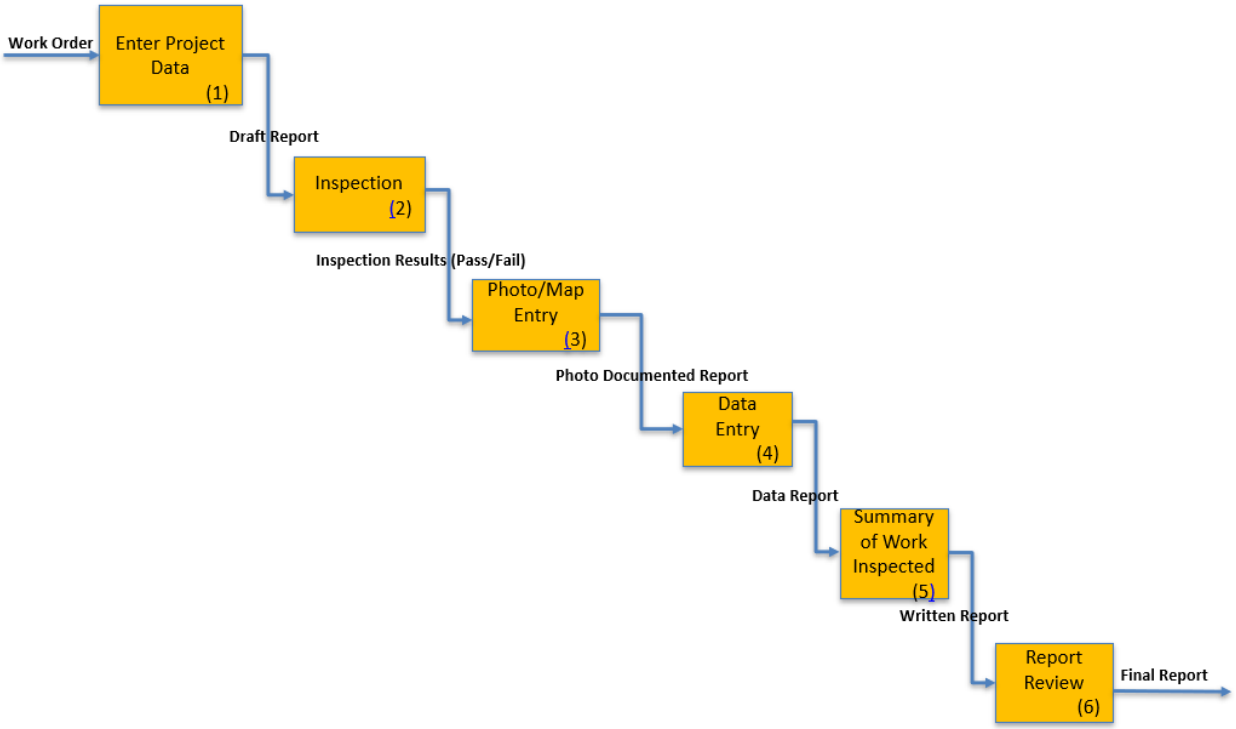

Figure 4.1: IDEF0 Model - Special Inspection Report Process

The viewpoint, purpose, and context of the IDEF0 model for the Special Inspection Report Profess is defined below.

Viewpoint: The viewpoint for this model is that of a special inspector completing the report and project manager reviewing, approving, and distributing the final report to the client.

Purpose: To model the preparation, completion, approval, and distribution process of special inspection reports.

Context: Special inspections and special inspection reports are a daily activity for the branch. Reports are required to be distributed within 24 hours. The IDEF0 model was used to help

organize the process and as a tool to improve efficiency in line with our strategy map and balance score card.

The terminology in Figure 4.1 is defined below:

Special Inspections: Inspections and observations of materials, fabrication, erection, or placement of components and connections critical to the structural integrity of the building identified in the statement of special inspections.

Work Order: A formal numerical identification assigning a task to an inspector or technician.

Building Code: A set of rules that specify the standards for constructed objects such as buildings and nonbuilding structures.

Special Inspection Report: A written report delivered to the project owner and building official stating whether the work performed complied with the project plans and specifications and building code.

Data: In this IDEF0 model, data refers to measurable and quantitative data that is part of special inspections. Data can include percent compaction achieved, concrete compressive strength, mortar compressive strength, grout compressive strength, or tensile strength of steel reinforcement.

Model Breakdown

Figure 4.2 to 4.7 below, display the inputs, controls, resources, and output of the six steps that make up the special inspection report process.

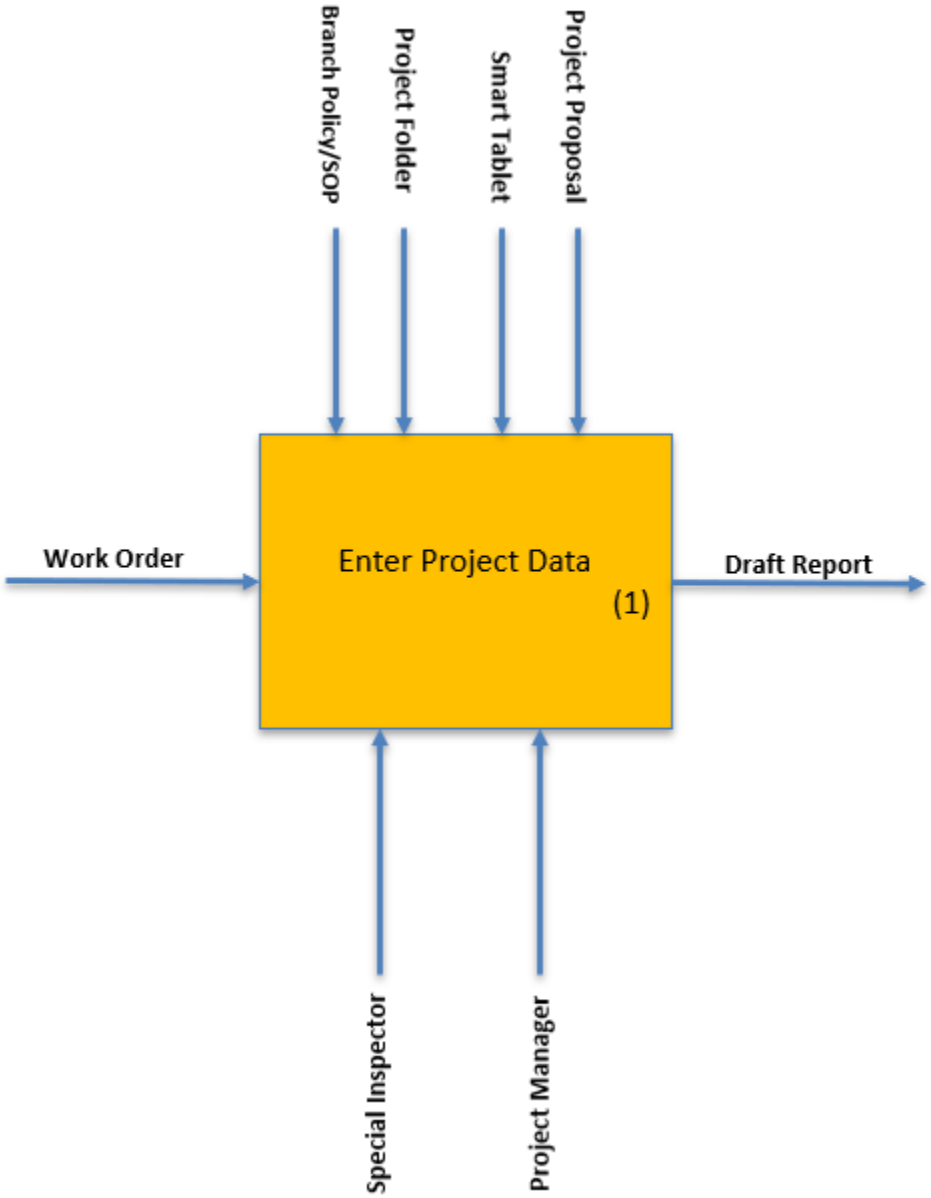

Figure 4.2: IDEF0 Model Step 1 - Project Data Entry

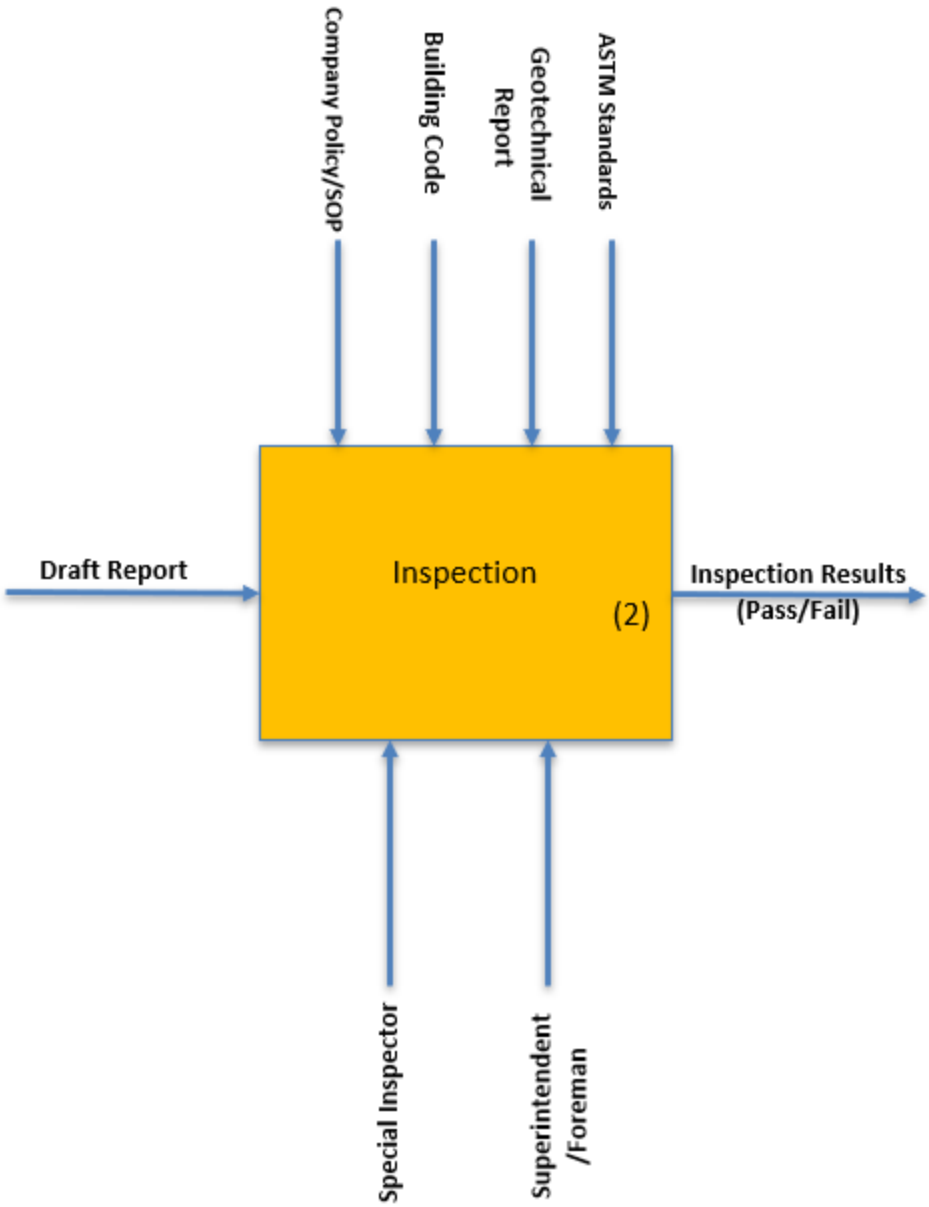

Figure 4.3: IDEF0 Model Step 2 - Inspection

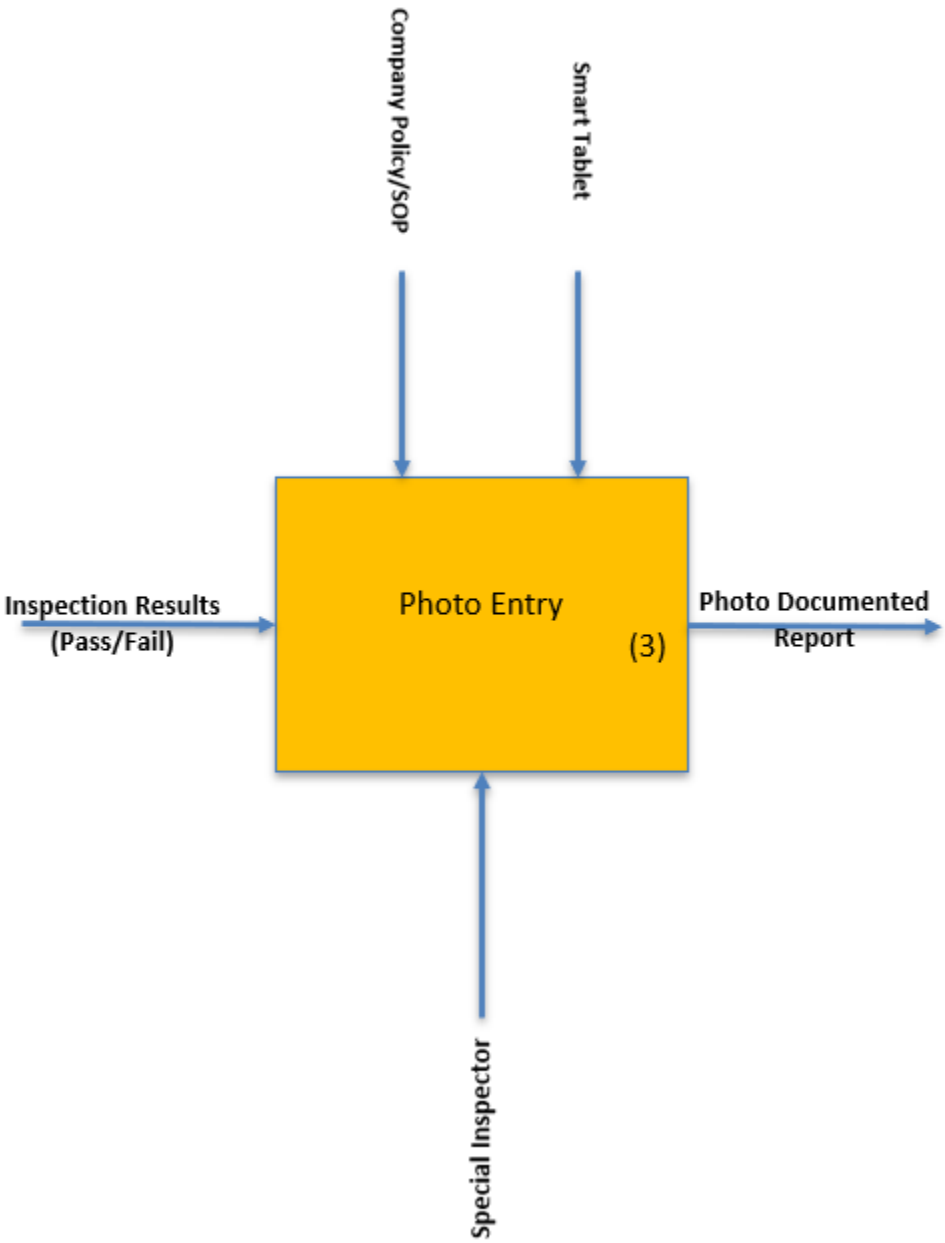

Figure 4.4: IDEF0 Model Step 3 - Photo Entry

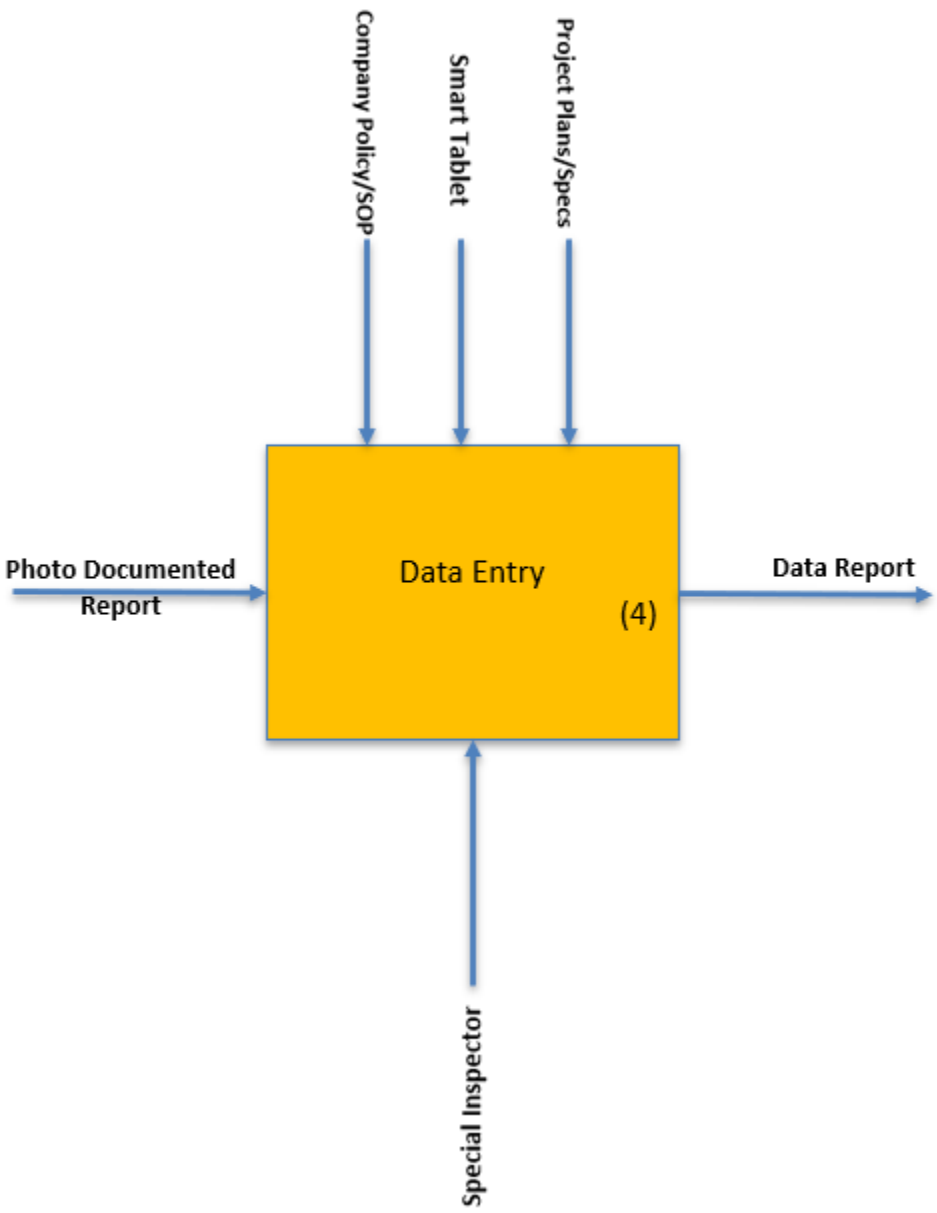

Figure 4.5: IDEF0 Model Step 4 - Data Entry

Figure 4.6: IDEF0 Model Step 5 - Inspection Summary

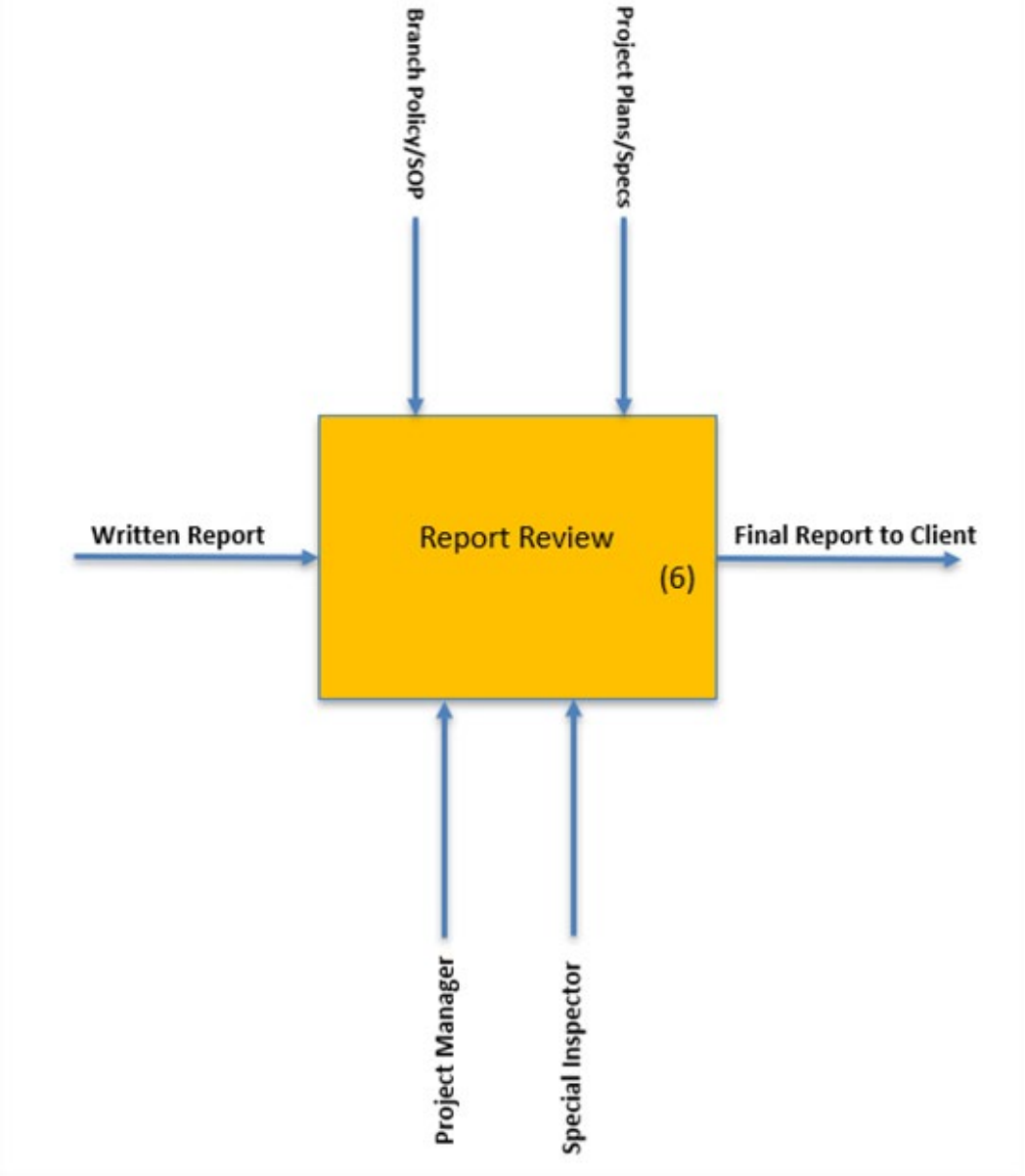

Figure 4.7: IDEF0 Model Step 6 - Report Review

Special Inspection Report Checklist

Table 4.1. Special Inspection Report Checklist

Special Inspection Report Checklist	
Draft Report	
Permit Number:	
Site Contact: (Full Name)	
Location: Be Specific	
Detail:	
Photo Documentation	
Map of test/inspection locations	
Photos of work performed included	
Data Entry	
All data entries filled out	
Data results verified with lab	
Written Report	
Work describes the 5 W's	
Work is Complete or In Progress	
Report reviewed for grammatical errors	
All failures deficiencies have been reported to the site representative and project manager?	

IDEF0 Model Discussion

Utilizing the IDEF0 modeling to improve the special inspection report process was invaluable. Inefficiency was minimized through organization, standardization, and communication. Dysfunction was highlighted, remediated, and minimized. Creation of the model identified deficiencies and the requirement for additional materials and resources. One such resource identified was the need for a branch standard operating procedure to streamline the preparation of the narrative summary of the special inspection report. Standardization paired with a checklist minimized human error. Return on management was increased.

The IDEF0 modeling methodology helped the organization create and implement changes in current processes and set the conditions for continuous improvement. It was a methodology that was easy to teach, easy to learn, and easy to implement. After an initial training session, any member could identify a process in need of improvement and start the reengineering process. In collaboration with a senior member, the reengineering process would be approved and implemented immediately.

Figure 4.8 below list the different processes that were created or reengineered using IDEF0.

Business Processed Modeled (IDEF0)

- Proposal Writing
- Estimating
- Sub Contractor Contracts
- Project Set-Up
- Special Inspection Report Completion
- Report Review and Distribution
- Non-Conformance Reporting
- Project Final Letters
- Build Pad/Rough Grading Certification Letters
- Billing
- Accounts Receivable Collection
- Accounts Payable Collection
- Dispatching/Scheduling

Figure 4.8: Business Processes Modeled (IDEF0)

LEAN

Lean is a system for process improvement with the aim of eliminating waste (Womack, 2003). The five principles of lean are value, value stream, flow, pull, and perfection. Additionally, lean provides a methodology for organizations to create an organized, clean, and productive work environment. This is accomplished through the five pillars of Lean which are

Sort, Set in Order, Shine, Standardize, and Sustain. At the center stage of lean is value, which can only be defined by the customer. Process improvement is continuous.

Concrete Testing Process Improvement

One area that was in desperate need of process improvement was the laboratory. When there was a lull in work, material testing was completed in a timely manner without issue. However, as work increased significantly, finishing tests on time was a problem and the current system was easily overwhelmed. A second problem was how equipment was stored in the laboratory. Equipment storage was in complete disarray, with no sound reasoning or logic behind how or where things were stored. Accountability of total inventory was doubtful. Waste was continually present in the form of wasted movement, cost incurred to purchase "missing" equipment, and wasted time and labor due to an unorganized workspace.

The first step was to identify a process improvement activity for a major process performed in the laboratory. Work performed in the laboratory consisted of soil testing and compressive strength testing of concrete and grout samples. The second step was to draw out the AS-IS value stream map (current workflow and identify value and waste activities). Waste that could be eliminated was removed. The third step was re-engineering the process and drawing TO-BE value stream map (improved workflow). The new process was then validated through simulation modeling using Simio[3] modeling software. Once approved by the team, the laboratory was reconfigured.

[3] Simio is a software that allows users to layout processes, run simulations, and analyze results via statistical outputs. For more information, please visit www.simio.com

Figure 4.9 below displays the AS-IS layout of the laboratory for concrete testing.

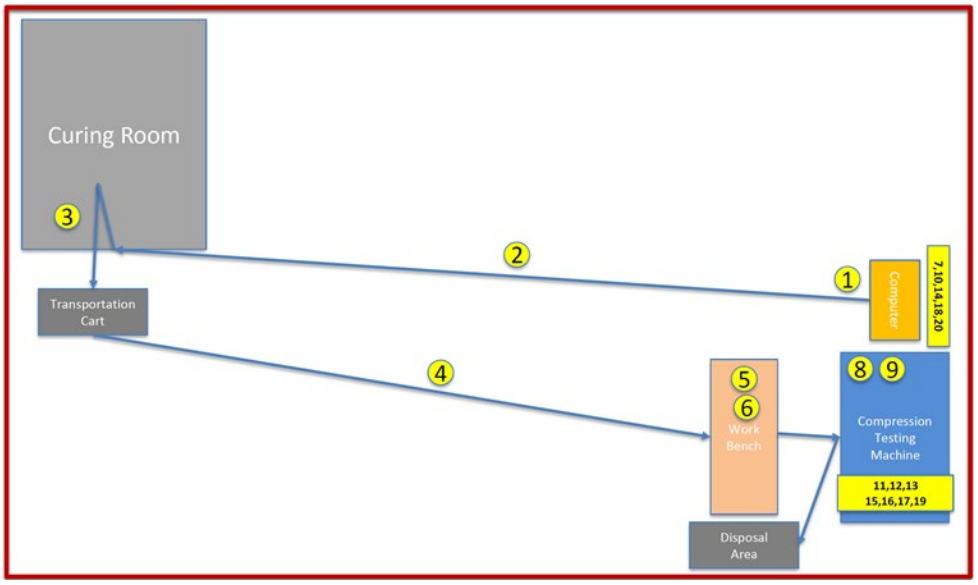

Figure 4.9: AS-IS Value Stream Map Concrete Testing

Figure 4.10 below displays the improved TO-BE layout of the laboratory for concrete testing.

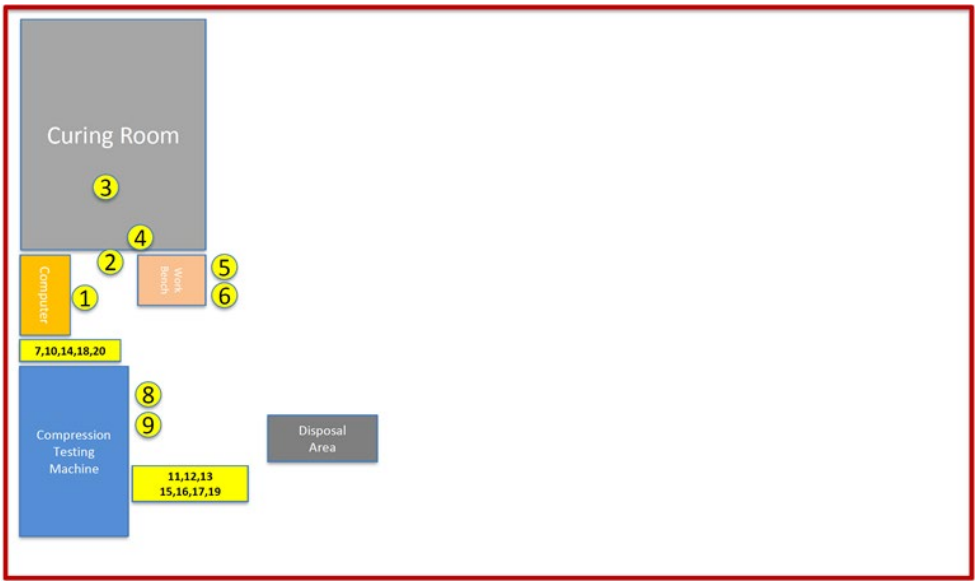

Figure 4.10: TO-BE Value Stream Map Concrete Testing

Compressive strength testing of concrete is a daily activity. Test results are constrained to specific dates due quality acceptance requirements per the building code. Barring any unusual test results, the process is simple and consistent. However, standardization and elimination of waste increased total time available for additional testing required throughout the day. The compressive strength testing of concrete processes improvement saved 31.50 minutes per week per set of five concrete cylinders. The value created in improving the process heavily outweighed the cost to reconfigure the process. The additional time saved could be used to perform additional testing or to perform additional value adding activities for the organization.

Process Improvement Events

Utilizing a team approach, several process improvement events were conducted. Process improvement events were conducted for Concrete Specimen Delivery, Proctor Soil Sample Processing, and Aggregate Wet Sieving. While the goals, objectives, and direction were provided by the engineering manager, it was the actions and experience of the team that truly helped achieve overall improvement. Individual members possessed valuable experience in performing the tasks within the processes and each individual member had their own record of past successes and failures. A team approach was vital in achieving success.

Table 4.2 provide a tabulated summary of process improvements pursued and improvement results.

Table 4.2: Process Improvement Summary

Laboratory Operations - Movement and Procedure Analysis							
Operation	Description of Issue	CURRENT STATE		FUTURE STATE			
		Current Process Breakdown	Average Time (based on observation)	Improved Process	Average Time (based on observation)		
Concrete Specimen Delivery	Concrete cylinder sets assigned a control number when delivered to the laboratory	Stripping	5	Stripping	5		
		Date Received/Printing Report/Assigning Lab Number	10	Marking Specimen	5		
		Marking Specimen	5	Placement in Curing Room	5		
		Placement in Curing Room	5	Movement	0.35		
		Movement	1.2				
		Total	131	min/5 days	76.75	min/5 days	
					Δ	-54.25	
Concrete Specimen Test in Compression	Compression machine located 55 feet from the curing room and 35 feet from disposal containers	Identifying Test Cylinders Due	3	Identifying Test Cylinders Due	3		
		Locate Cylinders and Transport to Machine	5	Locate Cylinders and Transport to Machine	2		
		Measure, Break, & Dispose Cylinder #1	5	Measure Cylinders	5		
		Measure, Break, & Dispose Cylinder #2	5	Break, & Dispose Cylinders	9		
		Measure, Break, & Dispose Cylinder #3	5	Movement	0.42		
		Transport Disposal to Disposal Container	2				
		Movement	0.65				
		Total	128.25	min/5 days	97.1	min/5 days	
					Δ	-31.15	
Proctor Soil Sample Processing	Processing 65 pound soil sample using 8" diameter sieves	Dry Sieving 65 Pound Soil Sample Using 8" Sieves	120	Dry Sieving 65 Pound Soil Sample Using 14.75 x 22.75" Screen	20		
		Sub-sampling, Weighing, Moisturizing, Bagging Sample #1	15	Sub-sampling, Weighing, Bagging	25		
		Sub-sampling, Weighing, Moisturizing, Bagging Sample #2	15	Moisturizing, Sealing	25		
		Sub-sampling, Weighing, Moisturizing, Bagging Sample #3	15	Tare Weighing	5		
		Sub-sampling, Weighing, Moisturizing, Bagging Sample #4	15	Pounding, Extracting, Weighing Sample #1	19		
		Sub-sampling, Weighing, Moisturizing, Bagging Sample #5	15	Cleaning Mold & Assembling	3		
		Pounding, Tare Weighing, Extracting, Weighing Sample #1	22	Pounding, Extracting, Weighing Sample #2	19		
		Cleaning Mold & Assembling	3	Cleaning Mold & Assembling	3		
		Pounding, Tare Weighing, Extracting, Weighing Sample #2	22	Pounding, Extracting, Weighing Sample #3	19		
		Cleaning Mold & Assembling	3	Cleaning Mold & Assembling	3		
		Pounding, Tare Weighing, Extracting, Weighing Sample #3	22	Pounding, Extracting, Weighing Sample #4	19		
		Cleaning Mold & Assembling	3	Cleaning Mold & Assembling	3		
		Pounding, Tare Weighing, Extracting, Weighing Sample #4	22	Pounding, Extracting, Weighing Sample #5	19		
		Cleaning Mold & Assembling	3	Cleaning Mold & Assembling	3		
		Pounding, Tare Weighing, Extracting, Weighing Sample #5	22	Final Cleaning	10		
		Final Cleaning	10	Dry Mass Determination	10		
		Dry Mass Determination	10	Inputting in System	20		
		Convering Values Grams-Pounds	5	Movement			
		Inputting in System	20				
		Movement					
		Total	362	min	225	min	
					Δ	-137	
Aggregate Wet Sieving (Washing)	Aggregate/soil samples washed by manual agitating	Sub-sampling	5	Sub-sampling	5		
		Manual Washing	45	Mechanical Washing	5		
		Dry Mass Determination	5	Dry Mass Determination	5		
		Dry Sieving	25	Dry Sieving	25		
		Movement	1.1	Movement	0.43		
		Total	81.1	min	40.43	min	
					Δ	-40.67	
Soil Samples Processing Station	Soil samples processed in one station						
		Movement		Movement			

Equipment Storage

Storage of equipment and testing supplies was in complete disarray. Following reconfiguration, laboratory equipment was organized and stored in accordance with the five pillars of lean. This re-organization led to a decrease in non-value-added time spent by technicians searching for equipment. The laboratory was able to accurately update inventory, retain essential equipment, and dispose of unneeded equipment. Accurate tracking of equipment also enabled proper maintenance and calibration procedures to take place. Activities that were crucial to maintaining accreditation and certification of the laboratory. The branch was also able to gain additional space to store vehicles and prepare for future work.

Lean Communication

Another key area where process improvement was applied was in communication. An analysis was performed to identify waste and value when communicating with clients and amongst other team members. One key event that was focused on was the preparation and issuing of the daily operation schedule. The daily schedule was a critical component of the success or failure of the branch. Scheduling could become overwhelming given the unpredictable rise and fall in work. The daily schedule served as a tool to dispatch the appropriate certified inspectors with the correct tools required to inspect work at a job site. Errors in the schedule led to waste in the form of excess costs, loss time, loss in quality, and wasted movement. Errors also had a negative effect on customer satisfaction.

To improve the daily schedule, first the daily assignment was set by discipline (concrete, masonry, structural steel etc.). Next, key information was pulled from the client (permit number, quantity of material, expected time etc.). Then, the inspector/technician was dispatched with the correct information and could properly prepare for the assigned work. Scheduling efficiency was

now also improved as inspection times could be better estimated, adjustments easily made, and inspectors could be scheduled for multiple jobs. This minimized the stress and challenge of an unpredictable workload. Value was created for the customer in the increase quality of work and reports. Value was created for the organization in an increase in operational efficiency.

Figure 4.11 below displays the original schedule assignment prior to improvement.

Thursday, April 30, 2020

DAY OFF:

PROJECT #	WO #	PROJ. NAME LOCATION	TYPE OF INSPECTION	TIME SCHEDULE	Tech	Called In By	DATE CALLED IN	TIME CALLED IN	CANCELLED	NOTES
1815	97	FEDEX RS	SOIL	7AM	AHMAD					
1413	355	CUMULUS	WATER PROOF	7AM	DIRK					
1812	89	DCX1 AMAZON RS	CPU	9AM	ERIK					
6888	556	LATC	CONCRETE 30CY	11AM	MAGED		4/29	BRAD		
1615	65	FKC MURRIETA	SOIL	8AM	JUSTIN		4/29	DAN		
SUBCONTRACTOR										
1818	46	ROSS PUMPHOUSE	WELDING	NOON	KRAZAN					
1861	6	DCX7 AMAZON TOR	CONCRETE 30CY	8AM	JE&B		4/29	PAUL		
1834	49	DCX2 AMAZON MV	EPOXY DOWEL	9AM	JE&B		4/29	CHRIS		
1818	47	ROSS PUMPHOUSE	REBAR	8AM	KRAZAN		4/29	STEVE		

Figure 4.11: Original Schedule Assignment

Figures 4.12 to 4.15 below display different examples of scheduling assignments.

Primary Inspector:	Victor Hernandez
Secondary Inspector:	
Project Name:	Public Storage College Station
Permit Number:	BLD-1-2022
Contractor:	ACE Contractors
Work Order:	00662022-2
Location	Generator Pad
Inspection Type:	1939- Rebar
Inspection Type:	
Time:	8:00 AM
Site Contact:	Don Miller (909) 794-0168
Address:	1234 Victory Lane College Station, TX
Notes:	Estimated 4 hours, Rebar Installation is Complete

Figure 4.12: Rebar Inspection Work Order Card

Primary Inspector:	Victor Hernandez
Secondary Inspector:	
Project Name:	ARCO AM/PM
Permit Number:	BLD-2-2022
Contractor:	American Steel
Work Order:	00662023-1
Location	Fueling Station Canopy/HSS Columns
Inspection Type:	1267-Structural Steel
Inspection Type:	
Time:	8:00 AM
Site Contact:	Clint Rider (408) 343-6904
Address:	1234 Freedom Drive College Station, TX
Notes:	Estimated 4 hours, Welding Base Plate to (4) HSS Columns

Figure 4.13: Welding Work Order Card

Primary Inspector:	Victor Hernandez
Secondary Inspector:	
Project Name:	Public Storage College Station
Permit Number:	BLD-1-2022
Contractor:	ACE Contractors
Work Order:	00662022-3
Location	Generator Pad
Inspection Type:	1009-Concrete
Inspection Type:	
Total CY Placed:	150
Approved Mix Design:	Mix# 2022-05-07
Time:	8:00 AM
Site Contact:	Don Miller (909) 794-0168
Address:	1234 Victory Lane College Station, TX
Notes:	Estimated 4 hours, Concrete to be placed via tailgate method.

Figure 4.14: Concrete Placement Work Order Card

Primary Inspector:	Victor Hernandez
Secondary Inspector:	
Project Name:	ARCO AM/PM
Permit Number:	BLD-2-2022
Contractor:	American Steel
Work Order:	00662023-2
Location	Fueling Station Canopy/CMU Columns
Inspection Type:	1939-Rebar
Inspection Type:	1012-Masonry
Total CY Placed:	10
Approved Mix Design:	Mix# 1960-02-05
Time:	8:00 AM
Site Contact:	Clint Rider (408) 343-6904
Address:	1234 Freedom Drive College Station, TX
Notes:	Estimated 4 hours, Grout for 1st lift (4 feet)

Figure 4.15: Masonry Work Order Card

Figure 4.16 below displays an assignment card issued to an inspector for concrete placement observation and inspection. Value is created by critical project information (Permit #, Contractor, Location, Total Cubic Yards, and Approved Mix Design) being pulled from the customer making the request. Value is created for the dispatcher by having the necessary information (Project Address, Estimated Time, and Notes) to properly schedule a properly certified and equipped inspector. Value is created for the inspector by providing the information to fully complete a special inspection report. Value is created for the organization by ensuring the correct cost codes are entered into the billing system. Total value is created by setting the conditions for an accurate and fully completed special inspection report increasing quality, customer satisfaction, and return on management.

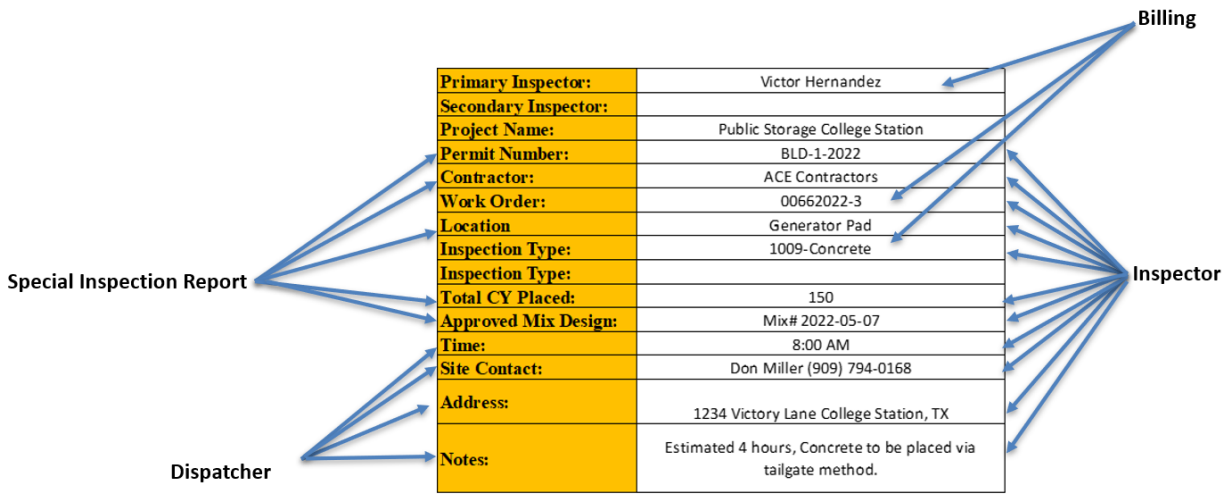

Figure 4.14: Concrete Placement and Observation Inspection

Total Value = Accuracy and Full Completion of work = Increased Quality, Increased Customer Satisfaction, Increased ROM

Figure 4.16: Value Creation

Discussion

A key aim of management is the effective and efficient use of resources. Lean principles and practices, IDEF0 functional modeling, and simulation modeling provide valuable tools to improve existing business processes. For organizations to be efficient, waste must be minimized. Furthermore, the elimination of waste must not be constrained to only physically productive processes. Administrative, physical, and technical processes must all be reviewed and targeted for process improvement. Process improvement is never ending and should reassessed with increase in proficiency, experience, and technology. A team approach should be employed for process improvement to take advantage of differing experience and points of view and to maximize the creation of value.

CHAPTER V

HUMAN CAPITAL

Inexperience and Deficiencies in Training

At the end of the summer in 2021, the branch had achieved many milestones. First, guidance and direction had been communicated and organizational goals and objectives had been established. The branch had become structured and organized. A business strategy had been drafted to achieve financial growth. Management control systems had been implemented to achieve congruence between the branch and its employees. A tool had been developed to manage, measure, and evaluate strategic progress. Operational efficiency had been improved through continuous process improvement. However, the branch was still composed of a very inexperienced team. For the branch to continue to succeed, training was required to increase technical expertise and to sustain the creation of customer value. The fall of 2021 semester would mark the start of these efforts.

In the current state of the branch, project management was primarily performed by the branch manager and geotechnical engineer. The branch manager oversaw construction services, and the geotechnical engineer oversaw geotechnical projects. Both individuals collaborated when mutual work intersected. For the proposed business strategy to be successful, an effective project management program was needed to handle an increase in workload. An effective project management training program was required to prepare junior staff to manage projects through the project life cycle. This training program would need to combine academic knowledge with field experience.

In multiple situations, project managers had been unprepared when heading to oversee projects in the field. In the summer of 2021, the team was tasked with observation and testing of

cement treated soil for a building pad that was having foundation issues. This was a first for everyone on the team. The team studied the appropriate references and study materials, but it was still a challenge to oversee and manage the work in front of the project owner and general contractor. In a separate situation, an inexperienced project manager severely underestimated the total required hours for welding inspections for a water tank. The project manager had no welding experience. The estimate was so low, that the final contract amount exceeded the established budget by a large margin. The mistake severed the relationship with a long-term client, and it led to a termination of follow-on work.

Geotechnical engineering is a niche within the engineering community. Young engineers arrive in the industry having only minimal knowledge. Very rarely do they arrive with field experience. True learning occurs through hands on work in the field. Within the branch, the geotechnical engineer was the sole proposal writer and estimator for geotechnical work. As the branch initiates the growth of the geotechnical team, training is required for incoming staff engineers in the areas of sub-surface site investigations, geotechnical testing, estimating, report writing, and project management.

Special inspectors are certified through the International Code Council (ICC) through a series of written exams in reinforced concrete, structural masonry, soils, fireproofing, and structural steel (High Strength Bolting and Welding). Inspectors must pass a written examination on plan reading and a second exam on interpreting the International Building Code (IBC) for each discipline to achieve full certification. In some cases, additional certification is required through the American Concrete Institute (ACI) for inspections involving material sampling, as is the case for reinforced concrete and structural masonry. While the special inspector training and certification is detailed, it was not sufficient on its own. Most of the external training available

was geared towards passing the test, and not in increasing inspector experience for work in the field. Field experience and practical application are essential. Furthermore, inspectors must also be knowledgeable in construction means, methods, and employment of construction equipment.

There have been several cases in the field where an inspector has failed to perform an inspection properly, caused hardship for the contractor, and lost the trust of the project owner. In these situations, the branch has always been asked to remove the inspector from a project completely. This results in unwanted tension between the branch and the project team. In the cases of proven negligence, the branch has been forced to absorb a portion of additional costs incurred. In the most extreme cases, the branch has lost the opportunity to perform additional follow-on work.

The primary duties of field technicians are to prepare and collect samples in the field, assist with laboratory testing, document test results, and to issue reports. The current policy was to provide newly hired technicians with on-the-job training. This training was backed up by company developed training through the corporate learning management system (10X Training). When possible, technicians would be sent to attend formal training and certification through the American Concrete Institute (ACI). Although the best effort was put forth, the training program was lacking in formality, structure, and organization. As a result, the branch was incurring unnecessary risk and liability.

In the late summer of 2021, a technician was measuring slump during the concrete placement for a wall footing. The slump failed. The failure was reported to the site foreman. The work continued without incident or further communication. Upon review by the structural engineer, the work was rejected, and the branch had to cover the additional expense for coring

the concrete and performing a petrographic analysis. Although only a $10,000.00 cost, the business relationship with the project owner and project team was severely damaged.

A Formal Training Plan

As stated by Matt Stevens in *The Construction MBA: Practical Approaches to Construction Contracting*, a firm must win multiple times to win one project. First, the firm must win the opportunity to perform the work by possessing the required qualifications. Second the firm must win the opportunity to perform the work by winning over the client. Third, the firm must win the client by providing value throughout the project life cycle. The branch's bid for success is the people. A large investment is required in human capital. The people are the backbone of the branch and the conduits for the work required to achieve success. For the people to succeed, a formal training program was required.

The primary objective was to create a formal training program with the following conditions. First the training program needed to be organized and structured, detailed, and manageable. Second, the training program needed to be composed of academic instruction reinforced with practical application and sustained through periodic evaluation. Third, the program needed to be easily accessible. The source material for the training program would come from current industry codes and standards and would incorporate existing corporate developed training programs. The training program would take advantage of lessons learned compiled from past successes and failures.

Project Management

The project management training programs I and II were developed for junior project managers to be able to execute a new construction services and geotechnical projects from the bid opportunity identification stage through project completion. Project management training program I was aimed at project managers overseeing special inspections and material testing. Project management training program II was aimed at project managers overseeing geotechnical work. The training was developed with the topics below.

Table 5.1: Project Management Training Program I

Project Management Training Program I	
Topic	**Method**
Introduction to Special Inspection and Construction Material Testing	Lecture
Introduction to Geotechnical Engineering and Earthwork Activities	Lecture
Estimating for Special Inspection and Construction Material Testing	Lecture
Bid Proposal	Lecture
Contracts	Lecture
Project Set-Up	Lecture
Special Inspection Report Review	Lecture
Material Testing Report Review	Lecture
Dealing with Non-Conformances	Lecture
Project Budget Management and Change Orders	Lecture
Final Project Letter & Closeout	Lecture

Table 5.2: Project Management Training Program II

Project Management Training Program II	
Topic	**Method**
Introduction to Geotechnical Engineering and Material Testing	Lecture
Estimating for Sub-Surface Investigations and Geotechnical Work	Lecture
Bid Proposal (Geotechnical)	Lecture
Contracts	Lecture
Project Set-Up	Lecture
Special Inspection Report Review	Lecture
Material Testing Report Review	Lecture
Dealing with Non-Conformances	Lecture
Building Pad Certifications	Lecture
Rough/Final Grading Certifications	Lecture
Final Project Letter and Closeout	Lecture
Project Budget Management and Change Orders	Lecture
Final Project Letter & Closeout	Lecture
Profitability Review	Lecture

In addition to the training program above, project managers are also required to earn the certifications tabulated below.

Table 5.3: Project Manager Certifications

Project Management Certifications	
Certification	**Agency**
Asphalt Paving Inspector	Asphalt Institute
Concrete Testing Field Grade Technician I	American Concrete Institute
Concrete Flatwork Associate	American Concrete Institute
Concrete Quality Technical Manager	American Concrete Institute
Soils Special Inspector	International Code Council

Special Inspectors

Training provided through industry certifications provided a good foundation for new special inspectors. However, the training was not paired with a performance examination component. Therefore, a training program needed to be created to prepare inspectors for work in the field and to interact and properly communicate with clients. The training program was developed with the topics tabulated below.

Table 5.4 Special Inspection Training Program

Special Inspector Training Program	
Topic	**Method**
Duties and Responsibilities of the Special Inspector	Lecture
Pre-Inspection Procedures	Lecture
Inspection Procedures and Client Communication	Lecture
Trouble shooting in the Field	Lecture
Non-Conformance Reporting and Documentation	Lecture
Data Entry and Report Completion	Lecture
Job Codes and Time Entry	Lecture
Project Mapping and Documentation	Lecture
Project Close-Out	Lecture
The Soils Special Inspector	Lecture
The Concrete Special Inspector	Lecture
The Masonry Special Inspector	Lecture
The Structural Steel Special Inspector	Lecture

To reinforce instruction, special inspectors were required to perform practical examinations for the tabulated activities below.

Table 5.5 Special Inspector Practical Examinations

Special Inspector Practical Examinations		
Test Method	**Reference**	**Frequency**
Nuclear Gauge Test Method	ASTM D6938	Quarterly
Field Sampling of Concrete	ASMT C172, C143, C39, C94	Quarterly
Field Sampling of Grout	ASTM C1019	Quarterly
Field Sampling of Non-Shrink Grout	ASTM C1107	Quarterly
Sand Cone Test Method	ASTM D1556	Quarterly

Field Technicians

Laboratory accreditation and certification are a must to be able to operate in the special inspections and construction material testing industry. Clients rely on the data provided by laboratory results to construct their projects. Laboratory personnel must fully understand established and accepted test methods, how to perform test, how to analyze and interpret data, and how to issue reports. An increased efficiency in laboratory operations, leads to quicker project turn over. The training program below was developed to meet the above-mentioned objectives.

Table 5.6 Field Technician Training Program

Field Technician Training Program		
Topic	**Reference**	**Method**
Introduction to Construction Material Testing	SOP	Lecture
Field sample collection, reporting, and chain of custody	SOP	Lecture
Sample storage procedures	SOP	Lecture
Equipment calibration procedures and documentation	SOP	Lecture
Soil classification	ASTM D2487	Lecture
Sieve Analysis (ASTM D-422)	ASTM D-422	Lecture
Proctor Testing (ASTM D-1557/D-1556)	ASTM D1557/D1556	Lecture
Atterberg Limits (ASTM D4318)	ASTM D4318	Lecture
Moisture Density (ASTM D-2216)	ASTM D2216	Lecture
Concrete Strength Testing	ASTM C39	Lecture
Concrete Coring and Strength Testing	ASTM C1604	Lecture
Grout Strength Testing	ASTM C1019	Lecture
Non-Shrink Grout Testing	ASTM C1107	Lecture
Capping Samples for Testing	ASTM C617	Lecture

To reinforce instruction, technicians were required to perform practical examinations on a quarterly basis. Additionally, technicians will be required to attain the below certifications within a 1-year period.

Table 5.7: Field Technician Certifications

Field Technician Certification Program	
Agency	**Certification**
American Concrete Institute	Aggregate/Soils Base Technician
American Concrete Institute	Aggregate Testing Technician – Level 1
American Concrete Institute	Aggregate Testing Technician – Level 2
American Concrete Institute	Concrete Field-Testing Technician Grade I
American Concrete Institute	Self-Consolidating Concrete Testing Technician
American Concrete Institute	Concrete Strength Testing Technician
American Concrete Institute	Concrete Laboratory Testing Technician Level 1
American Concrete Institute	Concrete Laboratory Testing Technician Level 2
American Concrete Institute	Masonry Field Testing Technician
American Concrete Institute	Masonry Laboratory Testing Technician

Discussion

The creation of organized training programs was vital to the investment in human capital necessary for the success of the branch. In addition to providing organized training, there was also a need to develop and instill a professional culture within the branch. Step one was developing the training programs and establishing the required certifications. Step two was creating a professional reading program enabling intellectual growth and attainment of experience through the success and failures of others. Step three was requiring personnel to provide monthly presentations on subjects/events occurring in the industry. The objective of this three-step approach was to instill a sense of commitment to the profession, people we service, and to each other.

Engineering is and will remain a technical profession. For an engineering organization to succeed, its human capital must possess the required technical expertise and competency. Industry training is well established and regularly updated. However, existing training is not without its shortfalls. Organizations must design and implement their own training programs tailored to their organizational goals and objectives. Training must be continuous and updated as needed. While an indirect cost, the cost benefits of training outweigh the cost of litigation and loss of work. Training enables organizations to continue to provide value and to remain viable.

Organizations rely on human capital to achieve organizational goals and objectives. Training equips people with the knowledge and skills to carry out those organizational goals and objectives. An investment in human capital leads to an increase in employee loyalty, satisfaction, and retention. As a result, an organization can create stability and set the conditions for organizational growth. Organizational growth combined with an increase in technical expertise leads to financial growth. Without proper training, organizational goals and objectives cannot be achieved.

CHAPTER VI

ORGANIZATIONAL DESIGN

The spring 2022 semester marked the start of the organizational design efforts. In order for organizations to achieve organizational goals and objectives, a proper organizational structure must be in place (Simons, 2005). The organizational structure should be designed to minimize dysfunction and handle an appropriate level of complexity. The organizational structure should be dynamic and be able to evolve as external and internal environment conditions change. The organizational structure should create an environment for employee growth and achievement. Without proper organizational design, achievement of success will be limited. Cost reduction and operational efficiency goals cannot be achieved by poor organizational design.

Dysfunction

In order for an organization to succeed, dysfunction must be minimized. While people are critical to attaining operational efficiency, management is responsible for developing and implementing the changes needed to remove dysfunction. Amongst the branch and its staff, there were five main dysfunctions that needed to be improved. The first major dysfunction was work overload of the geotechnical engineer. A major portion of work performed by the branch was field observation and inspection of earthwork. However, the branch was not always the geotechnical engineer of record. Therefore, the correct geotechnical engineer of record needed to be consulted when problems or issues arose in the field. Inspectors were instructed to communicate with the project manager, who would then serve as the liaison between the inspector and the appropriate geotechnical engineer of record. The geotechnical engineer was removed of any projects where the branch was not the geotechnical engineer of record.

The second major form of dysfunction was an acceptable amount of late laboratory work. Late laboratory work meant a decrease in quality, delay in project schedule, and decrease in customer satisfaction. The branch had only one laboratory manager, and he was easily overwhelmed. To achieve a solution, a cross training plan was implemented, some aspects of laboratory testing, and routine testing were delegated to properly trained inspectors and technicians. For example, daily concrete compressive strength tests could be performed by any certified inspector. The initial steps of a proctor test could be started by any certified inspector. A moisture tests could be completed fully by the inspector who collected the sample and performed the sand cone test. Geotechnical laboratory testing was delegated to geotechnical project engineers. The project engineers would sample and transport soil samples post-drilling to the laboratory, and the following day they would start performing testing. These actions enabled the laboratory manager to focus on more advanced testing and to properly manage laboratory operations. This also led to the creation of a daily laboratory operations schedule.

The third major form of dysfunction involved properly scheduling of inspectors for projects. The initial dispatcher possessed no construction experience and made minimal effort to improve. For an inspector to be properly dispatched, the inspector needed to be registered with the authority holding jurisdiction, properly certified and qualified, and equipped with the correct tools and equipment. For times where an incorrect inspector was scheduled or an inspection was missed, the branch was liable for the costs. To achieve a solution, the dispatch role was redesigned and assigned to a senior inspector. The senior inspector possessed a wealth of experience and knowledge. They were also knowledgeable about current rules governing the local jurisdiction. The dispatcher could still perform inspections as required, although on a more

limited basis. Additionally, this staff position allowed the senior inspector to assist with reviewing project final letters prior to final review and approval by a professional engineer.

The fourth major form of dysfunction was proposal overload. Requests for work often came in on an irregular basis. Most often than not, they came in waves and overwhelmed the one to two estimators in the branch. To achieve a solution, everyone in the branch was trained to prepare proposals for both special inspections and material testing and geotechnical work. The team was trained in estimating, proposal writing, pricing, and contracts. Subject matter experts were consulted as needed. For example, for projects with a large volume of welding inspections, the certified welding inspectors were brought in to assist in the estimate. Final review and approval remained the responsibility of the branch manager and geotechnical engineer. As a result, the team was able to meet customer demand.

The fifth major form of dysfunction was a lack of dedicated project management. The responsibility for project management rested solely with the branch manager and geotechnical engineer. As the workload increased, this situation become chaotic. It was not uncommon for the branch to have 40-60 projects per month to oversee. Furthermore, lack of project management created inefficiency in project administration. Excess and no-value added time was spent finding contracts, purchase orders, and additional required administrative documents. As a result, this would lead to inefficiencies in the payment collection cycle. To achieve a solution, select employees were trained in project management. Junior managers were assigned small scale projects, and the scale of projects increased as experience grew. Developing and implementing a project manager program provided multiple benefits for the organization. Customer satisfaction was increased, operational efficiency was improved, and employees were given an opportunity to pursue professional achievement.

Complexity

The Conant-Ashby Theorem states that every system should be able to self-regulate and to be able to withstand the variety imposed by its environment (Lassl, 2018, p.50). In regard to organizational design, the structure of the organization should be able to handle complexity. However, it is up to the organization to set the parameters of complexity that will increase or decrease variety. Organizations who create an environment of over complexity will struggle to achieve organizational goals and objectives.

At the start of the internship some very aggressive and optimistic goals and objectives were established. The branch had set goals to earn certification and accreditation for the laboratory through multiple agencies which would lead to future work. Two important agencies were the California Division of the State Architect (DSA) and the California Department of Transportation (Caltrans). DSA accreditation would allow the branch to start bidding on educational facility projects (K-12, University). Caltrans projects would allow the branch to start bidding on major state transportation projects. Throughout the course of the internship, a lot of effort was focused on preparing the laboratory for accreditation events. Unfortunately, only the DSA accreditation was achieved. The branch was not able to achieve the required Caltrans certifications.

After performing a review of the previous goals and objectives it was determined that the branch would not further pursue DSA or Caltrans projects. The primary reason was simple. The branch was not truly capable of executing those projects. The branch had no experience in those types of projects, inspectors were not properly certified, and the company brand was not well known. The execution and coordination of these types of projects would be demanding. A decision was made to maintain DSA accreditation, as this was still beneficial for the branch. In

the end, the branch decided to refocus efforts on projects that the company was truly fit for. For the branch, that was serving clients in the private commercial sector.

Organizational Structure

Taking into consideration the branch's core business processes, while minimizing dysfunction and complexity, the below organizational structure was developed as shown in figure 6.1.[4] The organizational structure was divided up by functional sections (Business Development, Administrative Support, Geotechnical, Special Inspection, and Material Testing) with direct reporting to the branch manager. Operational support was placed between the functional sections and the branch manager, allowing the Laboratory Manager, Field Manager, or Geotechnical Engineer to assist as needed with operational activities. of the functional sections.

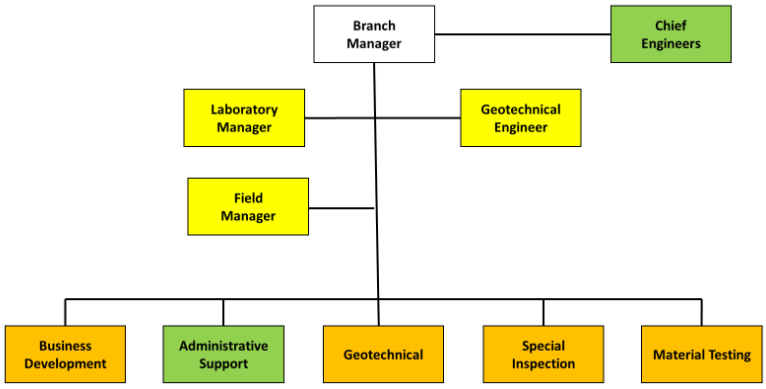

Figure 6.1: Branch Organizational Structure March 2022

[4] In figure 6.1, management is represented in white, operational support personnel are represented in yellow, administrative support units are represented in green, and operational units are represented in orange.

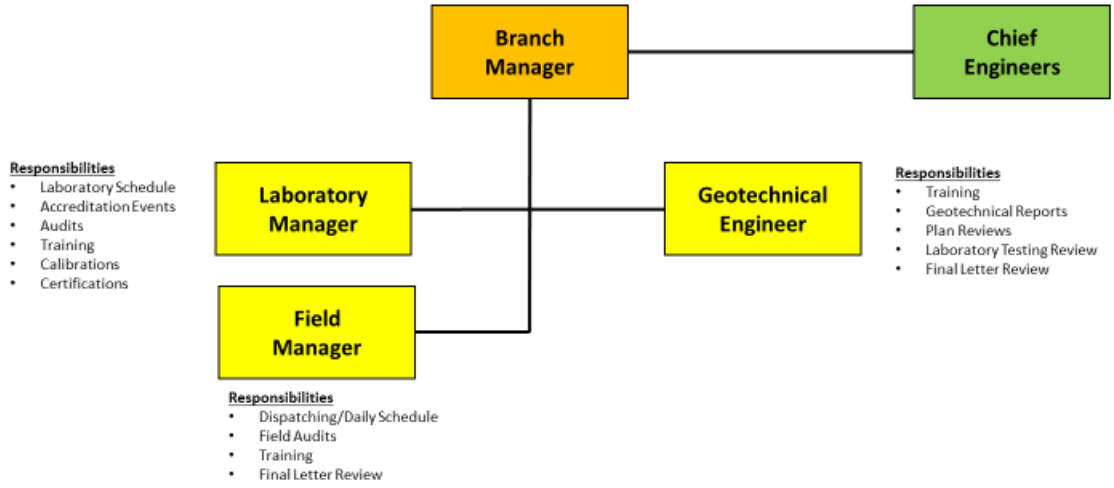

Figure 6.2: Branch Management Structure March 2022

Figure 6.2 above represents the Branch Management Structure. The removal of the Laboratory and Field Managers, and Geotechnical Engineer from the functional sections, greatly improved time efficiency. The geotechnical engineer was now able to focus on more in-depth geotechnical work that required senior expertise, but also provided greater revenue. The creation of the field manager position, allowed for improved dispatching and provided an experienced inspector (senior inspector) to assist with project coordination and project management. The laboratory manager was removed from getting too involved with laboratory testing and being able to focus on maintaining third party accreditations, calibrations, and audits. More importantly, all three operational support personnel could focus on planning and implementing training to increase organizational capacity. The chief engineers remained at the disposal of the branch manager when projects required senior expertise.

Figure 6.3 below displays the organization and functions of the Business Development Section.

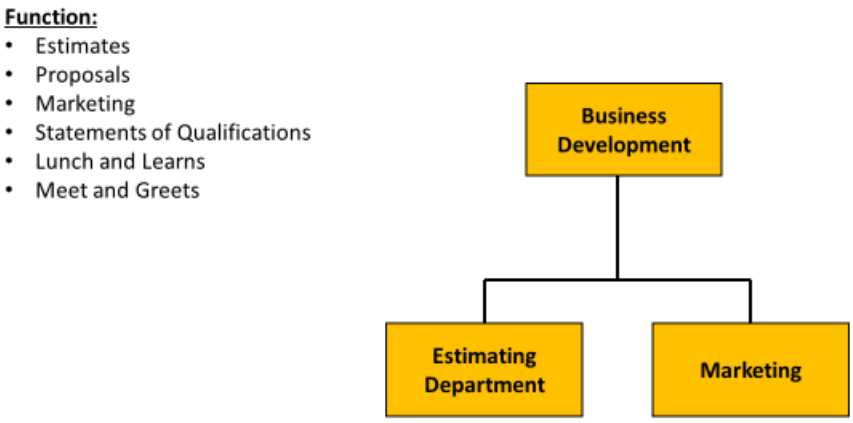

Figure 6.3: Business Development Section

To provide for a full-time capacity to generate work, a Business Development Section was implemented. The section was responsible for seeking out work through daily review of bidding programs, estimating, proposal preparation, and historical data collection to assist in future bids. Additionally, the section was responsible for preparing Statement of Qualifications, planning, and implementing lunch and learn sessions with prospective customers, and networking with industry professionals.

Figure 6.4 below displays the organization and functions of the Administrative Support section.

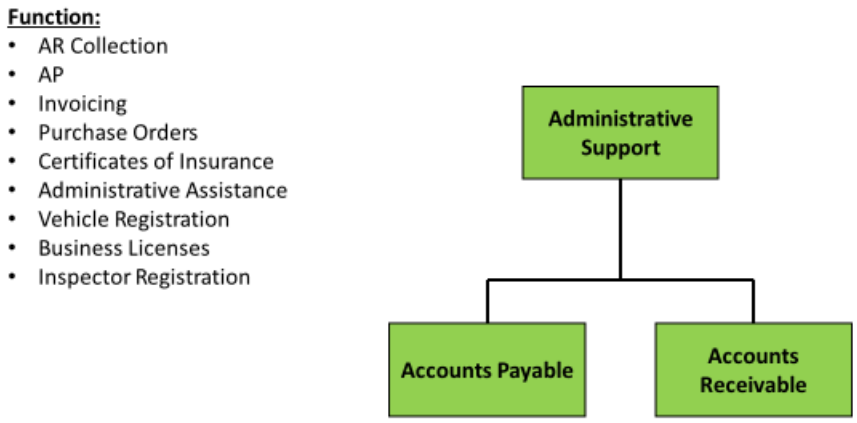

Figure 6.4: Administrative Support Section

While operating in an efficient manner the Administrative Support section ensured the branch's cash flow remained unimpeded, invoices were paid, and that all required licenses and certifications were up to date. Efficiency in administrative processes enabled management to truly focus on value adding work.

Figure 6.5 below displays the organization and functions of the Geotechnical Section.

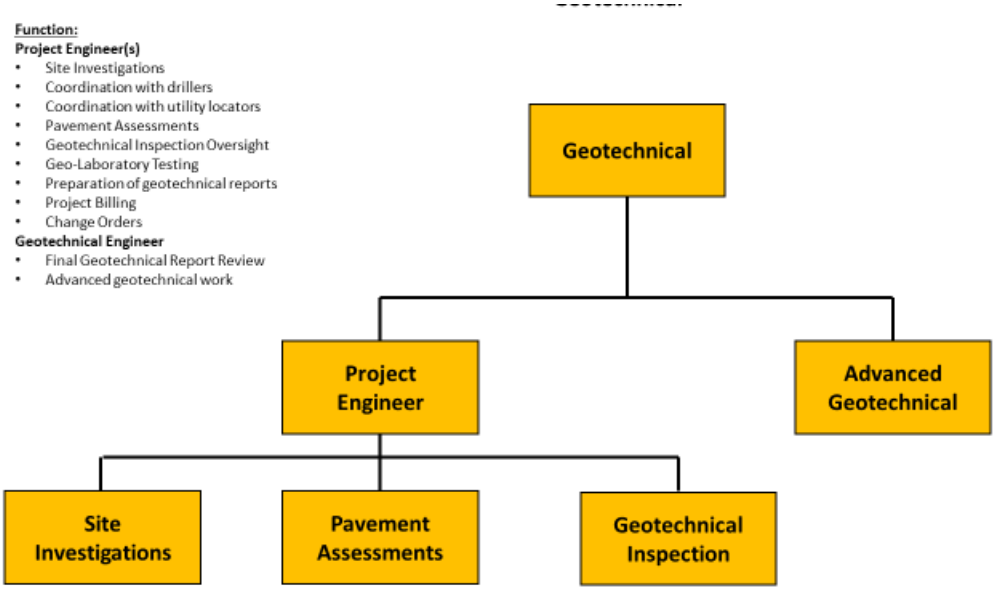

Figure 6.5: Geotechnical Section

The Geotechnical Section was divided up into two primary lines. The first line was supervised by project engineers who would be responsible for estimating, proposal development, and executing basic geotechnical work. This was performed under the overall supervision of a registered engineer but allowed the geotechnical engineer to focus on larger scale projects. Afterall, it was a more economical use of time to have the geotechnical engineer focus on a foundation design for a new interstate highway bridge versus four 20-foot borings for a new wooden framed coffee shop.

Figure 6.6 below displays the organization and functions of the Special Inspection Section.

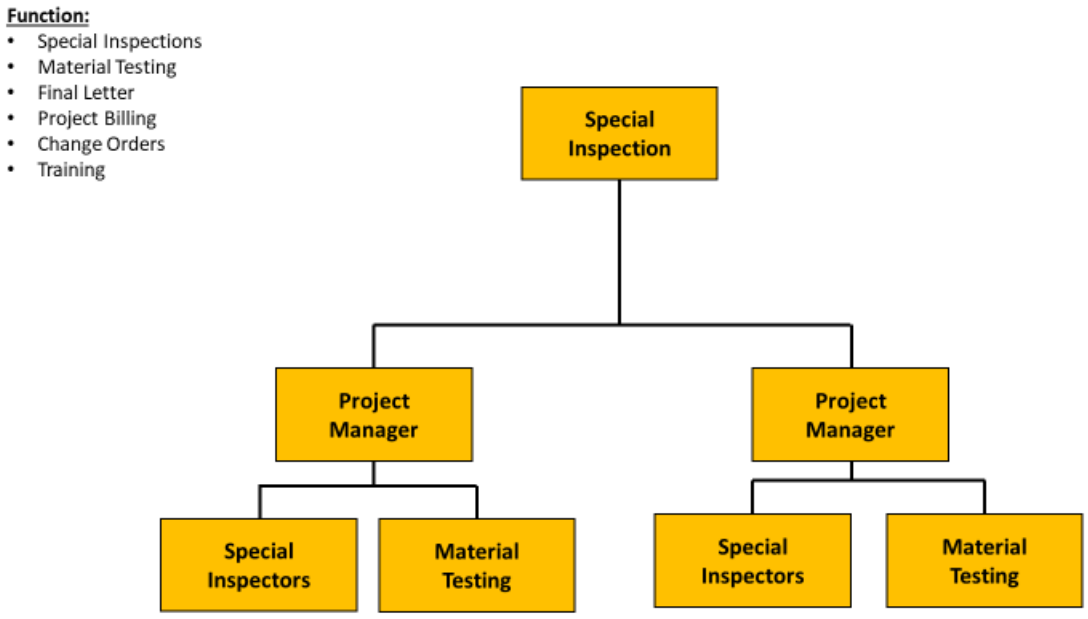

Figure 6.6: Special Inspection Section

The project manager position was added for the Special Inspection Section. This allowed for unity of command and unity of effort. A single individual would now oversee daily reports and testing reports and remain the main customer point of contact. The branch manager, laboratory manager, and geotechnical engineer would provide support as needed. The project managers would be responsible for ensuring projects were correctly staffed, the correct material testing was scheduled, and for ensuring projects stayed within budget. Project managers were also responsible for project billing and for proper project documentation.

Figure 6.7 below displays the organization and functions of the Material Testing Section.

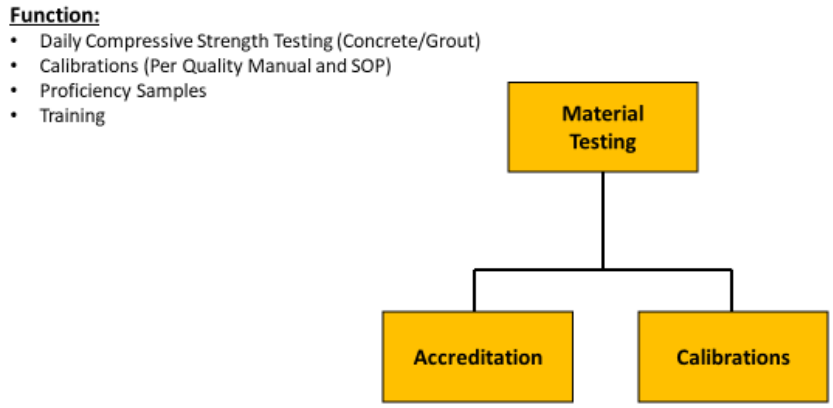

Figure 6.7: Material Testing Section

The Material Testing Section was designed to provide dedicated personnel to perform daily laboratory testing and required calibration activities. Per the company training plan (Chapter 5), inspectors and technicians would be cross-trained. The ability to perform testing in the laboratory, allowed inspectors and technicians to work full days and for the laboratory manager to focus on more critical items.

Discussion

The organizational structure designed and implemented by the branch allowed the organization to properly function and to improve overall operational efficiency. Dysfunction was minimized. The organizational structure was tailored to meet the capacity and capability of the branch. The organizational structure remained a top-down structure with decision making authority remaining at the top of the organization. This was necessary due to the limited experience of the team. The creation of new positions allowed for professional growth and development, providing a path for employees to advance. Cross-training allowed for individuals to fill multiple positions until the branch grew and became fully staffed. Most importantly the

improved organizational structure re-balanced the branch workload increasing time available for key personnel to work on value adding tasks.

Figures 6.8 and 6.9 below provide a graphical representation of the change in workload for key personnel in the branch from Pre-Organizational Design to Post-Organizational Design.

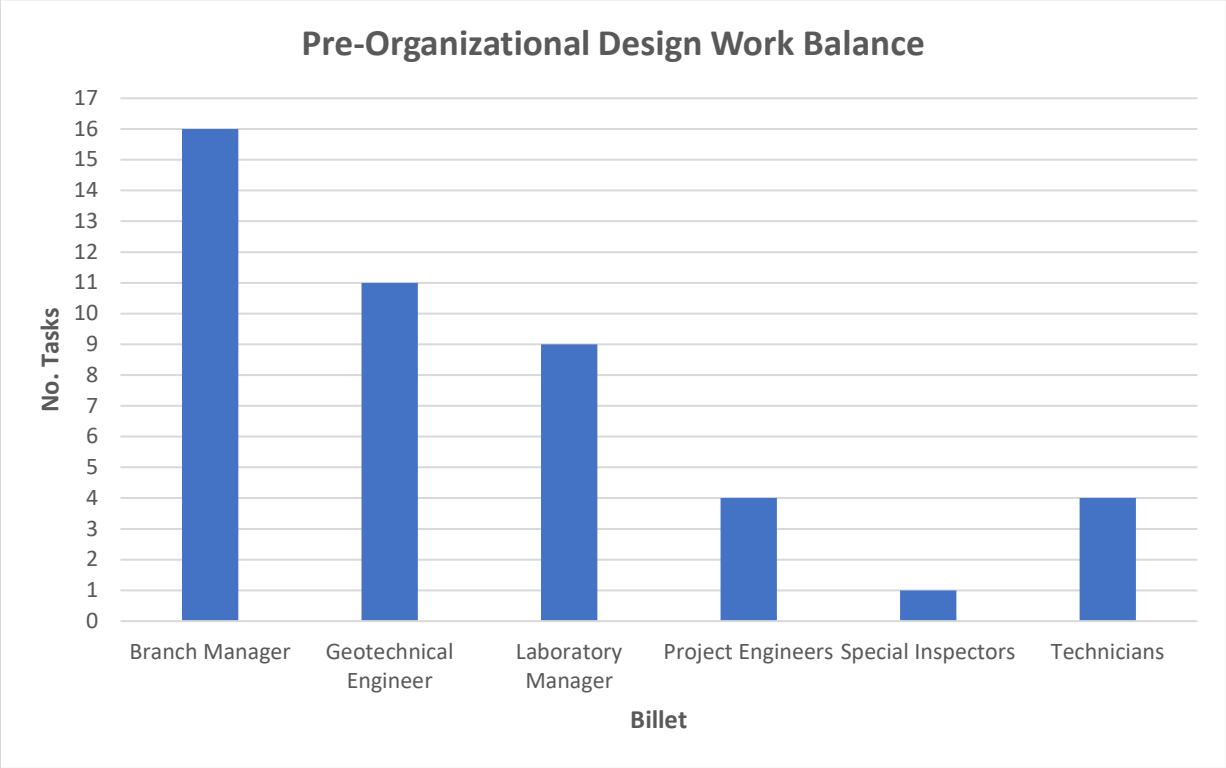

Figure 6.8: Pre-Organizational Design Work Balance

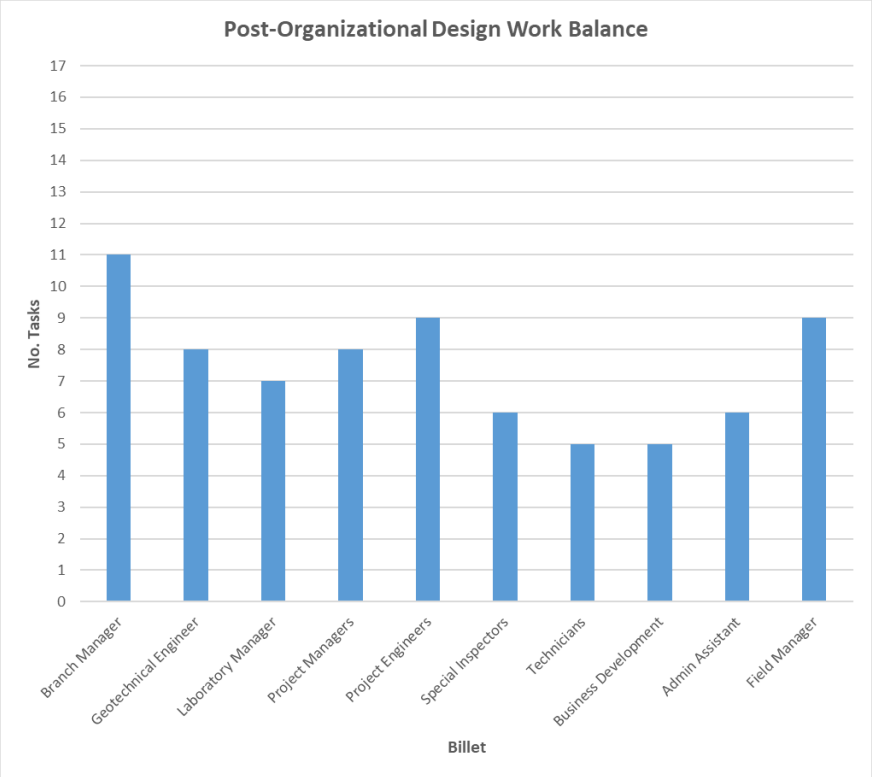

Figure 6.9: Post-Organizational Design Work Balance

CHAPTER VII

THE VIABLE SYSTEM MODEL

In order to survive, organizations must remain viable (Beer, 1966). To attain viability, the branch was analyzed in accordance with the Viable System Model developed by Stafford Beer. The Viable System Model consists of five systems. System one represents the primary activities concerned with performing key organizational functions. For the branch, those primary activities were the activities performed by the Administrative Support Section, the Geotechnical Section, Special Inspection Section, and Material Testing Section. System two represents the communication channels that allow sections within system two to communicate amongst each other and with system three. System two consisted of weekly and daily meeting, weekly progress reports, and financial reports. System three represents a command-and-control structure that regulates system one and communicates with systems four and five. The branch manager made up system three and was the branch's liaison to higher level leadership. System four represents an outward looking function responsible for ensuring the organizations is adapting and remaining viable. The Regional Vice President made up system four. System five presents a function responsible for establishing official organizational policies and equipping the organizations with the appropriate level of resources. System five was filled by the corporate level leadership.

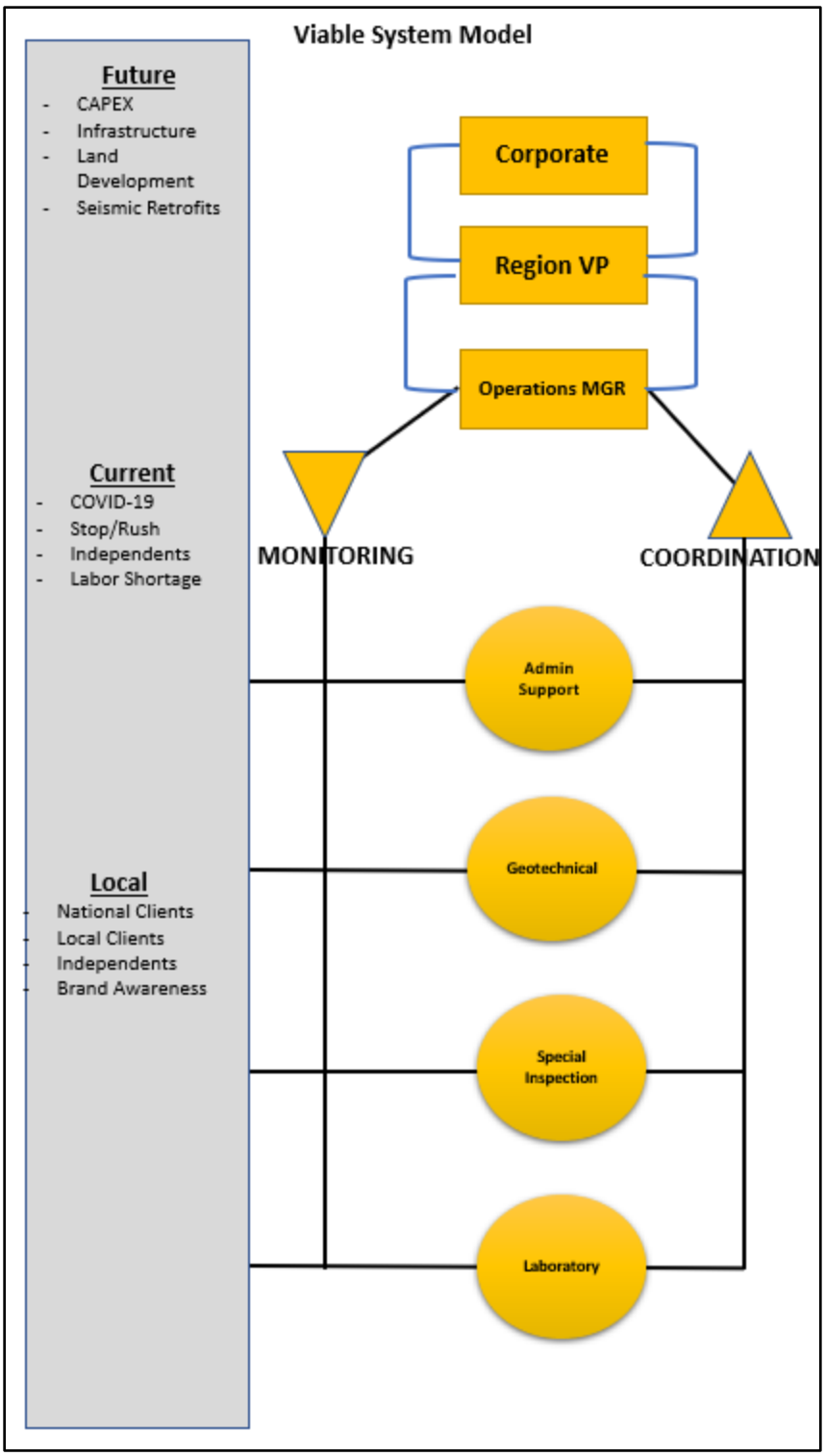

Figure 7.1: The Viable System Model[5]

[5] Figure 7.1 represents an adaptation of the Viable System Model as it applies to the operations of the branch.

The Environment

An organization is susceptible to its environment. Although an organization cannot change its environment, it must survive it. As a result, an organization must have the proper procedures to continue to observe, analyze, and predict changes. The organization must be able to adapt to change in a timely manner. For the branch, the environment consisted of three primary categories over the course of the professional internship. The Future environment consisted of future construction projects indicating where, when, and how the branch needed to prepare to be successful. National client work was driven by capital expenditure and capital project programs. Future state and municipal work were driven by needed improvements in current infrastructure. Future regional work consisted of trends in land development within the state. The current environment consisted of the impact of the COVID-19 virus, as well as local market conditions. The pandemic had shut projects down and delayed the start of future work. As life commenced to return to the new normal, clients were in a rush to finish projects. In California, independent contractors were still a primary source of competition and offered clients a cheaper source of labor, thus preventing an increase in pricing of services. As experienced by multiple industries, labor shortage was a real problem. The local environment consisted of current projects and current customers. Customer satisfaction and project success were the primary focus of effort. The branch needed to continue to perform in order to increase brand awareness. As the branch was not able to self-perform all work, independent contractors still needed to be managed in order to sustain quality and performance.

The newly designed and implemented organizational structure created a more favorable situation in which to observe, analyze, and act on the evolving environment. With an increase in return on management, the branch manager could now focus on the future and current

environment while communicating with higher level leadership for an increase in resources of support with increasing capability. Project managers, assisted by inspectors and technicians could focus on the local environment.

Amplifiers and Attenuators

Once established, organizational structures are not concrete. They are dynamic and must have built-in tolerance to handle variety. For the branch, the branch manager (system three) was responsible for command-and-control. Through the design, implementation, and analysis of amplifiers via system two, the branch manager could act via attenuator actions to bring the organization back into equilibrium. The following figures provide a more detailed view into how amplifiers were designed and implemented, and how attenuators were used to re-establish equilibrium.

Figure 7.2 below displays the amplifiers and attenuators for the business development section.

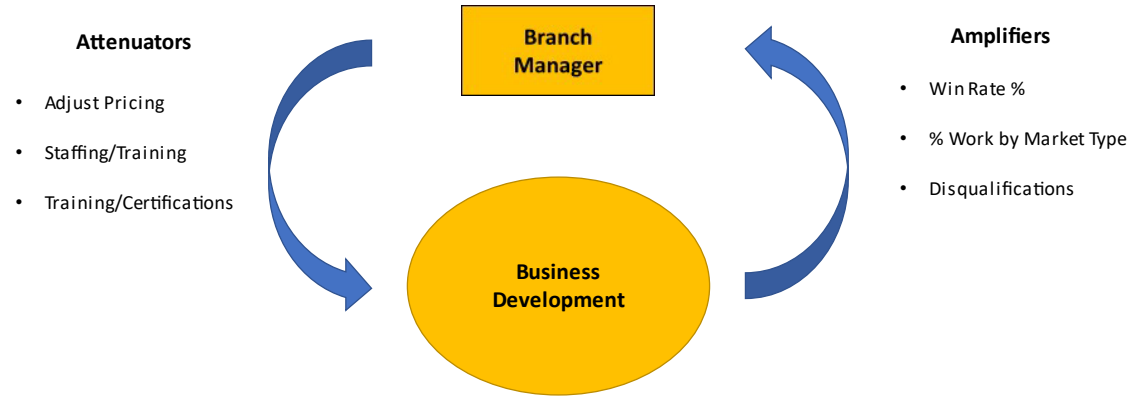

Figure 7.2: Business Development Amplifiers and Attenuators

When managing variety with the Business Development section, three primary amplifiers were established. First was the section's win rate percentage (WPR). An increase in WPR would signal the branch manager to analyze current staffing levels and to adjust as needed. A decrease in WPR would signal the branch manager to adjust pricing or find a way to reduce costs. The

second amplifier was the percentage of work won by market type. An increase in work in a specific market would signal a need to increase staffing with personnel with the appropriate experience and qualifications. For example, an increase in railroad work would signal the branch manager to increase the number of staff trained to work on railway projects or to hire a new employee with significant railroad experience. The third amplifier was disqualifications and factors that caused the branch to be disqualified to bid on specific work. This would signal to the branch manager what training shortfalls existed and what certifications were lacking. It also signaled whether or not such projects were worth pursuing from an economic standpoint. Figure 7.3 below displays the amplifiers and attenuators for the Geotechnical Section.

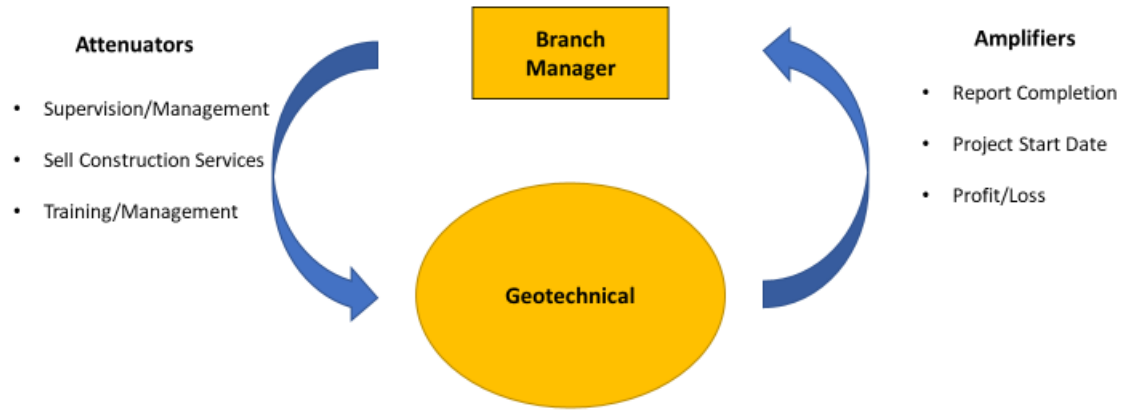

Figure 7.3: Geotechnical Amplifiers and Attenuators

For the geotechnical section there were three amplifiers. The first was report completion time. Failure to complete reports within deadlines communicated to clients would signal to the branch manager than an increase in supervision and management was needed. Calls needed to be made to Chief Engineers to expedite approval, staff in the laboratory needed to be increased, and meeting with the Geotechnical Engineer was required to prioritize and organize work. The

second amplifier was project start date. If the construction start date was within 90 days, the branch manager could signal to the Business Development section to prepare a proposal for special inspections hoping to win the client over with responsiveness. The third amplifier was the profit and loss results per geotechnical project. A decrease in profit margin from the set value in the proposal signaled poor project execution. This would signal the branch manager to plan and execute further training and increase supervision of the Geotechnical Engineer and Project Engineers on future projects.

Figure 7.4 below displays the amplifiers and attenuators for the Special Inspection Section.

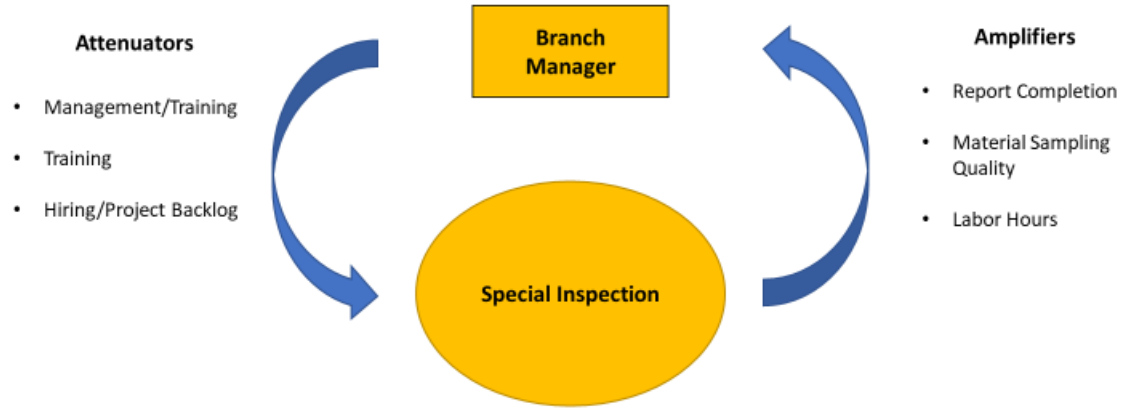

Figure 7.4: Special Inspection Amplifiers and Attenuators

For the Special Inspection Section there were three amplifiers. The first amplifier was the quality of reports. A decrease or failure to achieve established quality standards signaled to the branch manager that additional training or corrective action were required. The second amplifier was the quality of material sampling in the field. A decrease in quality or failure to achieve established quality standards signaled to the branch manager that additional training or corrective action were required. In cases were the tested material failed to reach project specifications, the failure signaled to the branch manager to contact the owner in a timely manner to jointly

determine a solution to the potential problem. The third amplifier was inspector labor hours. A high volume of labor hours signaled the branch manager to decrease the volume of future work being pursued. A decrease in labor hours signaled the branch manager to increase future work generating activities.

Figure 7.5 below displays the amplifiers and attenuators for the Material Testing section.

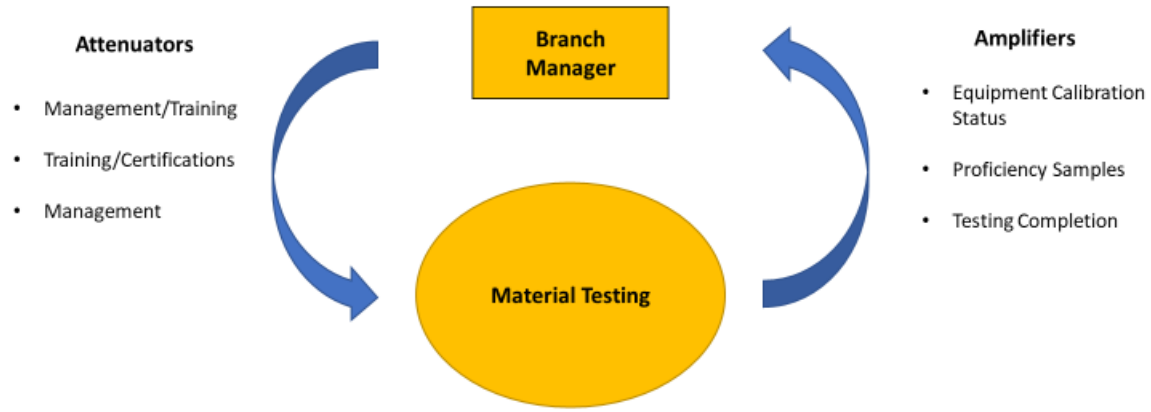

Figure 7.5: Material Testing Amplifiers and Attenuators

For material testing, there were three amplifiers. The first amplifier was the status of equipment calibrations. A high number of uncalibrated equipment signaled to the branch manager that more supervision and training were required. Uncalibrated equipment led to questionable test results and as a result potential legal liability for the branch. The second amplifier was the results of proficiency sample submissions. Per accreditation requirements, proficiency samples were sent to the laboratory and results would be published on a national basis. Poor test results would signal to the branch manager that additional training was required. The third amplifier was the adherence to completing testing on time. Customers expected to receive results as contractually promised and developed their schedules accordingly. Failure to

meet deadlines signaled to the manager that more supervision was required, and that work needed to be organized and prioritized.

Figure 7.6 below displays the amplifiers and attenuators for the Administrative Support Section.

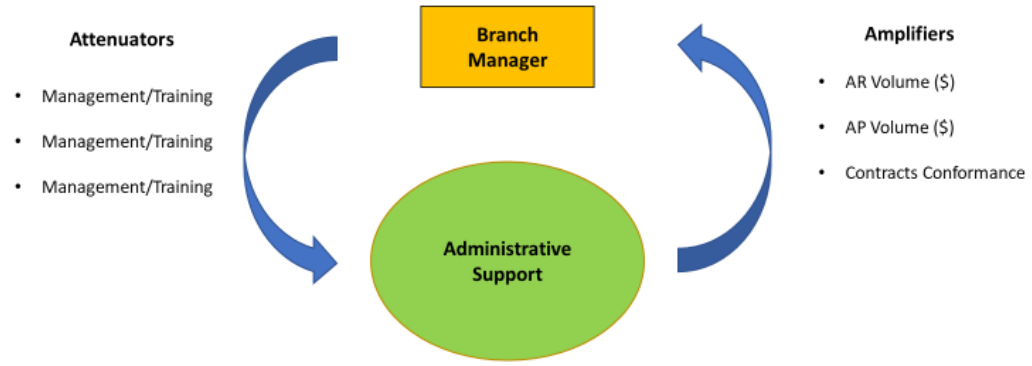

Figure 7.6: Administrative Support Amplifiers and Attenuators

For the Administrative Support section, three amplifiers were created. The first amplifier was the volume of money owed in accounts receivables. An abnormal amount signaled to the branch manager that direct involvement was required. Contracts needed to be reviewed to ensure the proper measures were in place to receive payment, and if needed, additional training was required for the staff. Customers needed to be contacted in a promptly manner. The second amplifier was the volume of money owed in accounts payable. An abnormal amount of money owed to suppliers and subcontractors signaled to the branch manager that direct involvement was required. Failure to meet financial obligations placed projects at risk and increase legal liability for the branch. The third amplifier was conformance to company established contracting requirements. Deviation from established standards increased legal liability and signaled to the branch manager that additional training and supervision were required.

Discussion

The organizational structure implemented was successful, but not perfect. As time elapsed, the external and internal environment challenged the integrity of the structure. However, by treating the organizational structure as a Viable System Model, the branch was able to foresee required changes and adapt and to regulate internal processes. Established communications channels within the system allowed for frequent and effective communication. Amplifiers and attenuators allowed for self-regulation of the system. Initially, amplifications were high, and a large amount of attenuation was required. Overtime, the range of variability decreased.

CHAPTER VIII

LEADERSHIP

The professional internship took place from January 2021 to March 2022. Over the course of that time, the internship provided a live laboratory in which to exercise various leadership styles and techniques. As the internship progressed many valuable lessons were learned. As a result, the existing leadership of the branch manager was reinforced and improved. The lessons learned complemented the existing military leadership skills and created a capacity to lead in a professional engineering setting more effectively.

Military Leadership

Upon assuming the duties and responsibilities of branch manager, I relied on the leadership gained from service in the military. I expected good order and discipline, accountability, mutual respect, obedience to orders, and a common desire to accomplish the mission. I expected a commitment to the profession and a desire to perform in the best interest of the overall team. I expected an individual desire to seek continuous improvement and achievement. However, the above expectations were not realistic. Although not the optimal choice of leadership style, a military style of leadership did have some merits.

Leadership can be defined as the ability to influence and motivate a group of individuals to accomplish a common task for the betterment of the overall group. Upon joining the team, I set out to influence and motivate my team to achieve mutual success by setting the example daily through my personal actions. I made it a personal goal to be the first person to arrive at the office. I ensured that I dressed professionally and, in a manner, consistent with the industry culture. I rearranged my office so that team members could visually see that I too was contributing to production. I made myself available through an open-door policy. No matter how

severe the situation, I placed myself at the point of friction and assumed my role as the leader. I made decisions in a timely manner as was required. I communicated frequently and with honesty. As a result, I was able to gain repour with the team and to gain trust. I took my position seriously, and I knew that employees were relying on me for long term stability and professional growth.

Prior to becoming the branch manager there was a multi-year void in the position. It wasn't for lack of qualified personnel. There were plenty. However, to become an effective manager, one must be willing to manage. One aspect of management that individuals tend to shy away from is conflict. More specifically, people dislike being involved in conflict involving individuals within the team. This is a challenge that I was forced to face, deal with, and act upon. A military style of leadership helped me achieve a solution.

Although not required frequently, the branch was required to perform night and weekend inspections from time to time. Unless safety was a concern, personnel were expected to work the night shift and weekend shift when required. It was commonplace within the organization for inspectors to turn down night and weekend work. As a result, the branch had to hire subcontractors at an increased costs and additional administrative burden. The solution was simple. If an employee was assigned work that was reasonable and did not pose a safety risk, then they were required to perform that work. If the work was turned down, that employee was sent home without pay for the remainder of the week. There were no arguments or loud discussions behind closed doors, it was a black and white situation. Exceptional organizational control, although not popular at first, improved employee behavior and the branch became a more effective and efficient organization.

Another valuable aspect of military leadership was the enforcement of maintaining equipment in a constant state of readiness. Although a professional engineering organization is not preparing for a life and death situation, maintaining vehicle and equipment in an appropriate level of readiness is critical to success. With inspectors sharing equipment and no accountability system in place, poorly maintained equipment created internal tension. Equipment that could be issued out to individuals was distributed and signed for by the individual. Individuals became accountable for maintenance, calibrations, and physical accountability of the equipment. Company vehicles were inspected on a weekly and monthly basis. As a result, the professionalism of the company increased, team cohesion increased, and overall safety was improved.

Military leadership is effective in a proper setting. In a professional engineering setting, it was not the most effective choice of leadership style. Nevertheless, military leadership is not without its merits. Through leadership by example, leaders can influence and motivate a team to achieve organizational goals and objectives. Leaders understand that discipline and accountability are necessary to minimize dysfunction in an organization. The proper care of vehicles and equipment is essential for any organization to achieve success. At the end of the day, individuals join organizations willingly but are not legally bound to stay.

Leadership Techniques

There are an endless number of books and articles on the subject of leadership and leadership techniques. While various sources differ and fail to agree on the optimal leadership technique, there is one absolute. The optimal leadership style is truly dependent on the situation and context in which the leadership is required. This was validated during the conduct of the internship. Success was achieved through the combined use of several leadership techniques.

Transactional Leadership

During the internship, employees could be classified into three primary groups. Group 1 consisted of senior employees who possessed a wealth of experience, who were accomplished in the field, and who's experienced exceeded the experience of the branch manager. The professional engineers made up group 1. Group 2 consisted of senior inspectors who possessed a wealth of experience, who were mature and who required minimal supervision. Group 3 consisted of junior employees who were new to the organization and the industry. Group 3 was composed of new inspectors and undergraduate interns who were excited to be a part of the organization and eager to learn and contribute.

To effectively lead the first group of employees, a transactional leadership style was required. In transactional leadership, leaders determine what followers want and establish mutually agreed upon objectives that will reward the followers. In the case of the professional engineers, there was heavy resistance to change. However, having only two engineers in the organization and a large volume of work, the engineers were constantly overwhelmed. In the case of geotechnical observations and inspections in the field, the branch was not always the geotechnical engineer of record. Therefore, although the professional engineers had oversight of field inspectors, the final decisions and approvals would come from the firm that was the geotechnical engineer of record. The engineers needed to be convinced that they would not be involved in projects in which the branch was not the responsible party, and as a result their workload was decreased. The engineers needed to be convinced that this change did not increase risk or liability, as the branch was simply reporting field results.

A second example where transactional leadership was employed was in planning and executing training. Holding training sessions during the week was a challenge. Not everyone

could attend, and the workload kept the team busy. Therefore, Saturdays were an optimal choice for training. This created a lot of grief with the engineers. However, they possessed the knowledge and experience and were the best candidates to lead the training. Although training was not conducted every Saturday, the sessions were extremely beneficial. Junior personnel learned how to prepare geotechnical proposals, prepare drilling logs, perform laboratory testing, and to prepare certification reports. As a result, these tasks were shifted away from the responsibility of the engineers allowing them more time to focus on advanced geotechnical work.

Collaborative Leadership

To effectively lead group 2, a collaborative leadership style was required. As mentioned before, group 2 consisted of senior inspectors and a senior laboratory manager. The personnel in group 2 had greater experience than the branch manager, and preferred minimal managerial oversight. However, the work performed was not without faults. For example, when sampling concrete, an inspector is required to measure air, temperature, and slump. Those measurements are required per our scope of work and per the requirements established by the American Standard for Testing Materials (ASTM). However, it was often the case that senior inspectors would only measure slump. In legal terms, this meant that the branch had failed to meet its contractual obligation. Initially, the failure went unnoticed due to lack of experience and knowledge on the part of the branch manager. Overtime, the experience and knowledge of the branch manager increased, senior inspectors were constantly consulted, and both groups of individuals learned together to increase the effectiveness of the overall team.

In the case of the laboratory manager, the resistance to accepting change was severe. The laboratory manager was highly qualified and certified and had over 18 years of experience. The laboratory manager was very stubborn and set in his ways. Some problematic issues were that he

was resistant to delegating responsibilities, over demanding in training junior personnel, and highly unorganized. The laboratory manager was the only employee who worked excess hours without good reason. Over the course of the internship period, constant collaboration and coaching was required between the branch manager and the laboratory manager. Individual training sessions were conducted in time management, leadership, training, quality, and customer service. As time moved forward, improvements were made. The laboratory manager was even able to be convinced to take vacation and forget about the laboratory for a few weeks.

Charismatic Leadership

To lead the third group of employees, a task oriented and charismatic leadership style was required. Junior inspectors had been hired with minimal to no field experience. Undergraduate interns were hired with no experience, but with some understanding of civil engineering work. For this group of employees, tasks, goals and objectives, and expectations had to be clearly communicated. Heavy supervision was required initially. In the case of inspections, the junior inspectors greatly added to the value of the organization. They were constantly eager and willing to obtain additional certifications, work was rarely turned down, and operational efficiency was increased. After initial training, the interns also provided great value. While work spiked, interns were able to reinforce the branch to prevent the organization from being overwhelmed. Interns assisted in the laboratory, in the field, and in the office. Interns also obtained additional certifications and assisted in project management duties. As the internship period progressed, less task-oriented leadership was required, and the leadership style transitioned into a collaborative leadership style.

The junior inspectors and interns were a success. However, to sustain that success and to create the conditions for future success a charismatic leadership style was required. The branch

manager needed to continue to communicate the "big picture." It was communicated to the team that the organization was in a development stage. As experience and qualifications increased, so would the growth of the organization. As a result, growth would eventually create a need for future project manager, senior inspectors, field managers, and branch managers. For the inspectors, growth would lead to being able to win higher profile projects with increased stability in terms of working hours. For the interns, growth would lead to having a secured job following graduation as well as advancement in the industry.

Discussion

The internship period provided many valuable lessons in leadership. This was a great benefit to the branch manager as leading a professional organization in the civilian world is different than leading a military organization. The primary lesson learned regarding leadership was that leadership must be focused on the people. We are indeed in the engineering business, but we are also in the people business. People must be engaged. They must be led, coached, mentored and their needs must be met. People must be convinced that organizations see and appreciate their value and contributions to the organization. Initially, the branch manager focused more on cost reduction and improving operational efficiency. While those actions stabilized the branch and contributed to financial and operational success, they were short-lived. Employees left due to reduced hours and accepted other offers where they saw the potential for professional growth. To achieve a solution, the branch planned and executed cross-training events. A road map was created to provide for professional growth, continuous investment was made in education and training, and employees were given the opportunity to participate in different roles. For example, inspectors were allowed to supervise and log drilling operations, a role normally given to junior engineers. Inspectors were allowed to perform laboratory testing,

securing additional hours of work, and easing the organization's workload. The investment made in people created a willingness to perform for the betterment of the overall organization.

A second lesson learned was that leaders need to be realistic and not be led astray by optimism. Throughout the internship period, two employees were dismissed, and one resigned before being dismissed. The first employee (an inspector) failed to make any progress earning additional required certifications and argued with an on-site contractor was causing hardship on a long-term project for a very important client by constantly arguing with the contractor on site. Multiple counseling sessions were held and mutual plans for improvement were developed. However, upon raising his voice in a meeting, the employee was immediately let go. A second employee (dispatcher) was consistently performing her work in poor manner. Client calls were not being picked up, inspections were being turned down or not scheduled. The employee was not engaged in her work at all. Failure to attend to her duties properly resulted in increased workload and stress for the staff. A third employee (lab supervisor) resigned before being dismissed. However, he created a very toxic environment in the laboratory and no matter the circumstance always had a negative attitude. While a very experienced and highly qualified laboratory manager, he was very resistive to training additional personnel and to increasing organizational capacity.

With the COVID-19 pandemic in place, it was a difficult decision to dismiss anyone. However, the three employees mentioned were not aligned with organizational goals and objectives. The employees lack of commitment created undue hardships for the rest of the team and decreased the performance of the organization. While it is important to see the good in people and believe that everyone is acting in the best interest of the team, it is simply not the

case. The dismissal of the employees created the ability to hire replacements who increased organizational performance and operational efficiency.

Leadership is a lonely position. That does not mean a leader cannot engage and communicate with followers. However, there does have to be a clear line between leader and followers. Workplace politics are highly in play in any organization. Employees will do what they can to influence manager opinions or actions or even to get on a manager's good side. It's best for leaders to completely remain neutral. For if any employees feel they have been treated unfairly, tension and conflict will increase in the organization. As branch manager, I ensured that the employees saw everyone was treated equally. I didn't just treat one person to lunch on their birthday, I treated everyone to lunch on their birthday. I ensured work was scheduled in a fair manner. I ensured everyone got their fair share of praise, and their fair share of accountability when required as well. While true friendships were developed, I ensured they did not obscure my professional duties and responsibilities.

Employees will make mistakes and failure will occur within an organization. It is inevitable. However, employees should be corrected and disciplined in private and away from the other members of the team. During the testing of masonry grout, a senior inspector failed to prepare the sample correctly in accordance with the industry standards. As the branch manager, I was disappointed and upset. I made the mistake of stating my opinion in front of other employees. My critique of the inspector's work eventually reached the ears of the inspector. The inspector was understandably upset, and a barrier was created between us. As the branch manager, I should have kept my comments to myself or communicated with my manager. To this day, the trust between the inspector and I was never repaired.

Leaders willing accept their position and duties and responsibilities that come along with the role. In a professional setting, the role can be very demanding. Operational efficiency and cost reduction must be maintained, profit goals must be met, customer needs must be addressed immediately. It is not uncommon to work late into the evening and on weekends. However, meeting business demands is not an excuse for a leader to ignore or sideline employee needs. It was not until the resignation of our laboratory manager that I learned of the toxic environment in which work was being performed. Employees were leaving in tears, employees were being disrespected, and employees were almost ready to resign. When asked why the situation was not brought up to the branch manager, the answer was "you are always so busy." It is important for leaders to stay engage with their team. To improve my effectiveness as a leader, I followed the Pamela Hackett's 1.5.30 engagement method outlined in her book *Manage to Engage: How Great Managers Create Results*. I made a point to check with the team daily, check on progress of current tasks on a weekly basis, and to sit down on a monthly basis for a counseling session. The results were tremendous. Communication with the organization increased. Employees were alerting me of issues before they turned into serious problems. I believe true team cohesion was developed.

CHAPTER IV

SUMMARY AND CONCLUSION

The primary objective of the internship was to apply leadership and management to turn around the performance of a geotechnical, special inspections, and construction material testing firm. Leadership developed, established, and communicated organizational goals and objectives to establish guidance and direction. Management provided organization, structure, and accountability. The design and implementation of management controls aligned individual behavior with the goals and objectives of the organization. Implementation of a business strategy transitioned the organization from a state of survival to the pursuit of financial growth. Process improvement increased organizational capacity and improved operational efficiency. Investment in human capital set the conditions for future success. The organizational team transitioned from the forming and storming stages to the apex of the norming stage.

Figure 9.1 below displays the 2021 financial performance of the branch measured in profit and loss.

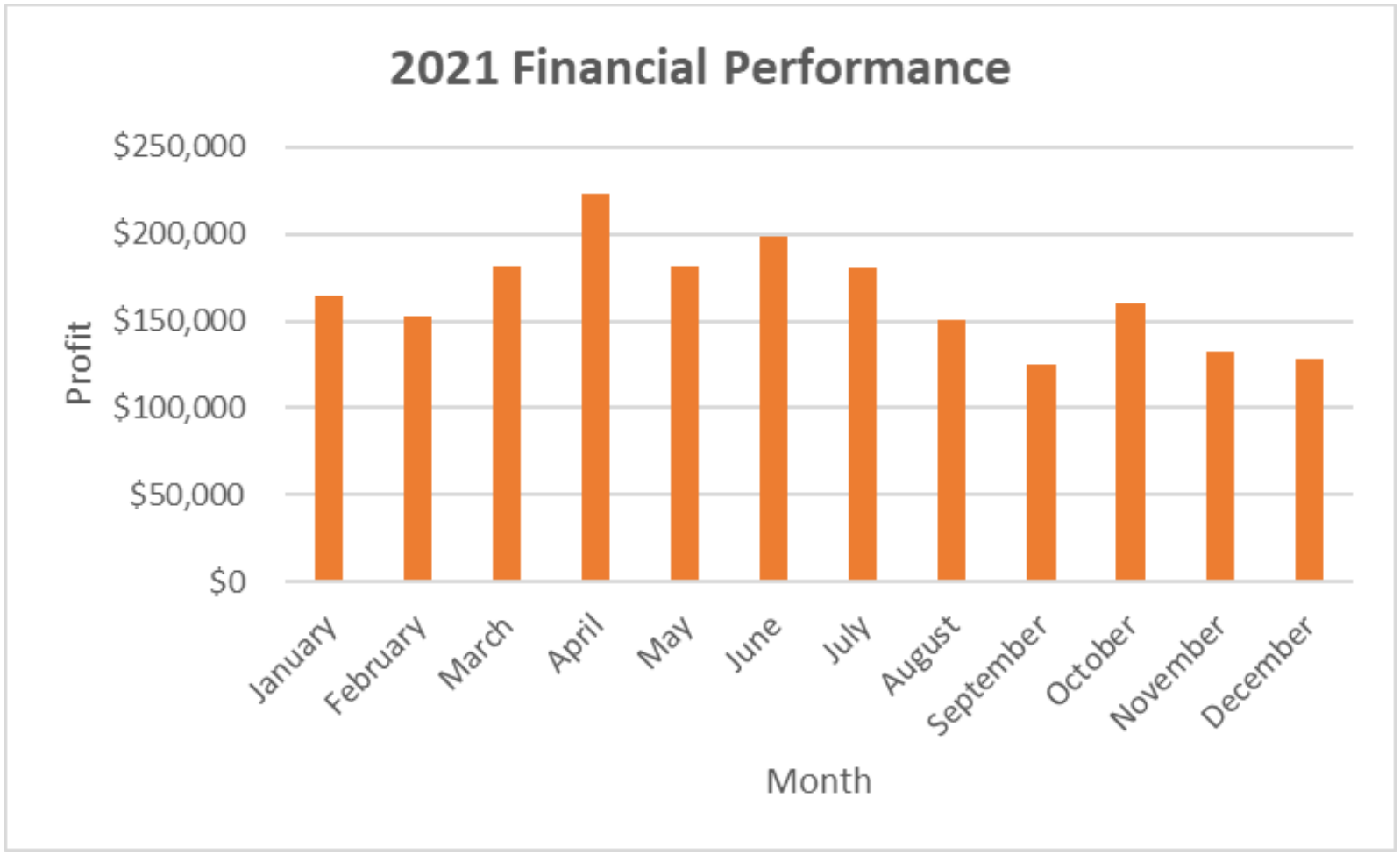

Figure 9.1: 2021 Branch Financial Performance (Profit/Loss)

In May of 2022, I accepted a promotion with Universal Engineering Sciences as the area manager for Southern California. As the area manager, I will oversee and manage five branches. The new position will allow me to apply the knowledge gained during the internship. Being composed of recently acquired companies, the California division needs leadership, strategy, process standardization and improvement, professional development, and talent retention to continue to grow. I look forward to the challenges ahead and to achieving success.

The Doctor of Engineering program has developed me into a technically proficient and confident engineering manager and leader. The curriculum and associated courses have allowed me to increase my academic knowledge in the areas of construction, business, management, and industrial and systems engineering. The courses completed in industrial systems and engineering have supplemented my civil engineering background and provided an alternative view of the management and design of organizations. Furthermore, the course material has improved my view and understanding of operations management and provided valuable tools for process improvement. The coursework combined with the required internship has allowed me to assume a professional position unprepared, learn and immediately apply academic knowledge with real-time feedback, and grow into a mature manager. The proof that this degree can be accomplished while working full-time and teaching part-time is an example for others that it can be done. I hope this serves as a source of motivation and inspiration for my peers, students, family, and loved ones.

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