JUNE 2, 2000

Projects Day

SCIENCE AND ENGINEERING
PROJECT CENTER
SENIOR DESIGN
PROJECTS 1999-2000
Welcome

This is the thirteenth year of the Science and Engineering Project Center. I congratulate all those within the School and outside for making this Project Center the success it is today. Welcome, all of you, and thank you for your participation.

On this, Projects Day 2000, we present the results of student work sponsored by industry, government, and our university, and developed by senior students in the science and engineering design program at Seattle University. This is a wonderful opportunity for our students to share with you the results of their hard work.

We are grateful to our sponsors — those who are veterans at sponsoring our projects and those who are new this year. It is a tribute to your faith in our students, and in the quality of their work, that you choose to invest your time and resources in these projects.

This senior capstone experience is perhaps the most important learning experience for our students in culminating their careers at Seattle University. Working in small groups, solving open-ended problems that may not have a unique solution, and being responsible to strict timelines, budgets, and the needs of outside agencies, are excellent preparations for the professional positions our students will soon fill.

Congratulations to our faculty, students, and professional mentors for bringing these challenging projects to fruition and to success.

George Simmons, Dean
School of Science and Engineering

On behalf of our faculty and students, I also welcome you to Projects Day 2000, our annual presentation of design team results to sponsoring organizations, visitors, and friends. I am grateful for the encouragement and assistance provided by our Science and Engineering Advisory Board and the Project Center Advisory Committee in promoting the external sponsorship of our projects. I would also like to acknowledge the coordination efforts of professors Rolf Skrinde in Civil and Environmental Engineering, Robert Heeren in Electrical Engineering, Ananda Cousins in Mechanical and Manufacturing Engineering, Everald Mills in Computer Science, as well as Sheridan Botts, contracts manager; and Kathy Fletcher, administrative assistant for the Project Center.

Special thanks go to the students in our engineering organizations who are your hosts today and who volunteer to carry out many of the tasks associated with our Projects Day celebration. These student societies are the American Society of Civil Engineers (ASCE), American Society of Mechanical Engineers (ASME), Institute of Electrical and Electronics Engineers (IEEE), National Society of Black Engineers (NSBE), Society of Environmental Engineers and Scientists (SEES), Society of Women Engineers (SWE), and Tau Beta Pi.

Patricia D. Daniels, Director
Science and Engineering Project Center
PROJECTS DAY

9:00 A.M. LEMIEUX LIBRARY FOYER
Projects Day Registration, project displays

9:15 A.M. - 10:55 A.M. SCHAFTER AUDITORIUM
The Boeing Company
AGRA Earth & Environmental
Harrison's Comfort Footwear
Appian Graphics
A. K. Gordon & Associates

10:55 A.M. - 11:10 A.M.
Break

11:10 A.M. - 12:30 P.M. SCHAFTER AUDITORIUM
Kenworth Truck Company
VirtualWarpSpeed
Visio Division of Microsoft Corporation

12:30 P.M. LEMIEUX LIBRARY FOYER
Buffet Lunch

1:30 P.M. - 3:30 P.M. SCHAFTER AUDITORIUM
GTE Network Services
Seattle University

1:30 P.M. - 3:30 P.M. STIMSON ROOM
The Boeing Company
Puyallup Integrated Circuit Company
Seattle University
David Evans & Associates

Senior Design Projects 3
INT 00.2
Design, Test, and Implementation of Boeing Antenna Analysis Software
The Boeing Company
Kurt Heidergott
Prof. Robert Heeren and Prof. Everald Mills
Mark Hoang, Kenneth Kirchoff, Craig Livingstone, Jarek Predki, and Jimmy Soong

A major division within The Boeing Company, the Boeing Commercial Airplane Group designs and builds airplanes in a global arena. Boeing purchases airplane antennas from contracted vendors and tests these antennas for adherence to supplier stated specifications, at its outdoor antenna range. Boeing reports the outcomes of these tests to internal and external organizations, including the FAA. The old analysis software contained multiple bugs, was not compatible with newer operating systems such as Windows 98/2000/NT, and did not plot the antenna test data in the desired Boeing report format. The team designed, tested and implemented a new stand-alone software package. The new software enables Boeing to analyze, manipulate, extract and plot antenna pattern data from their antenna test range. The software is compatible with newer software operating systems and has the flexibility to expand with the company's growing needs.

CEE 00.2
Geotechnical Study of the Proposed Student Center at Seattle University
AGRA Earth & Environmental
James M. Brisbine
Prof. Nirmala Gnanapragasam
Ryan Barrett, Roel Dulay, Brian Matsumoto, Ryan McLaughlin

Seattle University is currently planning for and designing a new Student Center. AGRA Earth & Environmental, an engineering firm contracted by Seattle University, asked the team to perform a geotechnical study for the proposed Student Center. The team performed field and laboratory soil tests and constructed a geologic profile of the site based on boring log information provided to them by AGRA Earth & Environmental. The team came up with recommendations for the foundation, shoring, drainage and dewatering based on the information collected and the Student Center preliminary architectural plans.
Custom Insole Manufacturing Process Improvement
Harrison’s Comfort Footwear
John O’Brien
Prof. Greg Mason
Grinda Chiewcharat, Silas Curbman, Nick MacDonald,
Dale McKee

Harrison’s Comfort Footwear manufactures custom orthotic insoles used to correct certain types of foot ailments. Harrison’s asked the team to review their current manufacturing process, identify problem areas, and recommend improvements to increase production rate while still allowing customization throughout the process. The team identified the vacuum-forming procedure as a bottleneck. The team built a dual vacuum-forming chamber to allow multiple pairs of insoles to be vacuum-formed at one time. The new dual vacuum-forming chamber doubled insole production. The team also ran insole cooling tests to determine the earliest possible time of insole removal.

Appian Graphics
Michael Larson
Prof. Bruce Duba, Prof. Bert Otten, S.J.
David Giner, Emily Jorgenson, Shahid Khatri, Frank Paglia, Matthew Sanford, Teresa Straub

Multiple monitor desktops are becoming popular because computer desktops have become overcrowded. Appian Graphics offers a solution to this problem by developing multiple monitor video cards that allow computer users to simultaneously use two or more monitors with one computer. Currently, the Jeronimo 2000 multiple monitor graphics card operates only on IBM compatible PCs running Windows/NT and Macintosh based systems. Appian Graphics asked the team to adapt its J2000 to the Sun SPARC platform, a UNIX based system. The team developed software to support the J2000 through manipulation of publicly available code. The team delivered a fully functional J2000 graphics card for the Sun SPARC environment. The project included the development of an Open Boot ROM, an X11 server, a C language library of accelerated hardware functions, and a seamless desktop window manager.
Alan K. Gordon & Associates has developed bridge-rating software for the Washington State Department of Transportation and its consultants. This software, BRIDG97, is designed to determine a live load rating capacity based on a prescribed set of national standard truck loadings. Alan K. Gordon & Associates recently upgraded BRIDG97 to analyze truss bridges in a three-dimensional mode and commissioned the team to verify that the new truss utility is reliable. Using conventional methods of structural analysis, and employing Washington State Department of Transportation design codes, the team performed an independent structural analysis of a truss bridge. The team then used the upgraded BRIDG97 software to rate the bridge. The team prepared a report detailing their methods, their findings and a comparison of the two bridge ratings.

The Kenworth Truck Company currently uses suspension air bags to level the height of their heavy duty trucks. The amount of air in the bags is regulated by a mechanical sensor and pneumatic valve. The team introduced an electrical sensor and solenoid valves controlled by a logic circuit to increase the reliability, ease of use and functionality of the height control leveling system. The improved system will also eliminate wear and premature failure.
Some Personal Digital Assistants (PDA) can download information from some web pages without hard wired connections. To then transfer that information to another device requires direct connections. Virtual WarpSpeed asked the team to develop a prototype wireless PDA using Bluetooth Technology that can both download information from all web pages (Receive HTML) and communicate that information to other devices (Push HTML). The team designed a prototype that downloads web pages, music, games, and video from the web to various non-connected peripherals (such as screens, printers, and speakers). In addition to Push and Receive HTML, the team's prototype is able to perform multimedia streaming (broadcast streaming media from the internet) and internet telephony (makes and receives internet telephone calls). The team simulated the PDA prototype by using two laptops equipped with Bluetooth demonstration cards and Software Developer Kits. They demonstrated the success of their design by sending complete web sites to peripheral displays and downloading music and stream video from the internet to Bluetooth Technology enabled peripherals.
Visio 2000 software is a worldwide standard for creating, storing, and exchanging business drawings and diagrams. The Visio Division of Microsoft Corporation is exploring the development of applications that operate on a palm-size personal computer. The limited memory and screen size of the palm-size personal computer platform create many challenges, one of which is the development of a user interface that supports the functionality of Visio 2000. The Visio Division of Microsoft Corporation asked the team to develop a prototype user interface, codenamed PocketVisio, which operates on the Microsoft Windows CE platform. The team interviewed prospective users, compiled a list of desirable user interface features, and developed a prototype that incorporated these features and optimized available screen space.

Project Title: Natural Drawing Recognition
Students: Bruce Amsbaugh, Teague Mapes, Chris Oje

Description:
Visio software uses drag and drop technology to create detailed flowcharts, technical drawings, and network diagrams. Most users however, tend to initiate a drawing using pen and paper or a whiteboard and later translate the hand drawn sketch - or natural drawing - into a more formal Visio diagram. Today, input devices exist that can capture drawn or written information and electronically store the strokes in a computer. The design team’s responsibilities included developing an interface to enable Visio software to receive input from these devices or natural drawing systems. The team developed an application programming interface (API) that takes the form of a Visio Plugin or dynamically linked library (DLL). This DLL extracts points and time information from the natural drawing system and uses this information to create a Visio document through C++ automation. The team also developed a modified Visio interface to facilitate the use of this DLL.
CSSE 00.1
Intranet Based Synchronization Map and Timing Output Assignment Record
GTE Network Services – Northwest Region
Garth Oksness, Morrie Sachsenmaier
Prof. Susan Reeder
Daniel J. Buenas, Kenneth M. Cam, Dinesh K.C., Voravat Maleenont, Firoozeh Ojagh

DESCRIPTION:
GTE Network Services field engineers need access to Synchronization Maps showing Central Office locations, and for each office, the synchronization source, switch type, stratum clock level, facility type and timing route as well as access to Digital Clock Distribution assignment tables. The maps are in proprietary CAD software and Digital Clock Distribution assignment tables are on Mylar drawings. The team was asked to create an intranet website to display the map and assignment tables, providing read/write permissions to network designers, and read-only permissions to other telephone company personnel. The team converted a map into a web-accessible format and transcribed the Digital Clock Distribution tables into a database. The team then linked the map to the database to draw Central Office locations and their respective timing routes. Now field engineers have easy access to Synchronization Maps and Digital Clock Distribution assignment tables.

CSSE 00.2
A Document Image Analysis Viewer (DiaView)
Seattle University
Yahn Wang (Washington Technology Center)
Prof. Ihsin Tsaiyun Phillips
Marchel Cohn, Farhad Hafezipour, Karrie Meyer, Craig Tadlock, Thach Tran

DESCRIPTION:
Illuminator is a Graphical User Interface tool that can be used only on Sun workstations to read and modify documents in DAFS (Document Attribute Format Specification) file formats. The team's goal was to use Java to design and implement a new more powerful Graphical User Interface tool, which is called DiaView (Document Image Analysis Viewer). DiaView is an improvement over Illuminator in two ways: 1) DiaView can be used either on stand-alone PCs or Sun workstations, and 2) DiaView can display, edit, and navigate the content of documents in either the DAFS or XML (Extended Markup Language) file formats. DiaView can display a document as a scanned image, as a combination of image and data, or as data alone. The data may be viewed in and altered in any of various modes.
CSSE 00.3
Market Sim
Seattle University
Prof. Mitchell Spector
Tim DeGregori, Henry Goss, Hardy Sugiarro, Victor Tsai

The goal of this project is to demonstrate how a self-evolving algorithm works. Our program employs and demonstrates self-evolving algorithms by generating "organisms" that can reproduce and evolve on their own. Using a market simulation, the organisms compete against each other by buying and selling goods. Our program determines the organisms that may stay alive and continue to reproduce and the ones that should be eliminated based on their ability to accumulate wealth.

CSSE 00.5
Wellness By Design
Wellness By Design
V.M. Popovsky
Prof. Barbara Popovsky
Marisa Aversa, Paul Houillon, Brian Kobuki, Donna McKee, Peter Salama

Wellness By Design commissioned the team to design and construct software to aid volleyball coaches. Incorporating Dr. V.M. Popovsky's volleyball methodology and training techniques, the team designed easy to use software that tracks individual athletic progress. Coaches can apply the tool at all levels of athletic performance, from beginner to expert. With minimal input, the application creates and displays reports that graph an athlete's age, skills and ability against their performance. From that information, the coach with the help of an accompanying user manual, can build a training improvement plan designed to develop the athletes' fullest potential.
**STIMSON ROOM AFTERNOON**

**PROJECT NUMBER:** CEE 00.1
**PROJECT TITLE:** Environmental Analysis of Alternative Plating Processes

**SPONSOR:** The Boeing Company
**SPONSOR LIAISONS:** Laurence Weinberg, Joseph Osborne, Roark Doubt, David Logsdon, Denis Bourcier
**FACULTY ADVISOR:** Prof. Phillip Thompson
**STUDENTS:** Dean Bose, Olivia Buban, Fred Jienke, Holli Klages

**DESCRIPTION:**
Cadmium plating is currently used to protect certain metal parts at The Boeing Company. However, because of the toxic nature of cadmium, the Joint Group-Pollution Prevention (JG-PP) has recommended that safer and less hazardous plating processes be evaluated. Boeing has proposed ion-vapor-deposited aluminum, tin-zinc, and zinc-nickel plating as three feasible alternative processes, each of which is anticipated to provide plated products that are equivalent in quality. A ranking of these plating processes was performed using three decision making tools: Life Cycle Analysis (LCA), Life Cycle Costing (LCC), and an Environmental and Health Risk Assessment (EHRA). The results of this evaluation may enable Boeing to reduce waste management costs and risks associated with regulatory compliance or worker exposure, as well as provide the customer with a more environmentally friendly product.

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**PROJECT NUMBER:** EE 00.1
**PROJECT TITLE:** Dual-Clock, Two-Port, First-In/First-Out Static Memory Array Design & Simulation

**SPONSOR:** Puyallup Integrated Circuit Company (PICCO)
**SPONSOR LIAISON:** Don Haueisen
**FACULTY ADVISOR:** Prof. Paul Neudorfer
**STUDENTS:** Chris Norwood, Axel Peterson, Jolly Walia

**DESCRIPTION:**
The Puyallup Integrated Circuit Company asked the team to design and simulate a two-port, 256 X 64 first-in/first-out (FIFO) static memory application specific integrated circuit. The two ports allow for independent and simultaneous read/write operations governed by separate clocks. The design and simulation were carried out using CAD software from Tanner Research.
**PROJECT NUMBER:** INT 00.4  
**PROJECT TITLE:** Design and Construction of a Power-Assisted Wheelchair  
**SPONSOR:** Seattle University  
**FACULTY ADVISOR:** Prof. Ananda Cousins  
**STUDENTS:** Meshal Al-Doub, Tamara Conant, Consuelo Guzman, Je-Won Kim, Brian Schwenka

**DESCRIPTION:**
Currently the only options for people who use wheelchairs are fully manual chairs (which require good upper-body strength and coordination) and full-powered chairs (which provide no exercise). For a large group of people who use wheelchairs an intermediate solution would be appropriate: a "power-assisted" wheelchair. Such a chair assists the person by providing some fraction of their own effort in propelling the chair; for example, the motor may be set to match the person's own force, thus providing 50% of the required propulsive effort. Our team designed and built a power-assisted wheelchair using a motor driving a fifth wheel. Strain gauges measure the instantaneous propulsive force on the wheel and provide a proportional assistive motor torque. The level of motor assistance can be reduced if the person becomes stronger with training. The primary benefit of the chair is to allow even people with reduced upper-body strength to obtain the exercise benefits of a manual chair, since the assisted chair amplifies their own efforts rather than replacing them entirely with a motor.
David Evans and Associates, Inc., a multidisciplinary engineering consulting firm, requested the team to prepare a design report and roadway plans for the 132nd Street SE Improvement Project in Snohomish County. The current configuration of this one-mile stretch of 132nd Street SE is a two-lane, two-direction roadway. To facilitate neighborhood accessibility, alleviate current traffic congestion, and increase intersection safety, 132nd Street SE is to be widened to a five-lane roadway with two lanes in each direction and a center left-turn lane. This increase in roadway size will accommodate the expected traffic volume increase when 132nd Street SE is connected to State Route 9. The final design report addressed horizontal and vertical alignments of the roadway, channelization, bicycle lanes, curbs, gutters and sidewalks. The final design plans include roadway cross sections, detailed specifications, and an estimate of the cost of the project.
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SPONSORING ORGANIZATIONS AND LIAISONS

We want to acknowledge with special thanks the organizations that sponsored projects in 1999-2000, and especially the liaisons representing the sponsors, who worked with the students throughout the year. The time these liaison representatives spent in consultation with our teams is much appreciated by the students and their faculty advisers. It is the liaisons who provide the history and background of each project, its relationship to other work in the sponsoring organization, and much of the technical direction that makes a project successful.

AGRA Earth & Environmental, James M. Brisbine
A.K. Gordon & Associates, Alan K. Gordon
Appian Graphics, Michael Larson
The Boeing Company, Denis Bourcier, Roark Doubt, Dave Logsdon, Joseph Osborne, and Laurence Weinberg
The Boeing Company, Kurt Heidengott
David Evan and Associates, Manuel Feliberti, Gina Hortillosa, and Anna-Trang Nguyen
GTE Network Services, Garth S. Oksness and Morrie Sachsenmaier
Harrison's Comfort Footwear, John R. O'Brien (from The Boeing Company)
Kenworth Truck Company, Dan Farmer and Roger Penzotti
(from PACCAR Incorporated)
Puyallup Integrated Circuit Company (PICCO), Don Haueisen
Seattle University, Yalin Wang (from Washington Technology Center)
Virtual WarpSpeed – A Division of RKM Holdings, Hank Meuret
(from Meuret Consulting)
Visio Division of Microsoft Corporation, Wendy Richardson and Brett Eddy
Wellness by Design, V.M. Popovsky
DIRECTIONS

Take the James Street exit off I-5 (southbound exit # 165, northbound exit # 164A), continue east to Broadway. Turn left at the light on Broadway and north two blocks to East Columbia. Turn right onto East Columbia and immediately left into the Seattle University parking garage (P5). Request a parking permit from the attendant. Projects Day presentations are at the Lemieux Library (10).