

Renel International Education Outreach Incorporated



2016 Philippines Project Plan August 2015

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1. PLAN SUMMARY

Reneal International Education Outreach (Reneal IEO) installs low-cost computer labs in high schools in the Philippines and Tanzania. Eleven schools in the Philippines were evaluated via on-site visits in June and July of 2015, and five schools that were judged to meet or exceed Reneal IEO criteria for project involvement have been approved by the Reneal IEO Board of Directors for implementation. One school was completed in July of 2015.

The Reneal IEO mission statement is provided in Section 2. Section 3 includes a summary of estimated costs and required resources for Reneal IEO to complete the projects. Project completion is contingent upon those resources being available.

Section 4 outlines expectations for the beneficiary schools. School Heads must read and agree with these expectations before the project will be implemented at their school. Project implementation will begin in the January of 2016, and schools must have their IT labs fully prepared per expectations by that time.

2. RENEAL INTERNATIONAL EDUCATION OUTREACH MISSION STATEMENT

Our purpose:

The paradox in many developing countries is that education is the path to improve lives, but schools are underfunded and many young people can't afford to attend. The specific purpose of Reneal International Education Outreach (Reneal IEO) is to provide support for students, their parents, teachers, and school administrators to enhance education opportunities in schools in developing countries. Recognizing the power of technology in particular to change lives, the primary focus of this organization is to provide Information Technology expertise and assets (computer hardware, computer software, and learning resources) to these schools.

What we do:

Our goal is to give students and teachers in developing countries better resources for learning. Key Reneal IEO activities are:

- Developing and installing low-cost computer systems for schools
- Developing the Philippines School Information System (SIS)
- Providing teacher training in IT
- Serving as a conduit to get educational materials to schools
- Providing funding for scholarships and microfinance programs

How we do it:

To support these activities, Reneal IEO will:

- Develop hardware and software solutions and associated trainings that are tailored for developing countries
- Freely share these solutions and trainings with other individuals, agencies, and corporations
- Perform on-site installation, consultation, and training in developing countries
- Capitalize on connections and cultural skills built through the founders' United States Peace Corps experiences
- Leverage multiple decades of experience in software and technology
- Seek corporate support for projects and provide tax deductions for donations

Why we do it:

Information Technology has the potential to ignite the love of learning in students and teachers and to

open doors for new opportunities for those in developing countries. We wish to share our passion for IT with others in order to help them achieve a better life. The ultimate reward is seeing the spark in someone's eyes as they realize this potential themselves.

3. PROJECT DESCRIPTION

3.1. Beneficiary Organizations

With inputs from Department of Education officials (Cebu Province Division and Mandaue City Division) and local team members and partners in Cebu, eleven schools in the Philippines were identified as candidates for 2016 projects. These schools were evaluated via on-site visits in June and July of 2015. The following five schools have been approved by the Reneal IEO Board of Directors for implementation of the Reneal IEO low-cost computer infrastructure in 2016. Each of these schools meets or exceeds the Reneal IEO criteria for selection.

- Almacen Torrevillas National High School, Medellin, Cebu
- Consolacion National High School (Day), Consolacion, Cebu
- Mulao National High School, Compostela, Cebu
- Tabok National High School, Mandaue City, Cebu
- Tipolo National High School, Mandaue City, Cebu

One of the schools evaluated in 2015, Medellin Science and Technology High School, was completed in July of 2015. If time and resources permit, the remaining five candidates (Calape NHS, Curva NHS, Maya NHS, Medellin NHS, and Tominjao NHS) may also be reconsidered for installation in 2016.

A summary of the evaluation criteria as well as the selected schools is included in Appendix A.

3.2. Technical Details

The Reneal IEO low-cost computer infrastructure was initially developed to support a high school in the Philippines. This approach allows a school to connect many (10-20) less powerful computers ("clients") to a single powerful computer (the "server"). Each of the clients looks like a capable unit to the user, but programs are actually running on the server. More powerful clients allow for local load-sharing as well.

Key features of the Reneal IEO low-cost computer infrastructure include the following:

- Centralized file storage and management
- Use of a client/server architecture
- Use of Open Source software (Linux, Libre Office, other applications)
- Integrated software environment, customized for secondary schools

A description of the advantages of this approach and details of the software environment are provided in Appendix B.

The original implementation of the Reneal IEO low-cost computer infrastructure used much less capable machines as clients (Pentium 1 and Pentium 2 desktop computers). However experience has demonstrated that there are significant advantages of acquiring more capable used equipment from a single source:

- Supported by newer versions of the Xubuntu operating system
- Sufficient power to run selected applications locally, reducing server load
- Can have other operating system present for stand-alone operation
- Homogeneity greatly speeds lab set-up

3.3. Estimated Resources Required

Estimated Reneal IEO costs and the donated hardware required to complete these projects are summarized in Figure 1.

Figure 1: 2016 Philippines Projects Estimated Costs and Hardware Needs

School	Proposed Implementation	Estimated Reneal IEO Costs*	Donated Hardware Needed**,***
Almacen Torrevillas National High School, Medellin, Cebu	Add server, 1-Gbit NW switches, plus 8 additional client units****	997 USD	8 units + server monitor + keyboard
Consolacion National High School (Day), Consolacion, Cebu	Add server, 2-Gbit NW switches, plus 8 additional client units *****	997 USD	8 units + server monitor + keyboard
Mulao National High School, Compostela, Cebu	Add server, 1-Gbit NW switches, plus 5 additional client units *****	975 USD	5 units + server monitor + keyboard
Tabok National High School, Mandaue City, Cebu	Add server, 1-Gbit NW switches, plus 8 additional client units *****	997 USD	8 units + server monitor + keyboard
Tipolo National High School, Mandaue City, Cebu	Add server, 2-Gbit NW switches	1160 USD	Server monitor + keyboard
TOTALS		5126 USD	29 units, 5 monitors, 5 keyboards

* Does not include the value of the donated used computer hardware

** A “unit” is either a laptop or a desktop+monitor+keyboard

*** PLEASE NOTE THAT THESE QUANTITIES ARE CONTINGENT UPON RENEAL IEO RECEIVING SUFFICIENT HARDWARE DONATIONS – THEY ARE NOT GUARANTEED.

**** Receipt of additional clients is contingent upon the school providing tables and chairs.

A comprehensive, detailed list of computer equipment required to stand up the five laboratories is provided in Figure 2. Donated items are shaded with light blue. Reneal IEO will supply all other project hardware. These are the costs noted in Figure 1 in the column marked “Estimated Reneal IEO Costs”.

The main expense is the server, which requires a multi-core processor, a large amount of RAM, two high capacity hard disks, and two Gigabit network cards. Servers are typically custom built and the software image is then copied to the disk. Donated units will also require one mouse per seat. A network switch is required for connectivity between the server and clients. Ethernet cables are fabricated to reduce cost and to give maximum flexibility for room set-up. It is also essential to provide voltage regulation and surge suppression for the server, all clients, and the network switches due to variations in power that are sometimes experienced. Quantities for these will be estimated once the specific computer layout is determined at each school.

The rationale for the column in Figure 1 entitled “donated hardware needed” is summarized in Figure 3. A total of 29 laptops or desktop/monitor/keyboard sets is desired. **If this hardware is not obtained, then the number of computer units that can be provided to each school will be reduced.**

Note that this estimate does not include shipping costs of \$75 per large box. Desktops shipped from the US would obviously cost more than laptops to ship, but even with laptops it would probably take at least six boxes (10 laptops per box, 3 monitors per box, plus network switches, keyboards, and smaller server parts). Some of those funds are recouped by the lower cost of parts here in America.

Figure 2: Detailed Estimated Costs for Reneal IEO 2016 Philippines Projects (as of 8/23/15)

Item	Unit Cost (PhP)	Unit Cost (USD)	Alm Torr NHS	Alm Torr NHS Total	Conso-lacion NHS	Conso-lacion NHS Total	Mulao NHS	Mulao NHS Total	Tabok NHS	Tabok NHS Total	Tipolo NHS	Tipolo NHS Total	Total Quantity	Estimated Total Cost
Server computer	26500	602.27	1	602	1	602	1	602	1	602	1	700	5	3109
Ubuntu Operating System, applications, custom software for schools, installation, and training	0	0	1	0	1	0	1	0	1	0	1	0	5	0
Uninterruptible power supply (UPS)	6000	136.36	1	136	1	136	1	136	1	136	1	136	5	682
Network switch Gigabit 24-port	4800	109.09	1	109	1	109	1	109	1	109	1	109	5	545
Network switch Gigabit 16-port	3600	81.82		0		0		0		0	1	82	1	82
Network switch Gigabit 8-port	1100	25.00		0		0		0		0		0	0	0
USB optical mouse	200	4.55	9	41	9	41	6	27	9	41	1	5	34	155
Power strip, 4-outlet	365	8.30	4	33	4	33	3	25	4	33		0	15	124
Power strip, 6-outlet	580	13.18		0		0		0		0		0	0	0
Cat 5e Ethernet cable (per meter)	11.67	0.27	150	40	150	40	150	40	150	40	250	66	850	225
Voltage regulator for network switch	590	13.41	1	13	1	13	1	13	1	13	2	27	6	80
CMOS batteries	50	1.14	5	6	5	6	5	5	5	6	5	6	25	28
Cable tacks (box)	160	3.64	1	4	1	4	1	4	1	4	2	7	6	22
Kit bag items (cable ties, clamps, tape, labels, etc)	88	2.00	1	2	1	2	1	2	1	2	1	2	5	10
RJ45 connectors	10	0.23	40	9	40	9	40	9	40	9	80	18	240	55
USB cable for UPS	80	1.82	1	2	1	2	1	2	1	2	1	2	5	9
Desktops (used, donated)	4400	100.00	8	800	8	800	5	500	8	800		0	29	2900
Monitor (used, donated)	2200	50.00	9	450	9	450	6	300	9	450	1	50	34	1700
Keyboard (used, donated)	220	5.00	9	45	9	45	6	30	9	45	1	5	34	170
TOTAL (USD)				2292		2292		1805		2292		1215		9896
Donated to Reneal IEO				1295		1295		830		1295		55		4770
Purchased by Reneal IEO				997		997		975		997		1160		5126

Exchange rate 44 PhP/USD

Figure 3: Summary of Schools' Student-to-Computer Ratio

School	No. Students	Current No. of Computers	Current No. of Computing Nodes	BEFORE: Ratio	Desired No. of Seats to Add	AFTER: Ratio	Comments
Almacen Torrevillas National High School	618	6	0	103	8	44	Significant damage from Yolanda
Consolacion National High School (Day)	2000	14	40	143	8	91	Somewhat limited space for expansion
Mulao National High School	482	10	40	48	5	32	Not sure if all 10 existing units will be usable as clients
Tabok National High School	811	12	0	68	8	41	
Tipolo National High School	1099	38	0	29	0	29	Needs more powerful server due to large number of existing clients

Expectations for beneficiary schools are summarized in the next section. Please read this section carefully. These expectations must be agreed to by the school and met in order for the project to proceed.

4. EXPECTATIONS

Beneficiary schools are expected to provide space and security for the IT lab. Tables for the computers and chairs for users must also be supplied. As noted in Figure 1, several of the schools must provide additional tables and chairs if sufficient units are obtained from donors to Reneal IEO for these projects.

Beneficiary schools are expected to provide resources for maintenance and for expendable items as needed. Optional items that have been proven to be useful to schools (a projector or large refurbished TV for projection, a printer, and cooling) are also suggested if not already available.

IT coordinators at the beneficiary schools will be expected to spend time with Reneal IEO volunteers to learn about the system and to assist with teacher trainings. Training sessions will be provided by Reneal IEO for teachers at the selected schools, with special system administration training for the IT teachers. These trainings will be scheduled in cooperation with the school heads to minimize disruption to classes.

School heads and IT coordinators at the schools will be expected to commit to use of Open Source software with the installed system. In addition, it is expected that United States copyright laws will be respected in the use of this equipment. Installation of pirated software on any computer hardware provided by Reneal IEO is strictly prohibited. However software that is already installed on existing computers at the school does not have to be erased and the existing computers can be used in dual boot mode if desired.

Equipment donated by Reneal IEO to schools cannot be sold, removed, or used for purposes other than education without the express written consent of the Board of Directors of Reneal IEO. Donated equipment should never be taken from the IT lab, even for temporary use. Experience has shown that it frequently is not returned.

This donation is made solely to assist the students and teachers of these schools in their pursuit of quality education. It is expected that the computers provided by Reneal IEO will be used by students to learn about IT and for projects and research in other subject areas. It is expected that the computers will be used by teachers to prepare for classes, complete school reports, compute grades, and other school-related tasks. Because of limited Internet bandwidth, video streaming (even for educational purposes) is discouraged. Computers provided by Reneal IEO should be treated as a learning resource for students and teachers, not as an Internet café.

5. PROJECT MONITORING

Each of the selected schools will be asked to track two measures of success to monitor the project and evaluate its effectiveness. The first is computer usage rate in the IT lab. This will be tracked monthly by the IT coordinators. The second metric is based on teacher self-assessments of computer skills, conducted over time. This will be done by the IT coordinator in conjunction with Reneal IEO.

6. PROJECT RISKS AND MITIGATION

Below are listed the project risks:

- A key risk is hardware failure. The server is configured with two hard disks and daily backup so that single disk failure is not catastrophic. Clients can be removed or added to the configuration seamlessly in case of failure. However other hardware failures (e.g., a network switch) would be catastrophic, at least until they can be replaced during the Reneal IEO visit the following year.
- While provisions for security have been discussed with the schools, IT laboratory security is a concern. Site visits were encouraging in that a room dedicated to IT lab use was available. Laptops are advantageous in that they can be easily secured elsewhere.
- Reneal IEO experience has been that once computers arrive on campus, there will be intense competition for use, including IT classes for students, teacher administrative tasks, and use by teachers of all subject areas for research and teaching. A process must be in place for IT lab scheduling to minimize conflicts in use.
- The Linux user interface has been customized to look like Microsoft Windows®. However teachers that have some familiarity with Microsoft OS and applications will need to learn new skills. This risk will be mitigated by training sessions conducted by Reneal IEO for the teachers that will be done coincident with the installations.
- IT teachers are usually not familiar with Linux and Open Source software when the system is first installed. System administration training is provided, along with a detailed system administration manual. For schools with internet, Reneal IEO volunteers can log in to the server remotely to assist with troubleshooting. There is also a local expert in Compostela to help with any issues that arise.

7. ORGANIZATIONAL QUALIFICATIONS

Reneal IEO is a 501(c)(3) organization, incorporated in April of 2012. The co-founders have planned, designed, and executed multiple similar projects since they served as United States Peace Corps Volunteers in the Republic of the Philippines (2006-2008). The co-founders each have almost three decades of experience in technology-related fields. Brief background information is included as Appendix C. A history of their work is provided on the Reneal IEO website at <http://reneal.org/content/history>.

8. CONTACT INFORMATION

Reneal International Education Outreach Incorporated
FEIN: 45-5439085
Address: 3746 Oxford Common, Fremont, CA 94536
Telephone: 925-319-7459/7460
E-mail: contact.reneal@gmail.com
Website: www.reneal.org

Reneal International Education Outreach Incorporated is a 501(c)(3) public charity. All donations are tax deductible to the full extent allowed by law.

APPENDIX A: BENEFICIARY SCHOOLS

For Reneal IEO computerization projects, the following criteria are used to determine suitability for a recipient organization:

- Basic infrastructure to support school computerization (e.g., secure space for computers, source of electricity, tables and chairs, internet desired but not required)
- A designated school Information Technology point-of-contact, such as an IT teacher or IT lab head
- Existing basic computer skills among the teacher population
- School is accessible from a main road with reasonable proximity to a city
- Potential to get internet
- Priority given to secondary school level
- Interested, enthusiastic principal and IT teacher, supportive parents and community
- A vision and passion for using IT in education

Selected schools for 2016 are listed below, along with comments from their evaluation visits.

1. Almacen Torrevillas National High School, Medellin, Cebu

Evaluation visit comments: Almacen Torrevillas NHS has about 618 students. Prior to the most recent curriculum, Visual Basic programming and standard office applications were taught. It is hoped that this teaching can resume if computers are received. There is a dedicated IT teacher who also has extensive experience as a technician.

There are approximately 6 working computers in the Almacen Torrevillas NHS lab (DCP Acer units) with 4 not working (the IT lab was damaged by Yolanda). The IT lab is spacious and already has air conditioning. Tables and chairs would need to be supplied by the school if additional computers are donated. There is internet in the office. Both Ceres and Rough Rider buses pass right by the school.

2. Consolacion National High School Day, Consolacion, Cebu

Evaluation visit comments: Consolacion NHS Day has about 2000 students. Grade 7 students receive exploratory training in computers. Offering a research class on the computers. The IT teacher is very knowledgeable about Linux and administering a Linux system.

There is an IT lab with 14 computers. They are older computers, similar to those that we have seen at the other high schools in Cebu. They are running Ubuntu, and it is a very well-maintained lab. Consolacion NHS also has an NComputing lab.

Additional tables and chairs would need to be added to the lab. There is an internet connection. Security seems adequate. The school is very easy to access since it is right by the National Road.

3. Mulao National High School, Compostela, Cebu

Evaluation visit comments: MNHS has about 482 students. Grade 7 students are taught computer literacy. They would like to have additional research opportunities for the students.

The IT lab has four working units, most of which are from the early-2000's donation that we've worked with at the other schools. There are six units that are not operational; potentially they have hard disk problems, in which case the units may be usable in the Reneal IEO system. The IT room was orderly and well-organized, and there is already an air conditioner. There is no internet connection. MNHS also has an NComputing lab.

Tables and chairs would need to be provided by the school for additional units. Security seems adequate. Transportation would need to be provided by the school or municipality, since there is no public transportation to the school other than habel-habel.

4. Tabok National High School, Mandaue City, Cebu

Evaluation visit comments: Tabok NHS has about 811 students. Grade 7 and 8 students are taught basic computer applications.

The IT lab has 12 working unit from the early-2000's donation that we've worked with at the other schools. There is an internet connection. Tables and chairs would be needed to be provided by the school for additional units. There are two air conditioners in the lab.

Security seems adequate. The school is off the National Road but trikes are readily available.

5. Tipolo National High School, Mandaue City, Cebu

Evaluation visit comments: Tipolo NHS has about 1099 students. School has been encouraged to innovate in the area of ICT, in spite of the current very limited curriculum.

The IT lab has 38 working units, about a third of which are from the early-2000's donation that we've worked with at the other schools. Some computers already have a workstation version of Ubuntu, and the IT teachers is very familiar with Linux. The IT room was orderly and well-organized. There is an internet connection.

Security seems adequate, and there is a school guard. The school is within walking distance of San Miguel, and students can be summoned to help carry equipment from there to the school.

APPENDIX B: SUMMARY OF RENEAL IEO LOW-COST COMPUTER APPROACH

Advantages of the server/client architecture and open source software environment:

- Easy maintenance – software is only on the server
- Clients can be added or removed easily
- Clients can be less capable computers (original implementation used obsolete P1/P2 machines as clients)
- Modular, extendable architecture: can run multiple servers in a large school
- Open source software is free, with no concerns about piracy
- No problems with viruses – this is a significant issue for schools
- All access to Internet is controlled through a single computer to provide filtering of content
- Users can access their own files from any computer
- Files are centralized for easy backup

Software is integrated and customized for a school environment:

- Internet filtering and caching
- Automatic backup
- Teachers
 - Individual password-protected accounts
 - Individual user profile information
 - Personal file storage space for each account
 - Shared file storage space for all teachers
- Students
 - Common look-and-feel for all student accounts
 - Folders for each student for individual file storage

Software elements:

- Linux Ubuntu operating system
 - Linux XFCE user interface created to look like Windows
- Libre Office (word processor, spreadsheet, presentations)
 - Can save/read Microsoft Office format
- Other standard applications (Mozilla Firefox and Google Chromium web browser, Adobe Reader, VLC movie viewer, Gimp photo editor, Bluefish web page design, CUPS printer manager)
- GCompris, TuxType, and TuxMath educational software

School resources configured for immediate use:

- WordPress blog
- School Wiki
- Moodle
- Squid internet filtering and caching with filters in place and set up for weekly update
- Internal Apache web server, home page with links to internal services and key external sites
- Firewall configured to protect all internal resources
- VPN for remote trouble-shooting and maintenance
- Prebuilt student and teacher accounts and file management structure
- Individual file storage area for each student
- Student accounts that are automatically rebuilt upon student logout to remove unwanted student changes
- Teaching and training resource repository, including 4000+ Khan Academy videos and Rachel educational materials

Complete documentation available at

<http://reneal.org/sites/default/files/documents/ComputerInfrastructureForSchools.pdf>

APPENDIX C: CO-FOUNDER CURRICULA VITAE

Neal R. Bierbaum, Reneal IEO Board President

Work Experience

April 2012 – Present, President and Full-time Volunteer for Reneal IEO

Continued projects in the Philippines and Tanzania. Primary focus is on software development.

January 2009 – April 2012, Full-Time Volunteer

Continued work in Philippines. Developed Philippines Student Information System, provided low-cost integrated software system to Aboitiz Foundation. Began work in Tanzania.

March 2006 – December 2008, United States Peace Corps Volunteer

Served as Volunteer at Compostela National High School, Compostela, Cebu, Philippines. Created low-cost distributed computer infrastructure on campus.

June 2001 – March 2006, Consultant - PACE, Inc.

Engineering consultant for Sandia National Laboratories. Developed simulation models of specialized network applications, a new network protocol, and remote high performance file systems. Designed and implemented major integrated multi-host software general test package.

September 1999 – February 2002, Consultant - PACE, Inc.

Continued consulting with Hybrid Networks. Performed significant redesign of numerous system elements for reliability and ease of use. Ported entire system to Solaris, Linux, and a new version of FreeBSD. Developed software architecture for Hybrid's next generation hardware.

May 1999 – August 1999, Transcontinental tandem bicycle ride with wife

October 1998 – May 1999, Consultant - PACE, Inc.

Chose to become consultant. Continued work with Hybrid Networks.

May 1995 – October 1998, Senior Engineer - Hybrid Networks

Primary engineer for “Head End” system. Designed and implemented all GUI Configuration, Monitoring, and Subscriber Database applications. Designed all control for 2-way cable system.

July 1991 – May 1995, Senior Engineer - Make Systems

Chief engineer for NetMaker Internetworking Simulation and Design tool. Created new conceptual model for simulation; personally designed and wrote all internetworking simulation software.

February 1989 – June 1991, Staff Engineer - Vitalink Communications

Senior software engineer in product engineering department. Developed software for wide area network bridge/routers. Created integrated software development environment.

September 1986 – January 1989, Systems Development Engineer - General Electric

Development engineer under contract to NASA Ames National Aeronautics Simulation (NAS) supercomputer center. Primary work in computer network communications.

June 1983 – August 1983, Transcontinental bicycle ride

August 1974 – June 1983, US Air Force

Commissioned officer (highest rank Captain). Experiences included instructing advanced students in the T-38 supersonic jet trainer and serving as C-130 Aircraft Commander.

Education

- Engineers' Degree Electrical Engineering, Stanford University, Stanford, CA, August 1986 (Thesis: “Space Station Experimental Control by a Remote Control Center”. Same academic load as a Ph.D.)
- Master of Science in Electrical Engineering, Stanford University, Stanford, CA, December 1984
- Bachelor of Science in Electrical Engineering, US Air Force Academy, Colorado Springs, CO, June 1974 (double major in Electrical Engineering and Computer Science)

Rene L. Bierbaum, Reneal IEO Board Treasurer

Work Experience

November 2013 – Present, Treasurer and Full-time Volunteer for Reneal IEO

Continued projects in the Philippines and Tanzania. Primary focus is on Reneal IEO operations and teacher training.

June 2014-Present, Part-Time Consultant - Sandia National Laboratories

January 2009 – November 2013, Reliability Analyst - Sandia National Laboratories

Resumed career as reliability analyst following U.S. Peace Corps service. Received Individual 2012 Defense Programs Award of Excellence for work in surveillance metrics and sampling rationale.

March 2006 – December 2008, United States Peace Corps Volunteer

Served as Volunteer at Compostela National High School, Compostela, Cebu, Philippines. Conducted 41 training classes and modules for the teachers of CNHS and other municipal high schools, downloaded web resources for teachers, developed admin tools for teachers.

September 1999 – March 2006, Reliability Analyst - Sandia National Laboratories

Responsible for reliability analysis of various Sandia hardware and methodology development. Appointed Distinguished Member of Technical Staff (top 10% of technical staff) in 2000.

May 1999 – September 1999, Transcontinental Tandem Bicycle Ride with husband

January 1998 – May 1999, Reliability Analyst - Sandia National Laboratories

Because of desire to make greater technical contribution, returned to technical staff position following 5-1/2 years of management experience. Was responsible for reliability analysis of various Sandia hardware.

August 1992 – January 1998, Manager - Sandia National Laboratories

Managed a group of ten technical staff and a budget of approximately 3M\$. Department mission included reliability analyses and use of electrical simulation tools to support Sandia products.

December 1988 – August 1992, Project Leader - Sandia National Laboratories

Led multi-agency system integration effort involving system and component designers and production engineers. Responsible for liaison and requirements negotiation with external customers.

December 1986 – December 1988, Systems Analyst - Sandia National Laboratories

Developed computer software to analyze the effectiveness of various sensor technologies in tactical battlefield applications using high-resolution war gaming models.

June 1984 – December 1986, Electrical Engineer - Sandia National Laboratories

Part of a team responsible for developing an infrared imaging system. Specific tasks included acquiring and configuring test instrumentation and characterizing imaging system performance.

Education

- Master of Science in Electrical Engineering, Stanford University, Stanford, CA, June 1984.
- Bachelor of Science in Electrical Engineering, University of Nebraska, Lincoln, NE, May 1983 (also completed all requirements for a major in Mathematics, plus extensive coursework in chemical engineering and computer science)