LEARNING IN THE FUTURE

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July 31, 1997

It is 883 days to the beginning of the new millenium. We will look backward to the nineties as a period of economic uncertainty followed by sweeping changes. We will look with pride at our revitalized campuses and the role we as educators have played in building a prosperous community. Now come with me to the year 2001. We are standing in front of the new library building at the entrance to the City Campus. To the left is a multi-tiered parking structure. Students are streaming onto the campus. We move with them as they file into classrooms, laboratories, the library, and the technology building. . .

The new technology building was once a library.. It is beautifully remodeled, with television studio-classrooms on the first floor. Television classes via cable and microwave reach unserved segments of the community, link campuses for classes with small enrollments, and share the most popular instructors and courses. A farm of satellite antennas on the roof sends classes across the hemisphere and receives classes to expand our curriculum offerings. (A statewide curriculum project funded in 1997 set quality standards for telecourses that opened the door for sharing with Community Colleges courses nationwide.)

In another part of the technology building we see faculty on computer workstations developing multimedia courses for Internet II and the World Wide Web. There are servers connected to networks that radiate through each RCC campus, then to schools and businesses, community organizations and homes. Wide Area Networks connect RCC campuses with the statewide network, 4Cnet, and with Internet II.

The second floor of the technology building is a large 24-hour computer lab with all-new equipment. This is the last of the projected inventory from the 1997 Technology Plan. At one end there are three classrooms for instructor-led classes. When not used by classes, these are opened to extend the capacity of the lab. Lab-aides and instructors move throughout the lab quietly assisting students. Others instructors work from their offices sharing computer screens and keyboards as they communicate with students on-campus and at remote sites.

The basement houses servers and technical support. The *Media Center* is integrated with *Academic Computing*. The familiar equipment carts have disappeared and well-equipped *Smart Classrooms* facilitate teaching with audiovisual media, television and computers. Faculty who need them have computers in their offices, others prefer to work in the well-equipped faculty labs where they receive production and training assistance.

The new library is a model for the twenty first century. It has electronic information systems, a computer commons, teleconferencing and rooms for

multimedia and television. The library embodies state-of-the-art information and learning technologies. Even the small group study rooms have computer and television access.

RCCD now provides unparalleled service to the Riverside community. *Passport to Learning* has developed enthusiasm for education in parents as well as students. College programs attract a growing and diverse community of learners from all walks of life who seek job skills and education programs. Live courses can be accessed both on- and off-campus. Others are available on an anywhere-anytime basis. Learning technologies customize teaching and learning programs for individual needs and learning styles. Partnerships with business and industry provide students with internships, work experience, and an easy transition to their chosen careers.

. . . . .

How can such remarkable change occur in just a few years? It requires a common vision, a common commitment, and a community effort. We as a Community College, under Dr. Rotella's leadership, can shape this vision. It requires a plan. It requires resources. It requires commitment. It requires collaborative effort. We can do it!

Today I will outline a preliminary plan for technology for your consideration. It is a straw-man for faculty and staff and administrators and students to discuss, to explore, to shape, and from it to build the College plan. It will be a collaborative plan that reflects the needs of students and community, faculty and curriculum, staff and administration. We need a mechanism to facilitate dialog - a task force or working group of some kind to gather information and shape the final plan.

Communication technologies have become as fundamental to the educational process as electric light, water and plumbing. Technology was a luxury that was barely affordable under the chalk-and-talk college budgets of past. Now there is a radical change. Starting in 1997, substantial funding is available for planning and constructing infrastructure and networks, procuring hardware and software, and training faculty. Public opinion and government are focused on equipping schools and colleges for the twenty-first century.

Let us now examine the issues we, as a College, must consider as we start down the yellow brick road to the future.

Preliminary Technology Plan

July 31, 1997

Two kinds of technology are needed to support teaching and learning – *information technology* and *instructional technology.*

Information technology provides access to a wide variety of resources – text and data, multimedia and video. It includes systems for delivering information ranging from traditional libraries, textbooks, and videos to interactive multimedia, teleconferencing, electronic libraries, computer networks and the Internet.

Instructional technology is concerned with teaching and learning. It provides assessment, counseling and advising; a database of student characteristics, learning styles, goals, and accomplishments; curriculum structures and alternatives; courses, courseware, and interactive learning environments that include multimedia, the Internet with integral tools for diagnosis, prescription, benchmarking, and evaluation. Technology expands *access* to learning resources on-campus and off-campus. It makes college courses and programs available to populations that were previously unserved.

In 1997-98 the RCCD has secondary effects funds, capital funds and grant opportunities for technology. Activity is focused on training and equipping faculty; installing smart classrooms, computer laboratories, and networks; reassessing needs and revitalizing curricula; and providing technical support and continuity for technology based learning.

Purpose of the Preliminary Plan

This preliminary plan is intended to:

1. Focus major issues for consideration by the administration, faculty, staff, students, and the community at large.
2. Provide policy guidance, a design model, an implementation plan, and a budget plan.
3. Anticipate teaching and learning needs of faculty and students in a wide variety of disciplines.
4. Determine cost and cost-benefits of current and emerging technologies.
5. Explore options that can result in substantial long-term cost savings.

Effective implementation of new communication technologies will ensure that RCCD graduates are viable and competitive in the global marketplace and enhance economic growth of the Greater Riverside community.

The technology plan has five major components:

1. Computers and networks
2. Software – applications and courseware
3. Interactive television
4. Teaching and learning systems
5. Instructor training and instructional support

Technology funding is available for *computers, networks, software, interactive television, and the supporting telecommunications infrastructure.* The role of faculty and administration is to integrate technology to improve teaching and learning. The role of the Dean of Learning Technologies is to guide faculty and administration and provide the necessary support for successful implementation.

In the Fall of 1997, state-of-the-art technology will be available on all RCCD campuses supported by training opportunities for faculty, support technicians and lab aides.

COMPUTERS AND NETWORKS

RCCD is upgrading computer labs and networks. The following steps are already in progress:

1. District standards are being setup for computers, networks, servers, and printers.
2. Computer labs are being upgraded.
3. Token ring networks are being replaced by Ethernet.
4. General-purpose labs have been setup at Norco and Moreno Valley.
5. Funds are available to facilitate adoption of technology.
6. A bid process is facilitating major purchases of computers for Fall 97.

1. Standards

Several steps have been taken to ensure reliable equipment operation and prompt service when needed. These include:

a. Standardize on one type, make and model of computer.

b. Buy the most current model.

c. Have the manufacturer install and configure hardware and software.

d. Have the manufacturer unpack and test equipment on-site.

e. Replace token ring networks with Ethernet.

f. Use Switched Ethernet so that multimedia does not overload networks.

g. Use Asynchronous Transmission Mode (ATM) for network backbone.

h. Standardize networks, servers, printers, and lab procedures.

i. Establish policies and procedures for faculty training, lab support, and procurement, maintenance and replacement of equipment and software.

a. Standardize on one type, make and model of computer. This simplifies purchase, service, operation, and ultimately, replacement. It minimizes the number of makes and models for technical support and permits identical configuration.

b. Buy the most current model. The average useful life of a computer is five years. Buying last-years model reduces useful life to four years. It also takes away some of the functionality and power of the newer machines. For 20% less it is not a good deal because hardware cost is only part of the equation. The cost for installation and setup, maintenance, networking, software, printers, furniture, etc. may triple this cost. So the actual saving was 7%!

c. Have the manufacturer install and configure hardware and software. This requires planning and ensures a common configuration. Opening a new computer to install hardware doesn't make sense since it violates the integrity of the configuration determined by the manufacturer. Technician time is expensive. Technical support should be lean and mean yet responsive when needed.

d. Have the manufacturer unpack and test equipment on-site. Hundreds of new computers are being installed for the Fall of '97. The vendor can accelerate on-site installation since RCC technical staff are already over-committed

e. Replace token ring networks with Ethernet. Token-ring networks are unreliable and difficult to maintain. This upgrade is a real plus!

f. Use Switched Ethernet so that multimedia does not overload networks. Two or three multimedia programs can overload a *shared* network. Switched Ethernet provides every user with a ten-megabit-per-second pipe.

g. Use Asynchronous Transmission Mode (ATM) for the network backbone. The backbone must support all of the traffic on the network, so its collective bandwidth must be substantially greater than bandwidth to the desktop.

h. Standardize networks, servers, printers, and lab procedures. There will be one network to serve both administrative and academic services on three campuses. It will be optimized to ensure a uniformly high *Quality of Service*.

i. Establish policies and procedures for faculty training, lab support, procurement, maintenance and replacement of equipment and software. Faculty training will be provided by one new position shared between three campuses. One lab technician will be added to each campus whose primary function is to support the general-purpose lab. Academic computing will have its own technical support team. It will collaborate closely with the administrative computer support team.

To keep the equipment inventory current, it is necessary to replace 20% of the computers each year. For an inventory of 1,000 computers, that requires purchase of 200 new computers each year at $4,000 each, a total of $800,000 each year. (Lease adds a finance charge and amortizes cost over

four years, adding about 30% to the price (See Appendix A – Comparison of Purchase and Leasing Cost). Also, an inventory of 1,000 computers is not sufficient to support 16,000 Full Time Equivalent Students.)

COMPUTER INVENTORY BY CAMPUS

For planning purposes, June 1 '97 is used as a baseline. The Fall '97 projection is based on the proposed expenditure of secondary effects and capital funds. The original goal was to have these computers, servers, printers, and networks in place for the beginning of the Fall Semester. Moreno Valley delayed part of its purchase in favor of installation prior to the second 10-week session. Internet connections will be made initially to one student lab on each campus. Management procedures for student use of the Internet are yet to be set up.

Academic Computer Inventory – City Campus:

Lab Type	CPU Type	June 1	Sept 1	Nov 1	Server	Internet
Business Lab (BE 100)	286 486sx P6-266	25 15	25 15	 40	 1	
Art	P5-120	1	1	1	0	1
Chemistry	8088- 486 P5-60 P6-266	12	12	12 12	1	0
English / Writing	P5-120	76	76	76	2	0
Graphics	Mac	40	40	40	1	0
Info Systems & Technology	486sx- P6-200 P6-266	44 36	44 40 24	 40 68	3	60
Library / Media	P5-133 P6-266	10	10	10 11	1	10
Math	Mac	24	24	24	0	0
Natural Science	286 – 386 p6-266	5	5	 6	0	3
Nursing	386 P5-120 P6-266	6	6	6 6	0	0
TOTAL		294	318	352	9	74

The city campus has many obsolete computers and, except for large labs and some faculty offices, no networks. (The administrative net is near complete in that most staff and administrators who need it have network access.) With no construction funds or secondary effects dollars, technology funds are the only resource available to the City Campus at this time. Unless a new site can be identified, the most likely candidates for a general-purpose lab are the Information Systems and Technology Lab (IS&T) and the Writing Lab. None of the 76 Pentium computers in the writing lab have hard disk drives. Also, 44 now obsolete 486SX's in the IS&T lab do not have hard-disk drives.

Recommendation #1: *Establish a task force be to determine the requirement for a general-purpose lab on the City Campus and identify a suitable site.*

Norco Campus:

Lab Type	CPU Type	June 1	Sept 1	Nov 1	Server	Internet
General Purpose	P6-266		60	120	3	60*
Art	Mac 610	5	5	5	0	0
Computer Classroom	P6-266	0	40	40		
English/Writing	Mac 486 P6-180	4 12 40	4 40	4 40	1	0
Engineering	P-100 P6-200	20 52	20 52	20 52	2	20
Library / Media	486- P5-100 P6-266	4	4	4 11	0	15
Foreign Language	Mac LC	12	12	12	0	0
Social Science	486 P6-266	1	1	1 1	0	0
TOTAL		150	238	310	7	95

Norco moved many of its older Macintosh computers to the language laboratory. Its inventory is principally Pentium computers, and with purchases from Secondary Effects and Technology funds, numbers are close to adequate for the present courses and students. Secondary Effects dollars have also enabled replacement of the token-ring networks and upgrade of the campus backbone.

Introduction of the Internet will greatly accelerate lab use. Also, the new general-purpose labs will attract participation from disciplines and courses that do not currently use computer facilities.

Moreno Valley Campus:

Lab Type	CPU	June 1	Sept 1	Nov 1	Server	Internet
General Purpose	P6-266	0	0**	120	2	60
Computer Classroom	P5-120 P5-200			68		
English	286- P5-120	36 36	 72	 72	1	0
IST	P5-120 P5-200	32 35	32 35		1	0
Library	P		10	10		
Math	P5-120	35	35	35	1	0
TOTAL		174	184	305	5	60

** Installation is delayed to open before second 10 week session.

As with Norco, Moreno Valley is also benefiting from Secondary Effects and technology funds for purchase of computers and networks. It will similarly attract higher utilization through addition of the Internet and through commitment to a large general-purpose lab.

Computer Inventory by Type

The standard computer for RCC is a Pentium computer of 100Mhz or above. All new purchases will be for 266 Mhz Pentium II computers. Computers dating back to 1983 (8088) are still in use along with 286, 386, 486 and some older Macintosh computers. The following table shows numbers for each as of June 1 and projected numbers for November 1. The data shows replacement of a large number of obsolete computers and an increase in inventory from 618 to 967 computers. City Campus has a slightly larger inventory, but the ratio to FTES is much lower.

Campus and Date	Macintosh	8088-486	Pentium	Total
City Campus				
June '97	64	107	123	**294**
November '97	64	18	270	**352**
Norco				
June '97	21	17	112	**150**
November '97	21	5	284	**310**
Moreno Valley				
June '97	0	38	138	**174**
November '97	0	0	305	**305**

Computer Inventory and FTES

Based on district totals, on June 1 there were approximately 600 computers to support 16,000 full-time equivalent students – a ratio of one computer for every 26 FTES. If labs are open for an average of 50 hours/week, that is equivalent to 2 hours of lab time per FTES or less than 24 minutes per course per week. November 1 predicted totals improve the ratio to one computer for 17 students, 3 hours per FTES, or 36 minutes per course per week. It is clear that even an inventory of 1,000 computers district-wide will not be sufficient.

Recommendation #2: *Maximize availability of computers on each campus by adopting the following measures:*

1. *Assign priority to General-purpose computer labs over departmental labs.*
2. *Open labs for the longest number of hours consistent with use.*
3. *Adopt alternative methods of supervision/support so students can do lab work in the workplace or at home.*

The table that follows lists ways in which utilization of limited computer resources can be expanded. Suggestions in the right-hand column lower or contain costs. Judicious application of the above principles can double or even triple access for on-campus students. Additional cost reduction can be accomplished through planning and management of recurring costs and through cost-avoidance.

INCREASING UTILIZATION OF COMPUTER LABS AND INFRASTRUCTURE

INEFFICIENT USE OF FACILITIES	SUGGESTED ALTERNATIVE
Instructor led classes that are primarily lecture and demonstration.	**Teach in smart classroom**, then assign students to work in open computer lab where assistance is available.
Scheduled labs – e.g. 3 hours morning, three hours afternoon, three hours evening, 4 or 5 days.	**Create multipurpose labs operating 16-24 hours daily**. Instructors and/or lab assistants should be available as required.
Dedicated laboratory for one discipline. (Partially filled laboratories result in further loss of efficiency.)	**Create multipurpose labs**. If open labs are not suitable, combine labs for related programs wherever possible.
Labs closed because funds are not available for supervision.	**Consolidate small laboratories into larger units and combine support staff.** This will increase equipment utilization and maintain or reduce supervision cost.
Unsupervised laboratories.	**Add television surveillance** to all labs for added security. Supervised labs may be unsupervised for short periods. **Note:** Assistance should always be available to students when needed.
Requirement for all computer activity to be conducted in the assigned laboratory.	**Use open labs and remote access to expand lab capacity**. If students can use computers at home or in the workplace, this reduces space, equipment and maintenance requirements on campus. Connection via the internet and / or cable TV are less expensive than providing lab facilities on campus. Note: **Distance Learning** should be explored for expanding class capacity, reaching unserved students, and providing anywhere-anytime learning and just-in-time learning.
Overcrowded labs with inadequate air conditioning.	Personal comfort adds to lab efficiency for instructors and students. Also, overheated equipment is much more prone to failure.

Consolidating laboratories and extending lab hours will enable fuller utilization of facilities, equipment, software, and networking. Added cost for personnel and

maintenance is trivial compared to savings from higher utilization of facilities, equipment, network infrastructure, and software.

Inventory Distribution Based on FTES

Norco and Moreno Valley have more than twice as many computers per FTES as the City Campus. The City Campus will not benefit from Construction and Secondary Effects funding for at least four years, so a compensatory mechanism is needed to build ITS inventory more rapidly. This could be achieved in part by giving the City Campus higher priority for other sources of technology funding.

Recommendation #3. *The City Campus should have higher priority for technology funds to strengthen its inventory.*

SOFTWARE – APPLICATIONS AND COURSEWARE

Software presents its own problems. Computers come preloaded with software such as Windows 95 and Office 97. Textbook publishers may supply software as an inducement to buy their text. Most software is not free! Multiple copies or licenses for a range of programs and courses can escalate costs. Software that is upgraded frequently results in a continuing expense.

Initial purchase is more expensive than upgrades. Licenses are less expensive than multiple copies of software and manuals. Discount coupons may come with new equipment and the savings can be substantial.

Recommendation #4: *The Technology office should keep an inventory of hardware and software, licenses and discount coupons. It should coordinate software requests to avoid unnecessary purchases and to ensure the best price. Where free software is acquired, the terms and conditions of use must be in writing.*

Good management will save money. Ultimately the cost of software must be related to enrollments and course priorities.

Technical problems should be anticipated by testing in advance. New versions of software may not work on older computers, or may be costly in technician time to configure. New versions may require more memory and faster processors. They may overwrite older versions. Some software will disable other applications, overwrite drivers, programs and registry. Removal of programs to free-up hard disk space may also be problematic. These unknowns escalate operating costs for personnel, software, and ultimately – hardware.

Recommendation #5: *A set of policies and procedures should be developed to coordinate, testing, loading and removal of software. It should address problems of incompatibility of programs, loading multiple versions of the same program, the need for technicians to load and remove programs from the servers and work-stations, and the need for mirror images to reload software from the server.*

MULTIMEDIA COURSEWARE FOR TEACHING AND LEARNING

Interactive multimedia uses personal computers and specially designed courseware to facilitate teaching and learning. Instructional design, hypermedia, interaction, and evaluation guide the student toward successful achievement of the instructional objectives.

Information is presented via text, graphics, animations, sound and video. Students respond by typing; selecting, arranging, or dragging text and graphic elements using a mouse (click and drag), speaking into a microphone, or inputting data using keyboard, graphic tablet, midi keyboards, electronic sensors, and telecommunication devices. The computer analyzes each response, applies diagnostic-prescriptive algorithms, manages the sequence of learning, and records relevant learning events. Decision trees and elements of artificial intelligence are used to customize instruction for the needs of each learner.

Put simply, multimedia combines a variety of media to develop a dialog between a virtual teacher and the learner. Students learn at their own pace in a pattern consistent with their previous knowledge, learning style, personal interests, and schedule.

Multimedia for Learning at RCCD: Multimedia courseware can be purchased on CD-ROM; accessed through the World Wide Web, Community College Consortia, and publishers; produced by teams of RCC instructors; or produced by individual instructors in conjunction with their students. Production requires training to use hypermedia authoring-software such as Authorware, Hyperstudio, or Toolbook. It requires a lot of time, access to a variety of graphic, audio, and video resources, and a powerful PC.

Most production operations can be performed on multimedia PCs. At least one PC workstation should have a scanner to digitize text and graphics, a digitizer card for sound and video, a large storage disk, and a CD-ROM maker.

With the introduction of large general-purpose computer laboratories on each campus, faculty should be encouraged to experiment with multimedia in their courses. They can begin with off-the-shelf materials, and develop course segments of their own. Courses in the design and production of multimedia are available from local institutions of higher education and on the Web. State and Federal project funds are available to support development of curriculum materials in multimedia format.

Recommendation #6: *Faculty should receive training and assistance to use computer applications and courseware, and also to develop their own teaching materials including multimedia, web pages, and other interactive uses of computers.*

INTERACTIVE TELEVISION

Television is available in a variety options for education, training and teleconferencing:

1. Broadcast and cable television are open access technologies with one-way video and two-way audio. Telephone is used for return audio. Broadcast range is about 50 miles; cable access is determined by the franchise of the cable company. RCCD uses broadcast courses from KVCR and KCET, and distributes courses via local cable companies – *Charter Communications, Cross Country Wireless,* and *TCI.*
2. C-Band and Ku-Band satellite and digital satellite can be used for state, regional or nationwide distribution. 1-800 phone is used for return audio. RCCD has a classroom on each campus that can receive satellite broadcasts. Program origination is contracted to an outside vendor.
3. Instructional television Fixed Service (ITFS) is used for closed-circuit broadcast and requires a special down converter. Telephone is used for return audio. ITFS requires line-of sight from transmitter to any number of receive-sites in a fifty-mile radius. RCCD distributes classes to schools and homes via *Cross Country Wireless Cable* using the UC Riverside ITFS frequencies.
4. Interactive two-way television and video conferencing use ISDN telephone lines for point-to-point connection. A *bridge* is needed to connect multiple sites (multi-point). Telecommunication charges are substantially higher than telephone cost. RCCD has one set of equipment for interactive two-way television on each campus. Services must be requested in advance from the Instructional Media Center (IMC).
5. Videotape lessons can be checked out by instructors for classroom use. Students can view tapes in the IMC. They can also be obtained on loan, rented or purchased. For television courses, feedback is provided by on-campus sessions and/or by email, chat sessions, forums, and interactive multimedia on the Internet.
6. Internet and Intranet versions of two-way television use software such as CU-See Me to overlay a small video image on a computer screen. This process is called desktop video. It is inexpensive but the images are small, poor in quality, and on busy networks the system is unreliable.
7. 1-6 above can be combined. For example: counseling and advising via interactive video; learning from satellite broadcast lessons with telephone feedback; individual assistance and tutorials via email and the Internet.

All seven options are available to RCCD. 1–4 require specially equipped studio-classrooms or teleconference rooms to originate and receive television lessons. For optimum results, video technologies require instructor training, preparation time and technical support. Video lessons can be recorded for rebroadcast, review, study, and distribution on videotape. Additional information on television is included in Appendix B.

Recommendation #7: *Prepare a plan for effective television outreach. There is a need for a mission statement, policies and procedures, and resources for planning, marketing, scheduling, production, transmission, and evaluation. It should be related to on-campus instruction and distance learning. It should provide training for instructors who teach via television for those who teach in conjunction with television. Classroom(s) and conference room(s) should be remodeled to serve as studio-classrooms that optimize video and audio quality. Television classes should have priority on the use of these rooms.*

Television is not a replacement for traditional teaching, yet it has its own special values for solving logistical and access problems for students.

Recommendation #8: *Use television to expand low-enrollment courses and share courses in high demand. Make courses accessible to the community at homes, high schools, colleges, businesses, industries, government, and community facilities. Enrich the curriculum by importing courses from other colleges and universities.*

CLASSROOM TELECOMMUNICATION SYSTEMS

Every classroom and laboratory should have direct access to television, telephone and computer networks. RCCD campuses should be connected to each other, the school district, surrounding communities, and the Internet. Technologies are available to address these needs using the fiber backbone on each campus for computer, television and voice communications.

A video network is needed for central distribution of teleconferences, television classes, and videotapes to any RCCD classroom, laboratory, library, and to remote sites for distance learning. The entire media collection should be available during library hours; frequently used videos would be available 24-hours 7 days on players designed for multiple-videocassettes, CD-ROM servers, and/or video-on-demand servers. A dial-up system would provide automated access as well as personal assistance. The telephone keypad or computer keyboard can be used to dial up and control video media.

Recommendation #9: *Use the computer network to distribute video and telephone communications between campuses. Determine the pros and cons of such a combined network in terms of cost and Quality of Service.*

DISTANCE LEARNING

Distance learning is a way to reach unserved segments of the population. It serves those who are geographically remote from the campus, those with schedules not compatible with class times, those physically unable to attend for a variety of reasons, and non-traditional learners whose learning styles are not compatible with traditional methods of teaching.

The Open University in Great Britain has demonstrated how higher education can be made open as to people, open as to places, open as to ideas, and open as to methods. Today it has 150,000 students in degree programs and its reputation ranks among the leaders in higher education worldwide.

Two technologies play a dominant role: television for group teaching, and the computer for individualized learning.

Broadcast television translates the classroom paradigm of group teaching into multiple classrooms, industries, and homes. It is a *synchronous* method of learning that links people together according to a fixed schedule. The focus is on teaching and the teacher. It has the advantage of low cost distribution and is accessible to all that have a television. The "drop in" audience may be much larger than those enrolled for degree or certificate credit and should be considered as a community service as well as a promotional device for college programs.

Individualized learning is asynchronous. It can occur anywhere and at any time. It accommodates different learner preferences, schedules, and pace of learning. It can be interrupted and resumed at will. It opens educational opportunities for persons who travel, have families, or otherwise cannot participate according to a predetermined schedule. Videotapes can be used for asynchronous learning, but the new knowledge media – computers and telecommunications – are powerful instruments for interactive learning. It is notable that ten of eleven distance learning institutions with enrollments over 100,000 focus on individual learning, not on group teaching (the exception is the Chinese TV University system).

The British Open University attributes its success to four key elements:

1. Very high quality multi-media learning materials produced by multi-skilled academic teams. Study materials must be excellent and varied to make the campus in the home or workplace a congenial experience.
2. Dedicated personal academic support. Each Open University student has his own tutor for each course, one of Open University's 7,000 adjunct faculty. They comment on and mark the student's assignments, hold group meetings, and give support by phone, email, and computer conference.
3. Slick logistics. Each individual student must receive the right materials and information at the right time. With over 150,000 students around the world, that requires attention to detail.

4. A strong research base. When thousands of students use the material for each course and millions of people view each TV program, the content must be academically up-to-date. Thanks to economies of scale, the Open University has resources to move the academic paradigms steadily forward.

RCCDs approach to distance learning will initiate the opportunity for courses that are developed and shared on a statewide basis. A pilot project will be funded in September for Statewide Delivery of Distance Education. It is designed to . . . solve waiting list problems . . . select and revise and/or produce distance education courses for statewide delivery. Requires technology and volume lease-purchase agreements. RCCD should compete for this pilot project. It should also anticipate using system supplied and approved courses.

Recommendation #10: *Develop an effective distance learning program to serve the needs of the Greater Riverside community.*

Developments already underway include courses taught in local schools and telecourses available on local cable channels. It is important to note that RCCD already assigns instructors to distance learning students in a similar manner to the Open University. As the computer and telecommunications infrastructure is installed, courses can also be made available on the World Wide Web. This will be a large enterprise in the future are requires a comprehensive plan.

Appendix A

COMPARISON OF PURCHASE AND RENTAL COST

# Computers	Cost	20% Replace	1-yr lease	2-yr lease	3-yr lease	4-yr lease
100	400,000	80,000	437,280	243,840	175,680	146,400
200	800,000	160,000	874,560	487,680	351,360	292,800
300	1,200,000	240,000	1,311,840	731,520	527,040	439,200
400	1,600,000	320,000	1,749,120	975,360	702,720	585,600
500	2,000,000	400,000	2,186,400	1,219,200	878,400	732,000
600	2,400,000	480,000	2,623,680	1,463,040	1,054,080	878,400
700	2,800,000	560,000	3,060,960	1,706,880	1,229,760	1,024,800
800	3,200,000	640,000	3,498,240	1,950,720	1,405,440	1,171,200
900	3,600,000	720,000	3,935,520	2,194,560	1,581,120	1,317,600
1000	4,000,000	800,000	4,372,800	2,438,400	1,756,800	1,464,000
1100	4,400,000	880,000	4,810,080	2,682,240	1,932,480	1,610,400
1200	4,800,000	960,000	5,247,360	2,926,080	2,108,160	1,756,800
1300	5,200,000	1,040,000	5,684,640	3,169,920	2,283,840	1,903,200
1400	5,600,000	1,120,000	6,121,920	3,413,760	2,459,520	2,049,600
1500	6,000,000	1,200,000	6,559,200	3,657,600	2,635,200	2,196,000
1600	6,400,000	1,280,000	6,996,480	3,901,440	2,810,880	2,342,400
1700	6,800,000	1,360,000	7,433,760	4,145,280	2,986,560	2,488,800
1800	7,200,000	1,440,000	7,871,040	4,389,120	3,162,240	2,635,200
1900	7,600,000	1,520,000	8,308,320	4,632,960	3,337,920	2,781,600
2000	8,000,000	1,600,000	8,745,600	4,876,800	3,513,600	2,928,000

APPENDIX B

BUYING PRACTICES FOR COMPUTERS, NETWORKS, SERVERS, PRINTERS, AND SOFTWARE

Buying Practices for Computers: Best-buy of the current-year model computer ensures a five-year useful life. Buying last-year's model represents a four-year useful life and some loss of functionality. When the cost of research, procurement, installation, configuration of operating systems and software, and maintenance are added to the purchase price, the current-year model offers both cost and functional advantages. Functional advantage means better performance and the ability to upgrade to newer versions of software.

Compatibility: In the past, the software industry emphasized backward compatibility – that is – software should run on earlier versions of the CPU and operating system. Market research shows that sales of new software are principally for new computer systems. For this reason, many software manufacturers have abandoned backward compatibility in order to provide the new buyer with software that fully utilizes the capabilities of the new computer.

Changed file formats are also a nuisance. For example, *Word* for Office 97 uses a different file format to Office 95. Thus, files must be saved in Office 95 format under a different name to be readable by computers using the older format.

Installation And Maintenance: The manufacturer should install and configure software and peripheral equipment to the extent possible. This minimizes technician time for setup and ensures correct and identical configuration. Unpacking and on-site installation and testing should be conducted by the manufacturer wherever possible to conserve technician time. A maintenance contract with 24 x 7 support is required.

Replacement: If the useful life of a computer is 5 years, 20 percent of the computer inventory should be replaced each year. Based on an average cost of $4,000 per computer, annual replacement cost would be 1000 x 4,000 x 20% or $800,000 per year.

Lease Option: Most leasing plans are finance plans where you pay interest for the loan of the money. Most lease arrangements provide for buyout at the end of the lease. Lease is very costly if you update equipment every one or two years. The longest lease is normally four years, with a buyout cost of either 10% or $1. The cheapest rental costs 30% more than purchase over a four-year period.

Recommendation #4: *Buy top-of-the-line computers – proven brands of the current model –with applications loaded and configured ready for use. This will maximize Quality of Service and years of service and minimize technician time for setup and troubleshooting.*

Buying Practices for Servers, Printers, and other Peripheral Equipment: A server may support from 30 to 100 computers, while one printer can be shared by up to 16 computers. This number can be doubled for high-speed (25 pages/minute) computers. The specific numbers should be based on the applications involved. Useful life for printers and servers is 7 – 10 years.

Maintenance: Preventive maintenance is important. A replacement schedule should be setup to provide for wear and tear and changes in the technology before the equipment becomes unreliable or unusable.

As with computers, standardization and assured quality are fundamental for high reliability and efficient maintenance. Compaq and Hewlett Packard manufacture most servers used by RCCD. Hewlett Packard manufactures almost all printers in use at RCCD. Key items of peripheral equipment not discussed here are the modem pool to connect off-campus users and CD-ROM servers to provide central access to CD-ROM information and program development resources.

Buying Practices for Networks: The useful life of a network is ten years for where advanced technology (switched Ethernet, fast Ethernet, ATM) is selected. Older technology may bee useable for low demand applications such as email and word processing. It is important to correctly assess the network traffic as illustrated by the following examples:

- When 3-Com gave $1,000,000 to network San Jose City Schools, it planned to install shared 10-Base T networks, the standard for word processing and most business applications. 3-Com discovered that educational users make extensive use of graphics and multimedia (sound, graphics, and motion). These overtaxed the network capacity and caused it to be unreliable. Two changes were made. **10**-Base T **Shared** Ethernet was replaced with **100**-Base T **Switched** Ethernet. This increased the capacity and reliability of the system for multimedia. The change required the initial grant to be increased to $5,000,000.

- Token-ring networks at RCCD no longer meet our functional requirements and are being phased out in favor of switched Ethernet. This means purchase of new hubs to meet the new standards for speed and reliability. The minimum standard for new classroom and lab installations at RCCD is 100-Base T Switched Ethernet (also called Fast Ethernet).

The network should provide connectivity to every classroom and faculty office, with a 10% margin for future expansion. Assuming a baseline number of 1500 ports for all three campuses at a cost of $500 per port, the baseline investment in network hubs and interface cards will be 1,500 x 500 = $750,000. If optimum is four times this number, the investment in networking will be $3,000,000.

Even with 3-Com's PACE technology to give priority to picture and sound data, the bandwidth of a 100-Base T network limits the number of multimedia users

that can be serviced simultaneously without impairment to sound and picture. A better, though more costly solution, would be ATM.

Asynchronous **T**ransmission **M**ode (ATM) should not to be confused with the Automatic Teller system used by banks. ATM has much greater bandwidth than 100-Base T and its transmission protocol retains the continuity of video, sound, and multimedia.

Both telecommunication and networking systems are now migrating to ATM, initially for the backbone, and then for critical connections where high quality video and multimedia are required. Ultimately, ATM will enable voice, video, and data to be supplied via a single network instead of maintaining three separate infrastructures - phone-lines, television cable, and Ethernet.

At the time of writing, an ATM network costs almost twice as much as 100-Base T. By starting with an ATM backbone for the Intra-Net (internal campus networks), future computer and network purchases can be directed to ATM for priority users.

Purchasing regulations can undo the best research and planning, sometimes with disastrous results. For this reason, close collaboration is desirable between policy makers, purchasing agents, and users.

Replacement cost: Replacement should can be prorated 20% of the value of the computer inventory, 15% of the value of the printers and servers, and 10% of the value of network equipment such as hubs and routers. Additional sums may be needed to take advantage of innovations and significant changes in technology that cannot be predicted in long-term planning.

Buying Telecommunication Services: Initially the connection between campuses and connection to the Internet will be via multiple T1-lines leased from the Telephone Company or other communications provider. A dedicated T1-line currently costs about $1,500 per month depending on location. To connect though two telephone companies, as from Riverside to Moreno Valley doubles the cost. Several T1-lines will be needed on each campus to handle the different services – Administrative network, Academic Network, 4Cnet, direct Internet connection, and interactive videoconferencing.

4Cnet is provided by an Act of the State Legislature. It is an expansion of the CSUNet, which is not recognized for reliable service. As 4Cnet is expanded from 25 universities to include 106 community colleges, technical problems and interruption to service should be anticipated. For this reason, 4CNet should be used as a backup or supplemental resource and not as the primary Internet connection.

There are cost reductions for multiple T1-lines and there may be further cost reduction as a result of the Snow amendment to the Telecommunications Act of

1996. Some cost may also be absorbed by budget augmentation for new communication technologies from the Chancellor's Office. Even with reduced rates, telecommunication (transmission) costs are high and need to be contained. An alternative plan presented later uses State and Federal resources to buy infrastructure to reduce and contain future costs.

There are four ways to connect the three RCCD campuses.

1. The first and most obvious method is to contract these services from the Telephone Company. The anticipated cost is $2,500 per month per campus for three T1-lines for each campus.

2. A second method is to have *telcos* and other communication providers bid for this service. This method is currently used and results in some cost savings.

3. A third option is to establish partnerships with other users such as the Riverside Unified School District and the City of Riverside in order to share facilities, use existing infrastructures where they exist (the City has fiber optic networks for its power grid), and to collaborate on a common communications infrastructure to achieve economy of scale.

4. A fourth option is for RCCD to build its own system using microwave technology. Galen Tustison, an international communications consultant, should be contracted to conduct a feasibility and cost study for a microwave system to connect computer networks, telephones (voice and fax), two-way video, and central videotape distribution for all three campuses. This would provide a dedicated 45 Mbps ATM service with ample capacity for present and future needs.

Based on the rental cost of multiple T1 lines - 3 x $2,500 = $7,500 / month for three campuses, the microwave system would pay for itself in two to three years. An ATM microwave system has 32 times the capacity of a T1-line. Currently the telephone company would charge of-the-order-of $20,000 per month for each campus for a dedicated ATM connection.

Not included in this section is the cost of connection to the Internet and the cost of Internet addresses for faculty and students. However, it is clear that at $3,000 per computer, and allowing $500 toward server, $500 toward printer, $500 for network hubs and cards, $500 for electrical and network wiring, $500 for furniture and supplemental air conditioning, and $500 for software and software licenses, the cost per installed workstation is not less than $6,000.

Appendix C

Telecourses ands Teleconferencing at RCC

RCCD receives satellite teleconferences and courses on tape. It distributes television lessons by supplying videocassettes to local cable companies. At this time RCCD cannot originate live broadcast or satellite programs. The RCC campus is a head-end for Cross County (Wireless) Cable. Moreno Valley is negotiating a head-end for TCI Cable. In the future, it will be possible to originate live and recorded programs via local cable from each campus.

RCCD has interactive video (teleconferencing) equipment on each campus. Interactive video requires ISDN telephone lines and a multi-point connection where more than two sites are to be connected. Picture quality is improved when multiple ISDN lines are used. Each campus has purchased three ISDN lines (384K) under the Education First program from Pac Bell. An internal multi-point bridge can connect up to four sites using a single ISDN line (128K). External bridging can be rented for connection at higher data rates. All participating campuses must use the same data rate. ***RCCD equipment was recently upgraded to meet the current standard for the community college system and the California State University.***

Interactive video connections for RCCD campuses can be accessed from one of the following classrooms on each campus:

Riverside City Campus (patched by RCC IMC):
AD 122 (Board Room), Administrative Conference Room, BE 10, LB 102, LS 108, Quad 134, Quad 144, (Hall of Fame is yet to be installed).

Moreno Valley Campus (Patched by IMC Office in Hum 220):
Hum 120, Hum 129, Hum 209

Norco Campus (patched locally):
ATec 114, Hum 111, Student Services 101, (Little Theatre is yet to be installed)

Under the Pac Bell *Education First* initiative, three ISDN lines are provided to each campus at a flat rate of $75 per campus per month for the local area ($2,700 year unlimited use for the three campuses). This makes it possible for RCCD to connect to any educational organization in the Greater Riverside area including: California State University, San Bernadino; University of California, Riverside; Riverside Unified School District; California School for the Deaf; and similarly equipped classrooms and conference rooms in adult education centers, government and community agencies.