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Network Management: Developing a Training Curriculum

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Network Management: Developing a Training Curriculum

by

Keegan Newton

A creative component submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Computer Engineering

Co-Major: Cyber Security

Program of Study Committee:
Dr. Doug Jacobson, Major Professor

The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this creative component. The Graduate College will ensure this creative component globally accessible and will not permit alterations after a degree is conferred.

Iowa State University

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NOMENCLATURE

GPO	Group Policy Object
HW	Hardware
IT	Information Technology
SW	Software

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ABSTRACT

Effective technical training within an IT department, designed to meet the operational needs of a corporation, is necessary for proper network management and sustainment. Even if technicians are hired based on stringent training pre-requisites, technology changes at a rate that demands continual training. A successful IT training curriculum relies on three elements: defined learning objectives and requirements, experienced instructors who are skilled at teaching, and a hands-on learning environment. Throughout this creative component, we will examine a large corporation, which we will refer to as, “Corporation Alpha,” that initially lacked an effective training program for its IT Department. Its lack of relevant training led to increased technician errors, unnecessary delays in between problem identification and resolution, and overall negative levels of productivity and satisfaction from employees who utilized Corporation Alpha’s network infrastructure.

Corporation Alpha realized its absence of effective training had a negative impact and attempted two solutions without success. Management initially intended to condense all network and computer training needed to operate an enterprise-level environment into a two-week course with infrequently available training slots across the organization. Second, Corporation Alpha’s management pushed training responsibility down to individual IT Department offices, which were geographically separated but operated a single enterprise environment, train their offices individually, in a manner that lacked standardization or synchronization of any kind. These two solutions, although well-intentioned, failed. Meaningful training was still lacking and, instead, trained employees in a counter-productive manner.

Corporation Alpha’s Board of Directors set a deadline on when training must be improved and, unfortunately, the IT Department only had three months to meet this time

requirement. One potential solution to this task contained several phases. Overall, a single training location would be identified and used to train all IT Department employees. Corporation Alpha's Board of Director's included several more specific, sub-requirements. First, the training solution must include retraining all IT Department employees, while training new employees as they arrive, within a two-year timeframe. Second, the training provided must revolve around hands-on, lab-based training, instead of the existing Microsoft PowerPoint-based training. Third, the training must be contracted out to Company Bravo in Washington, D.C., which will provide training under the oversight of leadership from IT Department Office 1, also located in Washington, D.C. This creative component will examine the plan and process used to achieve the requirements posed by Corporation Alpha's Board of Directors.

CHAPTER 1. CORPORATION ALPHA'S TRAINING SYNOPSIS

IT Department Overview

Since the development of Corporation Alpha, it was plagued with technological issues stemming from a lack of computer and network training that resulted in reduced employee productivity and satisfaction that reverberated throughout the organization. Corporation Alpha's IT Department, which consisted of roughly 430 employees, was responsible for providing computer and network services to 350,000 employees. Corporation Alpha's IT Department was geographically separated over seven offices.

- IT Department Office 1 (Located in Washington, D.C., USA)
- IT Department Office 2 (Located in San Francisco, CA, USA)
- IT Department Office 3 (Located in Tokyo, JPN)
- IT Department Office 4 (Located in Paris, FR)
- IT Department Office 5 (Located in Melbourne, FL, USA)
- IT Department Office 6 (Located in Columbia, MD, USA)
- IT Department Office 7 (Located in San Diego, CA, USA)

The IT Department, collectively, was required to provide all aspects of computer and network management, to enable 24/7 corporate operations across 65 global locations. Included within the IT Department's responsibilities were management of network infrastructure, boundary devices, the Active Directory environment, intrusion detection and prevention systems, scanning and patching services, storage and virtualization, and all network and device monitoring systems.

State of the Network

Unfortunately, the IT Department was consistently unable to keep more than 50 percent of its workforce properly trained. This was due to the IT Department placing a higher priority on handling the problems caused by end-of-life network equipment than on training new or incompetent personnel. The training that initially existed was, for the most part, just a verbal overview of how a network should function with some PowerPoint slides in the background.

The constant network issues were not entirely the IT Department's fault. Funding was stretched across the needs of Corporation Alpha and, unfortunately, replacing old network equipment seemed to never be the highest priority. There was always a more pressing project or idea that absorbed extra funding. This way of business translated into frequent network outages and latent connectivity across the entire corporation, which caused an enormous number of wasted man-hours and frustrated employees. The IT Department was on its own and needed to figure out how to improve training with limited resources.

Failed Training Solution 1

The first attempted solution to solve this predicament was to condense all training required for all technician jobs into a two-week course. To effectively train technicians of all specialties an enormous amount of time is required. Two weeks of training, guided by PowerPoint slides, was not even close to enough time. To compound the problem, only one or two student slots were offered every few months. Remember, the IT Department consisted of 430 employees. Even if the course were outstanding, enabled technicians to do their jobs, and no new employees joined the team, it would take decades to train all employees within the IT Department. This solution wildly missed the mark.

Failed Training Solution 2

The second solution was to push the training responsibility down to the individual IT Department offices. One problem seen was that the IT Department offices did not have a hands-

on learning environment through which to train and learn. The first time an employee manipulated a firewall rule or deployed a GPO was on the corporation's live, operational network, which was valued at roughly \$10 billion. Perhaps a larger issue that arose is that management would frequently place underperforming technicians into instructor positions to prevent them making network changes. In other words, the responsibility of training new technicians was carried out by underperforming technicians. The instructors were the least competent of the office, instead of being experienced professionals who had the right skillsets to effectively teach. To make matters worse, each of the seven IT Department offices focused on different concepts for training and conducted training in different ways. There was no standardization in training approach or curriculum. This produced major discrepancies in how the IT Department offices would troubleshoot network outages, upgrade equipment, monitor devices, set up scanning repositories, etc. Corporation Alpha's IT Department was sabotaging a network that was already struggling to stay alive.

CHAPTER 2. TRAINING PLAN OF ACTION

Corporation Alpha's Directive

Corporation Alpha's Board of Directors frequently heard about issues with the network and began to demand a solution. The corporation was unable to provide funds to replace all old network equipment, but they determined to provide enough funding to overhaul the IT Department's training problem. Specifically, they contracted the training out to Company Bravo, located in close physical proximity to IT Department Office 1 in Washington, D.C., USA. Corporation Alpha's Board of Directors asserted training could be better provided by an independent company and standardized by sending all IT Department technicians through one training site. The proximity of Company Bravo to IT Department Office 1 would allow program oversight and an easy avenue for Company Bravo instructors to understand the network and stay abreast of any changes in operations or technology.

Training, if effectively designed and administered, has the potential to equip employees with the necessary knowledge and skills to accomplish their job [1]. A proper training program has the potential to optimize human resources, increase productivity, reduce the number of required personnel, and improve employee satisfaction [1].

The Board of Directors realized the training would not only need to be given to future employees, but also to current, underperforming technicians to truly affect how IT Department operations are conducted. As a result, the Board of Directors levied the requirement to retrain all current technicians and new employees, as they are hired, within two years. Although this was an aggressive timeline, it was deemed doable.

The final, major requirement was to ensure a training environment was included in the training program. A sufficient lab environment would be revolutionary for the IT Department

because this would enable technicians to learn in a realistic, nonthreatening environment without real-world consequences for bringing down an operational network. This would also be difficult, because the IT Department had never designed or built a lab environment that would replicate its actual network. In addition to designing and building the lab, the appropriate HW, SW, and licenses would need to be acquired.

Responsibility and Authority Delegation

The Board of Directors delegated both the responsibility and authority to establish an IT schoolhouse to IT Department Office 1, due to its physical proximity to Company Bravo. After all, it would be important to ensure Company Bravo maintained the ability to easily communicate with the end users – the technicians, in this case – of the provided training. To determine an optimal solution, IT Department Office 1 needed to examine everything that establishing an IT schoolhouse would entail. What overarching lines of effort need to take place for this to be a successful endeavor? Overall, allocating funds, determining a physical training site, ensuring the instructors understand the training material (we'll call this, "instructor spin-up"), developing the lab environment and training material, establishing a travel process, creating schoolhouse procedures, and advertising information all must be accomplished. Which milestones will be reached by Company Bravo? Which milestones will be reached by IT Department Office 1? Company Bravo would be responsible for providing the training site, instructor spin-up, and developing the lab environment and schoolhouse procedures, but under the facilitation of IT Department Office 1, which would be responsible for everything else.

CHAPTER 3. TRAINING PROGRAM DEVELOPMENT

Course Selection

As previously mentioned, the IT Department must keep the network up and running for approximately 350,000 employees. In order to accomplish this, the IT Department must have employees knowledgeable on every part of the network, to include: administering the Active Directory environment, maintaining all network infrastructure, operating peripheral boundary devices, conducting vulnerability scanning and consequential patching of network devices and employee workstations, managing antivirus solutions, Intrusion Detection Systems, and Intrusion Prevention Systems, running storage and virtualization, and overseeing monitoring solutions across the enterprise. All in all, the IT Department divided these responsibilities into eight technician positions and added in a ninth position to oversee network operations. This ninth position-type was essentially management of all technician positions.

How should the training pipeline be designed? Should there be a single training course dedicated to each technician position? Or should complementary roles, such as scanning and patching vulnerabilities, have a single training course to cover both jobs? It was determined to be necessary to develop a single course for each technician position, but that did not address one problem: if technicians were only knowledgeable on their individual responsibility, it could stifle inter-role coordination and problem-solving. If a technician only knows his or her role and does not understand how it fits into the bigger picture of network management, or does not understand the implications of his or her actions on another position, it could interfere with efficient operations across the IT Department. Each technician position might ignorantly (of course, though, with good intentions) accomplish their responsibilities in a way that fragments overall effort. An example of this is if a monitoring technician, charged with providing useful

monitoring solutions for all roles in the IT Department, creates a dashboard for storage and virtualization technicians but doesn't understand what the useful pieces of information are to those technicians in this role, it could be useless. The dashboard might appear beneficial to the monitoring technicians but could be pointless to a technician who needs to use the dashboard.

Course Requirements

By only sending technicians through one course, tailored to their job responsibilities, the IT Department would continue to see inefficient operations across the enterprise.

Simultaneously, it would be unreasonable to send every technician through the training courses of all other technician-types. It would not only be too expensive from a monetary perspective, but the time required for that would prevent the IT Department from meeting the Board of Directors' requirement of training all inbound and current employees within a two-year timeframe. To address both ends of the spectrum's concerns, the IT Department decided to generate nine training courses, each tailored specifically to the role of the different types of technician. In addition to this, a tenth course would be created. This would be a high-level course of how an enterprise-level network operates, focusing on major network functions and how these functions work together (i.e., what the dependencies and relations are between different technician responsibilities, such as how boundary devices and network infrastructure impact each other and the rest of the network).

Time Calculation

Some technician roles would require more training than other roles. For example, it was relatively simple and quick to train someone on how to scan a network enclave against a repository of vulnerabilities, but quite time-intensive and complex to train someone to administer Active Directory across the enterprise. To calculate the amount of time needed for each training course, lists of all required tasks for each technician type were created. From there, instructors

estimated the time required to train on each task and added those amounts of time together. Additionally, each course would need a certain amount of time allocated for course introductions, review, and testing. These numbers, collectively, would drive the time needed for each course. Overall, the time requirements for each course are shown below in *Figure 1*.

Training Course	Time Required
Boundary Devices	33 Hours
Directory Services	155 Hours
Enterprise Network Operations	62 Hours
Host Security	67 Hours
Network Management	114 Hours
Monitoring	80 Hours
Network Infrastructure	25 Hours
Storage and Virtualization	33 Hours
Vulnerability Scanning	12 Hours
Vulnerability Patching	14 Hours

Figure 1. Course Time Requirements

Corporate Approval Process

Before any training could be administered to technicians, the Board of Directors required each course to be certified by Corporation Alpha. What does this mean? Corporation Alpha had a series of requirements in place for training to be considered official. Overall, Company Bravo had to format all learning objectives in a way that aligned with Corporation Alpha specifications, submit those learning objectives for review, obtain approval, and then create a curriculum system within the corporation's overall training system. Although this sounds simple enough, the

approval process to create a new course is complex and requires many steps of approval that can often take months for that single course. To rapidly push 10 courses through the approval process, IT Department Office 1 consulted other schoolhouses and flew out a training expert who helped guide them in this process. Because of these two actions, Company Bravo and IT Department Office 1 were able to garner approval for all courses within a month, vice the usual timeline of several months.

Instructor Spin-Up

Critical to administering these training courses would be the task of instructor spin-up. After the training courses had been designed from a learning objective perspective, the instructors from Company Bravo began learning the nuances of the IT Department's network to become knowledgeable on its network operations. The physical proximity of Company Bravo to IT Department Office 1 was vital in the instructors' spin-up and allowed them to spend weeks with the technicians asking questions, becoming familiar with enterprise operations, and learning specific tool configurations, dependencies, limitations, and capabilities.

The most arduous task associated with instructor spin-up was freeing up the most knowledgeable technicians from IT Department Office 1 to train the instructors. There was an operational cost associated with spinning up the instructors because, after all, the most knowledgeable technicians were usually the most pivotal in day-to-day actions. These were the "go-to" employees who could get things done in a pinch, were the most adept at troubleshooting, would enforce best practices, and helping to train others across the office. This cost was deemed worthwhile because, for better or worse, Company Bravo's instructors would train every employee across the IT Department over the next two years. If ensuring the instructors were equipped to do their job meant shifting day-to-day responsibilities to slightly less-qualified

technicians, it was a worthwhile cost, even if it meant increased technician error-rates for the short term.

CHAPTER 4. TRAINING LAB DEVELOPMENT

Historical Training Approach

In the past, the IT Department had never sought to take advantage of a “hands-on” solution to training. As previously mentioned, the IT Department had employed the use of training that was based on audio- and visual-learning tactics, such as PowerPoint slides and class discussions, rather than training that was driven by tactile-learning tactics. There were justifiable reasons for this decision. The primary reason was that the HW, SW, and licenses to maintain a training lab would be costly. Additionally, designing, maintaining, and upgrading a training lab would take expertise. Finally, there always seemed to be a more pressing, real-world issue that took precedence over getting a training lab up and running. To compound each of these issues, Corporation Alpha enforced strict, inflexible processes for procuring equipment and spending money, which would make it difficult to create a training lab even if it were not costly or complex. Unfortunately, these reasons, although legitimate, did not negate the need for a training lab. Instead of tackling these issues systematically and creating a hands-on training environment, through which employees could learn, make mistakes, and become technically competent with no real-world consequences, the IT Department relied on employees learning the job on the live, operational network.

Technicians in the IT Department had a steep learning curve they needed to work through to become proficient at their jobs. As to be expected, the process to become technically proficient at their jobs was often plagued with rookie errors and mistakes, through which employees would learn actions to avoid, associated consequences of those actions, and alternative or optimal ways to achieve success. Even under close initial supervision, these mistakes were still made and, without having a safe, virtualized environment in which to

practice, these mistakes were made on a live network. The consequences of these mistakes being made on a production network can be monumental, especially when considering the IT Department controlled the network across the entire Corporation Alpha enterprise, which, again, serviced over 350,000 employees. Even a small mistake that caused a network outage for one hour during normal business hours could cause work stoppage for a large percentage of these employees, which could equate to hundreds of thousands of wasted man-hours.

Training Environment Design

The Board of Directors realized the IT Department needed to have a safe, hands-on learning environment and, thankfully, was fully on-board with overcoming any obstacles to make this happen. With the support of the Board of Directors, IT Department Office 1, in coordination with Company Bravo, determined there were multiple steps that needed to take place to design a training lab. These overall steps were to design the training lab, procure the appropriate amount of funding, acquire the appropriate HW, SW, and licenses, build the training lab, and integrate the lab into the training courses. Although this process would be difficult, the right people knew this would be a worthwhile endeavor. After all, active participation in the classroom environment, through these hands-on techniques, engages the intellectual and emotional processes that are foundational to learning [2].

Designing the lab environment was the first step in this process. To accomplish this, IT Department Office 1 scheduled a meeting with leadership from each technician role and requested support in compiling a list of every piece of HW, SW, and license that was needed for each technician type to accomplish his or her job. All in all, it was determined there were 36 specific requirements for HW and SW, plus associated licenses for SW, that must be included for an optimal training environment. IT Department Office 1 pushed this data over to Company Bravo for them to design the training environment.

Acquiring Training Lab Funds

At this point, a new problem was introduced. Company Bravo's initial design of the training lab cost approximately 10 times that which was initially allocated by the Board of Directors. The Board of Directors had allocated \$40,000 for the training lab to be created. Unfortunately, to develop a training lab that would realistically mimic the production environment, support a high-volume of students, and acquire the necessary licenses, the lab cost would be closer to \$400,000. At this point, IT Department Office 1 and Company Bravo decided to generate two versions of the lab design. The first version (Version 1) would be with the initial \$40,000 that the Board of Directors had initially approved – along with this version would be the pros and cons of employing this solution. The second version (Version 2) of the lab would include everything needed to accurately replicate the live network in a virtual environment with the ability to have high-volumes of students using it simultaneously, procure licenses, and retain product support.

Once these two designs were generated, IT Department Office 1 started crafting their request to obtain more money. This formalized request was briefed in-person to leadership at every level until it gained enough support to request the additional funding from the Board of Directors. Asking for 10 times the amount of allocated money was no small request, because there were many other requirements across Corporation Alpha demanding that same funding. Thankfully, the message was well-received at every level and garnered enough support across the corporation to obtain approval from the Board of Directors. Within two days of the money being approved, it was available for use by IT Department Office 1, who immediately began to purchase the necessary SW, HW, and licenses.

Training Lab Scenario Creation

As the next two months progressed, the necessary pieces for the lab environment arrived at Company Bravo, who would immediately incorporate them into the training environment. Although the training environment was not in use during this timeframe, Company Bravo was able to plan out exactly how it would be incorporated into each training course, which was also no small task. Again, up until this point, no hands-on training solution had been utilized, which meant that Company Bravo needed to not only determine where the training environment could be included, but also needed to design scenarios at every point. IT Department Office 1 and Company Bravo determined to train students in a hands-on manner to the maximum extent possible. To accomplish this, Company Bravo reviewed every learning objective for every course and designed lab environment scenarios for all tasks that technicians would be expected to accomplish while on-the-job.

Out of all steps taken to secure a useful training environment, the most difficult step was, perhaps surprisingly, spending the money to procure the needed SW, HW, and licenses. The corporation's stringent mechanisms that were in-place to ensure money was only spent appropriately caused it to be more difficult to spend the money than obtain it in the first place. This was unexpected for IT Department Office 1, but with close legal, contracting, and resource counseling, the right material was obtained to create the lab environment.

CHAPTER 5. SCHOOLHOUSE OPERATIONS

Administrative Procedures

In conjunction to the aforementioned efforts, there was a heavy-lift that needed to happen regarding the administrative aspect of a schoolhouse. A schoolhouse could have the most qualified instructors, an incredible curriculum, and a seamless training environment, but without the administrative processes to support that training program, it would fail. IT Department Office 1 and Company Bravo determined the vital administrative processes to include allocation of student slots for each IT Department office, student course sign-up, student travel coordination, distance and on-site support (answering student questions, providing emergency support, etc.), a schoolhouse syllabus, and a forecasted schedule of all courses. IT Department Office 1 would be responsible for prioritizing student slots across IT Department offices, facilitating travel coordination of all students, and assisting in on-site emergencies, while Company Bravo would be responsible for all other administrative actions.

Forecasting Courses and Facilitating Logistics

The first step in this process was for Company Bravo to draft a schedule of courses that would meet the training requirements of the IT Department in an efficient, prioritized manner. To accomplish this, IT Department Office 1 compiled a list that communicated how many technicians from each technician role required training. This list also prioritized which training courses should be offered with the highest frequency (based on IT Department needs), which drove how frequently and when each class would be offered by Company Bravo. Once Company Bravo had the forecasted course schedule approved by IT Department Office 1, the student slots were prioritized and allocated. IT Department Offices 3 and 4 were given slightly higher priority for student slots, because those offices are overseas and see a higher turnover of technicians, thus

increasing the need for them to be quickly trained. Once the training slots per office were allocated, IT Department Office 1 worked with all offices to advertise those slots and assist students in signing up for courses. Once students were signed up for a course, IT Department Office 1 would facilitate obtaining funds and coordinating travel.

Additionally, once a student was registered for a class, Company Bravo would immediately reach out to each student, provide a class syllabus, and help them prepare for their specific training. There were specific pieces of information that Company Bravo needed prior to students' arrival to create student accounts within different virtual environments and to streamline their experience getting started. All of this was taken care of by Company Bravo's registrar. Occasionally, during the technicians' time at the schoolhouse, various medical (or other type of) emergencies would occur. IT Department Office 1 handled all emergencies but was able to rely on Company Bravo for any necessary support throughout these events.

Course Scheduling Approach

In the overall schedule of courses, Company Bravo would send each student through the Enterprise Network Operations course, which would cover overall network operations concepts, tool dependencies, etc. and then through their technician-specific training. It was important to not only maximize the instructors' time, but also not leave a gap in between Enterprise Network Operations courses and the technicians' specific, follow-on training. Creating an optimal schedule was difficult and required constant adjustment based on operational needs, the instructors' schedules, and the number of students able to sign up for each course. This forecast of courses meant that, optimally, there should be concrete minimum and maximum amounts of time students would need to go through the training (both the Enterprise Network Operations course and the technicians' follow-on courses). As an example, the Enterprise Network Operations course requires 62 hours of class time. The technician with the smallest time

requirement for training is a Vulnerability Scanning Technician, who would require the 62-hour Enterprise Network Operations course plus the 12-hour Vulnerability Scanning course (meaning the minimum time required for any technician type is 74-hours, or roughly 9 business days of training). Similarly, someone who needs to go through the 62-hour Enterprise Network Operations course and the 155-hour Directory Services course, would be there for the maximum amount of training time (a total of 217 hours, or approximately 27 business days). Assuming the schedule can be created with zero delay between finishing the first course and beginning the second course, the minimum amount of training time required for a technician is 9 business days and the maximum amount is 27 business days.

Since all students traveled to Washington, D.C., for this training, every day of delay in between the first and second courses would waste money. It was a balance, however, because it would waste instructor time to administer the Enterprise Network Operations course before every follow-on class – if this were done, it would waste valuable seats in the bigger classrooms. As a result, Company Bravo's registrar had to determine ways to maximize physical classroom space, registered students, and associated travel costs for delay in between classes, instructor time, and priority of courses. Company Bravo, in conjunction with IT Department Office 1, decided the minimum students that must be registered to provide a class was four students. If there were less than four students, it would be a waste of money and resources to provide that class. It would cost money, but it would also be at the cost of sending other technicians through training.

Continuous Process Improvement Mechanism

Finally, it was critical to include a mechanism to drive positive change in the schoolhouse. This was the first attempt at creating a formalized, standardized schoolhouse with hands-on training and it would be naïve to assume that everything would be perfect from the beginning. Thus, Company Bravo instituted various feedback mechanisms to extract information

useful to schoolhouse improvement. To sum it up, the feedback mechanisms requested information about what went well, what went poorly, and how to improve that which went poorly. This feedback was formally requested from students at the end of both courses. It was also sent back to each IT Department office location three months after technicians returned from training for local leadership to access if the training was meeting operational requirements. Although every single piece of feedback was carefully reviewed by both IT Department Office 1 and Company Bravo, it was important to extract trends from student and leadership feedback. After these trends were detected and reviewed, they would drive process improvement of courses, the lab environment, travel processes, the student syllabus, instructors, and everything else associated with Company Bravo's schoolhouse.

CHAPTER 6. Summary and Future Work

Operational Lines of Effort

Multiple lines of effort were executed to actualize the directive of starting a schoolhouse to train all current and inbound members of the IT Department. The courses were designed, instructors were spun-up, the curriculum was tailored to meet corporate requirements, a lab environment was designed, funded, and built, and all administrative processes were created. The associated timeline for all of these to take place was three months. Due to this aggressive timeline, every line of effort needed to be initiated and completed as expediently as possible. Many lines of effort had dependencies on other lines of effort. For example, the ability to build the training environment was dependent on acquiring the necessary HW, SW, and licenses, which was, in turn, dependent on obtaining enough funding. Overall, the sequence of events resembled what is conveyed in *Figure 2*.

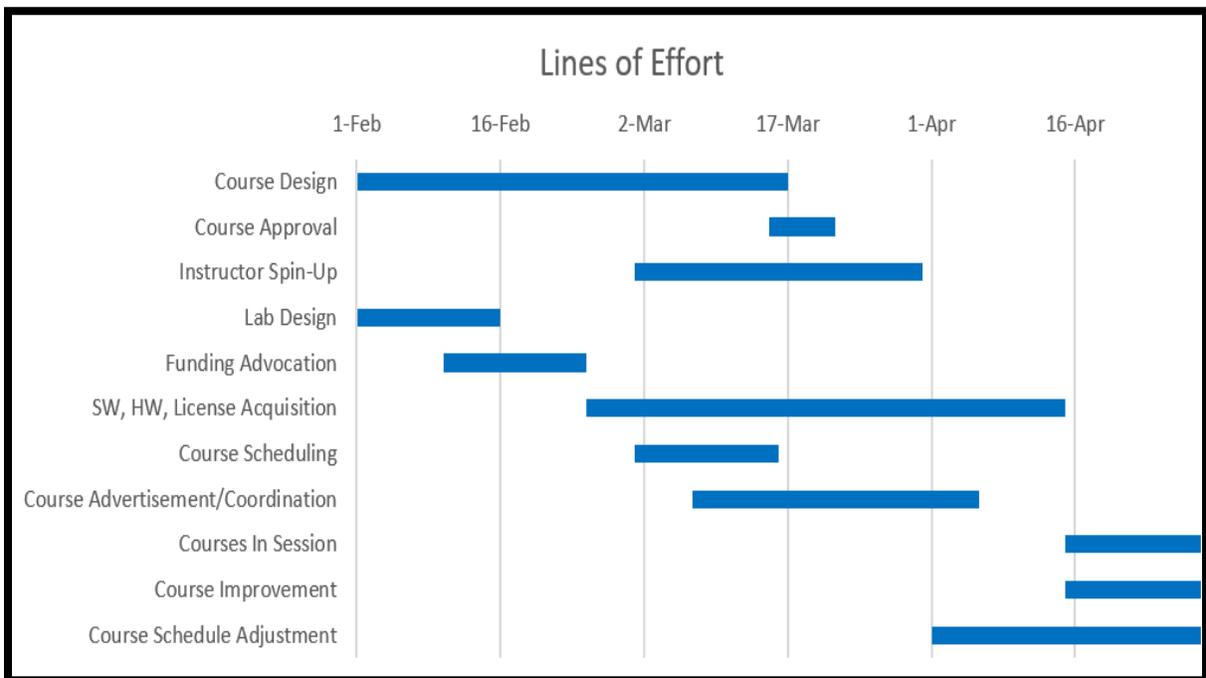


Figure 2. Project Lines of Effort

This process, under normal circumstances, would take approximately one year of action. The Board of Directors, however, saw the urgency of overhauling the training pipeline for all employees within the IT Department and provided the appropriate authority, funding, and support to condense this timeline into three months. The lack of training within the IT Department had caused consistent and frequent problems caused by technician-error, delays in troubleshooting issues, and an overall lack of coordination and continuity across IT Department operations. When the Board of Directors directed IT Department Office 1 to overhaul the training pipeline and standup a training schoolhouse, that office got to work and established the lines of effort that would need to occur for this to be a successful endeavor.

First, every task required by IT Department employees was listed out by position type. These on-the-job tasks drove the development of all courses and their associated time requirements. Simultaneously, all HW, SW, and licenses that were needed for the IT Department to function were compiled and used as a baseline for generating a lab environment design. As Company Bravo priced the lab environment, it became clear that the initially allocated \$40,000 would be nowhere near enough money to cover the cost of a useful training setup. With this information in mind, Company Bravo and IT Department Office 1 immediately began crafting arguments and reaching out to leadership to advocate for increased funding. Thankfully, the requests were well-received and, within a matter of days after the approval to increase the budget, the money was available for use by IT Department Office 1 and Company Bravo. This did, however, pave way for a new issue to take place: the stringent requirements that prevented ease-of-use of monetary resources. With careful legal, resource, and contracting counsel, IT Department Office 1 was able to navigate these obstacles with speed and acquire all necessary materials for Company Bravo to build the training environment.

As this was happening, Company Bravo, under the advisement and facilitation of IT Department Office 1, drafted all administrative processes. The most difficult portion of this project was to schedule courses in a way that met operational requirements and maximized both instructors' and students' time. Other administrative procedures, such as determining how to prioritize students, travel coordination, syllabus development, and creating a mechanism to facilitate process improvement, were simple in comparison, yet still vitally important. After all, without the appropriate administrative processes in place to support training, even the best training program in the world would surely fail.

Overarching Benefits

The standup of a schoolhouse resulted in three primary benefits. For the first time in the IT Department's history, training was standardized and widely available for technicians. The first failed training solution, prior to this schoolhouse, resulted in standardized training (albeit, minimal in nature) that was only available to a handful of students each year. This solution was unable to keep up with corporate demand. The second failed training solution provided widely available training but was fragmented and had differing levels of effectiveness, which resulted in varying implementations, best practices, and approaches to operations across the IT Department. A dedicated schoolhouse provided a venue for both standardized, and available, training to all technicians across all offices.

Additionally, the quality of training available was a night-and-day difference from where it had been prior to the standup of a schoolhouse. Not only was there a dedicated team of professionals constantly working to maintain and improve the training material, but a lab environment was the crux of the approach to training. Never had personnel from the IT Department been afforded the opportunity to learn, and to inevitably fail, in a safe environment. Previously, all technicians would learn through PowerPoint presentations and verbal discussions,

despite being expected to perform technical functions upon completion of training. The schoolhouse provided an innovative solution to learning and a place where technicians could learn the job without risk to an Enterprise-level network.

Finally, IT Department offices had been relieved of the responsibility to maintain and administer training to their employees. This was a time-intensive requirement that pulled technicians from their primary job of administering the network. Now, by focusing each IT Department offices' efforts and reducing their additional responsibilities, each IT Department office reaped the same benefits as an increase in manning, which further enabled them to better accomplish their jobs. This, combined with an increase in work quality of technician performance, led to reduced technician errors, streamlined troubleshooting processes, and overall customer satisfaction. Each benefit follows the path of what can be expected out of an effective training program [3].

These primary benefits, among smaller benefits, were seen immediately upon the start of the schoolhouse establishment. Was this solution perfect? No. There were many opportunities for improvement that were seen in rapid succession throughout the beginning stages of the schoolhouse being operational. However, there was a mechanism in place to facilitate improvement of the schoolhouse's training curriculum, processes, lab environment, and instructors. This mechanism was quickly adopted and used to identify trends of recommendations, which were used to drive change within the organization. Overall, standing up a dedicated schoolhouse for the IT Department was a major initial investment of time, talent, and money, that paid off exponentially once the schoolhouse was up and running.

Future Work

While this project immediately showed payoff within the IT Department and, at a higher level, the overall operations of Corporation Alpha, there are several efforts which must take

place for this project to be a continued success. First, the training objectives must continuously be reviewed and vetted for validity against the needs of the IT Department. For example, if the role of the IT Department changes (due to instances of certain devices or networks being phased out, new technology being adopted, etc.), then the training objectives of the schoolhouse should quickly adapt to reflect the updated requirements of the IT Department. It is reasonable to expect that frequent changes in technology will drive the need to regularly update training material, thus showcasing the importance of training review and adaptation [4].

This will necessitate the schoolhouse to stay synchronized with the IT Department. When technological changes are made the IT Department will need to fluidly work with the schoolhouse to ensure it has the proper training and technology to enable instruction on new technical actions. The schoolhouse's instructors must be able to quickly learn new skillsets (at a depth which allows them to teach those same skillsets) and use that knowledge to create or update training material. This updated or new training material must include training objectives, academic lessons, lab environment, lab scenarios, quizzes, and tests. It is important to note that the longer the delay between IT Department changes and schoolhouse adaptation, the more on-the-job training must occur when technicians graduate, thus defeating the initial purpose of the schoolhouse.

In addition to the schoolhouse's instructors and training material requiring future action, the administrative processes in place that support the schoolhouse will need proactive nurturing. Funding to enable technician travel, lab environment upgrades, and classroom equipment refreshes must be in place prior to the "need to spend" that funding. For this to happen, members from the Board of Directors, the IT Department, and the schoolhouse must remain in lock-step with each other and the Board of Directors must continue to prioritize the importance of IT

Department training from a monetary perspective. It is of high importance for the Board of Directors to continue to prioritize training, because the moment that executives fail to place value on training is the same moment the organization will fail to enforce proper training [5]. As long as members across Corporation Alpha, the IT Department, and the schoolhouse are vigilant to maintain effective communication, evaluate the course material, and make necessary changes to the training to sustain relevancy, the schoolhouse will continue to produce qualified technicians that are valuable to the IT Department and Corporation Alpha.

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