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In this issue:

Network Growing Pains

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Abstract: The objective of this case study is to give students exposure to basic network design, with a project management perspective. Following the completion of this case, students will have a basic understanding of the scope and the depth of a typical network design project and an understanding of the business needs involved. The case begins by following Terry Borden (a network architect) through a project kickoff meeting on her new contract assignment at NC Insurance in Wilmington, NC. The company is in need of a major expansion to handle its growth over the past 25 years since it was established. Terry was brought in to help with the network design of the new office building the company is planning to move into. Borden needs to focus on offering a network design for NC Insurance that will meet their business needs based on the information she collects from interviews with the system stakeholders. She also needs to incorporate various constraints such as time, money, people, etc. by putting her project management skills to work. The network design project deals with management issues as well as technology issues.

Keywords: case

Case: This article is a teaching case. Additional teaching notes and materials for instructors are available for EDSIG members at <http://jisar.org/restricted/>.

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Growing Pains: A Teaching Case

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Abstract

KEYWORDS: networking, network design, project management, decision making

1. INTRODUCTION

Terry Borden walked out of the three-hour project kick-off meeting. She was exhausted. Fortunately, her jet lag from last night's California to North Carolina flight was wearing off. Last week she had been contacted by Mark Hudson, CEO of NC Insurance, to help design and install a new computer network for the organization.

Seven A.M. and the meeting room was practically full. In addition to the CEO, an architect and several building contractors were gathered around a mahogany table in the center of the room. After introductions, Mark stood up, sipped his coffee, and talked about his vision for the space and its computer network.

Terry was impressed by the detail with which Mark verbalized his vision. Much of the office design had already been considered. He described an open office layout with cubicle style furniture for the majority of the 200 employees, some enclosed offices, eight enclosed meeting rooms, and a reception area.

The first three floors of the building would accommodate 60 to 70 employees each and have 2 meeting rooms per floor. The top floor would have offices for 35 to 45 employees and a meeting room. Mark described how contingency plans and contracts had already been put in place in case the company outgrew the space. He reiterated the building manager's commitment to provide space on additional floors in the building if needed, although depending on market conditions, the space may not be on adjacent floors.

Over lunch, Terry replayed Mark's final comments over in her head.

"Everyone, please help me welcome Terry to our team. She's already told me that she plans to pick the brains of almost everyone in this room. Please take the time to talk with her. As our network engineer, Terry is here to research our needs, recommend hardware, and install the entire network in the new building. We're lucky to have her here."

"No pressure," Terry thought as she dropped what remained of her chicken salad sandwich in the cafeteria trash. She picked the spiral bound notebook off of her lunch tray, looked at the list of questions she had jotted down over lunch (see Appendix A) and walked out of the cafeteria toward Jim's (IT personnel) office. As a seasoned network engineer, she appreciated the importance of determining business needs accurately. (Sample interview responses are provided in Appendix B to guide design and implementation considerations.)

2. COMPANY BACKGROUND

NC Insurance was started 25 years ago on the southeast coast of North Carolina, in Wilmington. As the small beach town grew so too did its insurance industry. Over the last several years, the 200-employee insurance company has outgrown its office space. To alleviate crowding, the company secured the top four floors of an existing office building in downtown Wilmington. Unfortunately the space required a massive retrofit. As the scope of the work emerged, Terry was called in.

3. THE NETWORK PROJECT

To create a viable network solution; planning, installation, and support processes must be implemented. Terry understood that her first steps should be directed at planning. Creating a new network is a complex task, with the requirements of the network based on current and forecasted needs.

To understand the wants and needs of her client Terry decided to conduct a business needs analysis, based in part on interviews. The identified requirements would then be used to define the scope of the project (to prevent scope creep), establish and schedule tasks, and delegate responsible parties.

After the requirements data was obtained, Terry's focus would shift to designing of the network and managing the installation process. Beyond design, Terry knew that she would have to review the hardware selection and carefully test all hardware before running it in a production environment. She also needed to put procedures in place to address the need for on-going network support so that the network would continue to

be analyzed for speed and efficient operation as it changed with time.

4. PLANNING

To understand user requirements of the new system, Terry started her project with a business needs analysis. Even though she had a list of interview questions ready, she looked through the company's Help Desk history to better understand their current problems. This helped her to refine the questions to pose to the managers, insurance agents, and tech support personal at NC Insurance (see Appendix A and B for sample interview questions and answers).

Terry interviewed managers throughout the company. From her years of experience, she knew that a confident attitude accompanied by a warm smile put people at ease and helped her collect accurate and useful information.

The interviews provided a departmental functionality overview and gave her ideas on how to separate different functional areas on the network (to control network congestion and prevent unauthorized inter-departmental access).

Additionally, Terry learned the number of network users in each department and different security/access restrictions for each department's users. The insights that she gained from managers regarding the company's future direction also helped her forecast future network requirements and brought possible scalability issues to the forefront of the design process.

During her interviews with the insurance agents, Terry compiled a list of the current software systems used throughout NC Insurance and noted how the programs (and their users) accessed information over the network. She also gathered data concerning network demand differences throughout the day and made a mental note to discuss "how network efficiency can be turned into user efficiency" with her team. The interviews gave her an idea of what bandwidth would be sufficient for the insurance agents.

It was a long couple of days. However, the information Terry and her team gleaned was invaluable. Interviews with the in-house tech support and network personnel revealed the organization's current network

topology, hardware base, and trouble areas. Terry knew that the success of any network design would be correlated with the experience of its support personnel. Through subtle questioning she learned about the level of experience of each of the support personnel via the future network architecture preferences of the support staff.

Following the preliminary interviews with Mark, Jim, various department managers and several insurance agents, Terry felt she understood what upgrades were necessary to meet current and future company needs and what her budget would be to fulfill those needs. She also started to create the schedule of activities that would be required to complete the network planning and installation project.

5. NETWORK REQUIREMENTS

With interview responses still in mind, Terry next considered bandwidth needs, resource needs, performance and quality of service requirements, network scalability and network security issues.

She knew that, if the department manager did not foresee any large changes, current bandwidth usage could be used to calculate future requirements. However, it would be necessary to plan for usage growth due to personnel additions and a general increase in network resource utilization.

To determine resource needs Terry reviewed items ranging from email accounts to network printing of shared folders. In the new design, she wanted to ensure correct functionality and efficient communication for the supported applications and protocol requirements. She also looked for evidence of older software that used non-standard protocols for communications. Several years ago, she learned the hard way that the installation of non-standard protocols required network hardware and software to be set up to facilitate them.

In her examination of the current network, Terry checked the performance and quality of service (QOS) requirements. She evaluated the response time between the clients and server and used this information to design and configure the network for optimum speed. She also considered what priority levels she needed to assign to different pro-

ocols so that each received the appropriate placement in the network queue.

Terry planned for modularity as an essential feature in the new network design. She explained to her team, *"Networks are easier to manage when they are modular in nature. Having a modular network will also help us in the future if we need to come back to bring new departments on line or if the company decides to divest one of its business units. Modularity will also isolate any network problems to one segment, ensuring the entire network is not affected."*

Even though the new design would surely help the company with its current growth pains, Terry and her team used the future growth expectations that she had obtained from her interviews to plan for network scalability. She did not want new network segments to create bottleneck issues on the existing network (Mueller, 2003).

Finally, Terry turned her attention to network security. She had to consider electronic access to the network through wired or wireless connections and physical access to network hardware. She told her team that all non-used hardware connections should be removed from the network. *"Even with tight network security, a hacker could gain access by plugging in a laptop or other portable device; viruses or spyware could be spread almost instantly."*

Terry also decided to put MAC address restrictions in place so that no outside device could use the firm's wireless connection. She chose network address translation (NAT) routers with a built-in firewall as Internet security devices (Murhammer, 1999) for her design. *"These routers use network address translation that lets us connect many computers to the Internet while hiding their true identities."*

6. THE NETWORK PROJECT MANAGEMENT PROCESS

As a seasoned engineer, Terry knew that managing a network installation project would be a complex and difficult challenge. Since each network design project consists of a series of interrelated activities/tasks, Terry needed to ensure that the project was run smoothly, would be completed successfully, and that resources were assigned effectively. The risks were high. Terry and

her team were outsiders, so the perception of the seriousness of any mistakes would be magnified. Further, cost overruns and unnecessary delays could always occur due to poor scheduling or inadequate control of the project. After the list of network requirements had been created, Terry discussed the findings with her team.

Managing a network design project involves three phases: planning, scheduling and controlling. During Terry's meeting with the team, the group focused on the planning stage by clearly outlining the objectives of the project and redefining its scope. To accomplish this, they brainstormed all required tasks in the project to create a simple work breakdown schedule (WBS). The WBS defined each stage of the project, divided each stage into smaller tasks, and detailed each task's components (Appendix C illustrates the WBS for developing the network requirements.) *"The division of the project into smaller tasks can be difficult but is critical in managing the project successfully,"* she pointed out.

Terry believed that the extra effort involved with creating a WBS would more than pay for itself by helping to ensure that no steps in the project were overlooked and that all tasks were completed in the proper sequence and on time.

After completing the work breakdown schedule, the group estimated resource requirements and the costs associated with each task. They also reiterated their objective to complete the project to specifications, on time and on budget. Based on Terry's previous meetings and discussions with the senior management of NC Insurance, she understood that the company was still growing, and had adopted a conscious cost structure that required all projects under development to stay within the budget.

Based on her interviews with the IT director, Terry concluded that the IT department at NC Insurance lacked the in-house knowledge and manpower required to complete a network installation project on its own. As a result, she decided to subcontract parts of the project by sending request for quotes (RFQs) to several vendors that she had worked with on previous jobs. After several days, she obtained cost and time estimates for each of the project's outsourced activities.

Few network teams are given the authority to proceed on a project no matter the cost so Terry and her team created a cost estimate for the entire project and submitted it to the senior management at NC Insurance for approval.

Upon receiving approval of the project cost estimate, Terry and her team scheduled the various tasks in the project and assigned resources (including people and money) to specific tasks. They began by sequencing all project activities/tasks specified in the WBS. The time needed to perform each (in-house) task was also estimated, along with the number of people needed for each task.

As the project took on a life of its own, Terry's team focused on managing and controlling the process. They began monitoring resource use, budgets, costs and quality. Plans were also revised and resources shifted to meet the goals established in the planning stage.

Terry's team had received extensive training in two widely used techniques for scheduling, monitoring, and controlling: PERT (Program Evaluation and Review Technique) and CPM (Critical Path Method). Terry understood that these techniques allowed her to make better use of people, money, and material resources by identifying critical bottlenecks in the project. She considered the techniques valuable because they accounted for the precedence relationships and interdependencies of activities, in addition to the time and cost estimates of each (Appendix D illustrates how the various activities are interrelated and the predecessor for the network installation process under consideration).

Terry's team identified the precedence relationships for each activity in the WBS (see Appendix D). Once the immediate predecessors of each activity was established, the information was entered into Microsoft Project to create a network diagram for the project.

The program helped Terry track activities, their costs, and expected time to be spent on each task. Based on PERT and CPM (which follow six steps as depicted in Figure 1), critical and non-critical activities were identified by Microsoft Project. This identified the activities that had to be completed on time to avoid delays in completing the

project (Ragsdale, 2007) and helped Terry focus on expediting those tasks. The PERT and CPM analyses also helped the team keep a running account of time and budget performance and whether remaining resources were sufficient to complete the project.

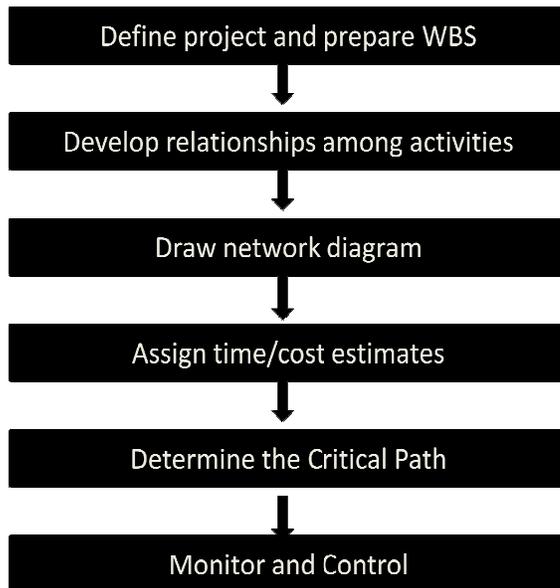


Figure 1 (Cliff T. Ragsdale, *Managerial Decision Modeling*, Thomson 2007).

An activity is a predecessor of another activity if the latter cannot be performed unless the former is completed

BIBLIOGRAPHY

Mueller, S., & Ogletree T.W. (2002) *Upgrading and Repairing Networks*. Indianapolis: Que Publishing.

Murhammer, M.W., Lee, K., Motallebi, P., Borghi, P., & Wozabal, K. (1999). *IP Network Design Guide*. Retrieved from www.redbooks.ibm.com

Ragsdale, C.T. (2007) *Managerial Decision Modeling*, Thomson.

FURTHER READING

Designing and Supporting Computer Networks Demo - Cisco Systems, Inc. Retrieved from http://www.cisco.com/E-Learning/prod/curriculum/cco_tdo_ldd/D4_eng/Discovery4_English_Ch2_Demo/index.html

SAFE: A Security Reference Architecture. Retrieved from http://www.cisco.com/en/US/docs/solutions/Enterprise/Security/SAFE_RG/SAFE_rg.pdf and [http://www.cisco.com/en/US/solutions/collater-ns170/ns896/ns954/white_paper_c11-527476.html](http://www.cisco.com/en/US/solutions/collater/ns170/ns896/ns954/white_paper_c11-527476.html)

Project Management. Retrieved from <http://ocw.mit.edu/NR/rdonlyres/Mechanical-Engineering/2-000How-and-Why-Machines-WorkSpring2002/A177E2C2-A9B4-403C-B616-33CC7AE59A51/0/management.pdf>

PERT, CPM and GANTT. Retrieved from <http://studentweb.tulane.edu/~mtruill/dev-pert.html>

APPENDICES

APPENDIX A: SAMPLE INTERVIEW QUESTIONS FOR THE DESIGNER

Questions to pose to the department manager

Do you have any current needs that the IT Department is not handling? *(If so, they must be listed in order of importance and addressed immediately.)*

Please give me a general overview of what your department does. *(Gives the interviewer a department summary and allows them to formulate additional questions based on the manager's response.)*

How many of your employees require network access? Do some of them have access to files that others do not? *(Useful for network wiring needs and provides needed info for a hierarchical security diagram.)*

Have you received complaints of network slowness or has slow network response time hampered productivity? *(If so, find out what programs were being used, what time of day, and what days the slowness was experienced. Create a log sheet for users to document slowness, so it can be examined by network personnel.)*

Do you see your division expanding rapidly any time soon? *(If so, then it might be wise to install a 48 port switch instead of a 24 port switch.)*

Is there any possibility that your department will be relocated in the near future? *(If so, the backbone and/or core switch needs extra scalability.)*

Are there any new laws that might affect the way you operate in the digital age? *(If so, those laws must be addressed. For example, privacy concerns are forcing companies to audit their security policies for improvement.)*

Is there new technology out there that will improve employee efficiency in your department? *(If so, do you plan on implementing it in the future, and what network requirements does it have?)*

Do you plan on upgrading or adding any new software in the near future? *(If so, how does it tie into the network? Does it require extra bandwidth?)*

Do you plan using VoIP (voice over IP) in near future? *(If so, PoE (power over Ethernet) switches are needed.)*

Questions to pose to department employees

What software are you currently using? *(List all software titles for analysis.)*

Do any of the programs perform slowly or hang up briefly? Is it intermittent or always slow? Do you notice it at certain times of the day? *(If always slow, report to Help Desk or network personnel. If intermittent, give user the log sheet so they can document it.)*

Do you use any programs that require a certain response time? *(If so, list the titles and the response time, if known.)*

What type of information do you access over the network? How often do you access the Internet, shared files, and email? *(List all for later analysis.)*

Do you know of any other programs available that would make your job easier or more efficient? *(If so, list the titles and time saving benefits.)*

If it were possible, would network speed improvements make your job easier or more efficient? *(If yes, note their response.)*

Do you have any other suggestions? *(Be prepared for criticism. Don't be defensive. Note their responses.)*

Questions to pose to in-house support

What is your current network architecture/backbone architecture? (*speed analysis.*)

Are you using switches or hubs and what is the rated speed of each? (*speed analysis.*)

What types of wiring are you using? Twisted pair? What speed rating? Any fiber? (*speed analysis.*)

Are you using wireless? 802.11n? (*planning the new network.*)

Who is your preferred Internet Service Provider? (*connectivity*)

Do you have any networking hardware vendor preferences? (*Support personnel might be familiar with configuring switches from a certain manufacturer.*)

What network backbone architecture would you recommend for the new network and how would you lay it out? (*support personnel's network knowledge.*)

APPENDIX B: INTERVIEW DATA**Interview with in-house tech support**

Q. What is your current network architecture?

A. We have a star topology using 100Base-T category 5 twisted pair throughout the offices. Everything has been patched together as we have grown using 100Base-T hubs and switches. Only a couple of offices still have hubs. We have been able to phase in switch technology over the last few years. We are using a collapsed backbone network and the core switch is simply a 100Base-T switch. In places, switches are cascaded off of each other in order to span distances longer than 300 feet. We don't have any fiber or wireless technologies. We have the basic Business Class service which offers 6 Mbps download and 2 Mbps upload speed provided by Road Runner.

Q. Is that sufficient?

A. Actually it is not. We have been looking at upgrading to a fiber connection for greater bandwidth, but knew this office move was approaching. We want to explore our options with Road Runner further and upgrade service when the new building comes on-line.

Q. Do you have any networking hardware vendor preferences?

A. No. Over the years, the head IT support person has been replaced several times. Our hubs and switches are a mix of brands, which probably reflects the preferences of the different personnel. As long as the new system is easy to configure, has excellent support, and works as advertised, I have no loyalties to any manufacturers.

Q. Having seen the preliminary plans for the new office space, do you have any recommendations on backbone architecture and system layout?

A. Our network is currently pretty maxed out bandwidth wise. The use of digital video and photography in the insurance industry is putting a strain on network resources. I would recommend gigabit speeds to the desktop. Some of our current computers can only connect at 100 Mbps, but all of our new computers are coming equipped with gigabit network cards. I would like to implement VLANs into the new network configuration, so Layer 3 switches would need to be purchased. We have also started to use all rack mounted equipment, so a rack based collapsed backbone would make sense to me.

Interview with the department manager

Q. Please give a general overview of what your department does.

A. We are responsible for handling motorcycle, automobile, and boat claims. We investigate all claims, interview clients and witnesses, document the findings. We are moving into a paperless filing system, so all of our information is digital. We also record interviews, so digital

audio files are also used. We have 55 employees accessing the same information so that when a client calls requesting information on a current claim, any one of my employees must be able to access their files. On occasion I have heard complaints that the computers and I guess network is slow when accessing digital video files. Our division expands maybe one to two new employees per year. We need to comply with privacy laws. Because we are in the insurance business, we send information back and forth to the big three credit reporting companies. We also have to comply with FEMA standards to ensure fraud is kept at bay.

Q. Do you send any personal information over the Internet or is it transferred to the credit reporting companies in hard copy or other digital format?

A. I believe we send the information on DVD.

Q. Do you know if they have the ability to receive that information over the Internet?

A. I think that might be a new service they are just starting to offer.

Q. Do you know of any new technology or software out there that will improve employee efficiency in your department?

A. No.

Q. Do you plan on upgrading or adding any new software in near future?

A. No.

Q. Do you plan using VoIP in near future?

A. No.

Interview with a department employee

Q. What software do you currently use to perform your job?

A. We have a custom application called Safeguard that allows us to enter all necessary information. I also use Microsoft Word and Excel to draft different documents. Other than email, that is just about it.

Q. How do digital audio, pictures, and video get on the system?

A. Safeguard is a pretty robust program. To conduct a phone interview, I click a button in the program to start recording. It automatically creates an audio file for it somewhere, and links it to the claim. Anyone can listen to it later by clicking on another button. Transferring pictures and video into a claim is easy also. Safeguard opens a browser window, and I just drag and drop the files in. Our digital cameras record video as well as pictures, and plug into the computer through this cable.

Q. Do any of the programs perform slow or just seem to hang up briefly?

A. When transferring files from the camera it seems a little slow. It also has problems playing back some of the audio and video.

Q. What do you mean by problems?

A. Occasionally it pauses during playback and takes few seconds to restart.

Q. Is it intermittent or always slow? Does it happen at certain times?

A. Honestly, I think it is always slow.

Q. Do you have any programs that require a certain response time?

A. Yes. When we first got Safeguard, it had problems recording audio. I was told that it was trying to record straight to the network server, and the slow network response time hampered that feature. An update to safeguard was later released that temporarily recorded the audio file to our computer, and then transferred it to the network server later.

Q. Other than Safeguard, how often do you access email, files on the network, or the Internet?

A. Pretty regularly throughout the day. I don't correspond with clients over email that often – we use email more as a means of inside communication. I do have to send a lot of letters. Safeguard has a plug-in that interfaces with MS Word to pull the client's information like a form letter, and that gets saved in the client's file. I do have to use the Internet pretty regularly to access information from government sites and other insurance agencies.

Q. If it was possible, would network speed improvements make your job easier or more efficient?

A. From what they tell me, a faster network would help out with digital audio, pictures, and video.

APPENDIX C: WORK BREAKDOWN STRUCTURE OF DEVELOPING THE NETWORK REQUIREMENTS

Activity	Description	Immediate predecessor
A	Understand network client and user requirements	none
B	Analyze business needs and data gathering by conducting interviews	none
C	Determining the network needs and requirements	A,B
D	Selecting the equipment	C
E	Designing the network architecture	C
F	Installing the hardware	D,E
G	Testing the network	F
H	Making Adjustments to the installed network	G

APPENDIX D: IDENTIFYING THE ACTIVITIES AND THEIR PREDECESSORS

Level	Level ID Number	Activity
1	1	Develop the Network Requirements
2	1.1	Develop bandwidth needs
2	1.2	Develop resources needs
2	1.3	Develop network security
3	1.31	Electronic and physical access
3	1.32	Spyware
3	1.33	MAC address restrictions
3	1.34	Connection to Internet