Research Findings and Formation of Planning Assumptions

I. Global Technical Environment:

Technology and computing is on the cusp of a transformation that will change the technical landscape and the way we perceive technology, much the way that the advent of the personal computer revolutionized computing in the 1980s. Institutions that hope to thrive and support student access and success must plan for these changes, which will impact not just the actual computing devices but also the operations and management of computing services. Effective technology plans for educational institutions must consider, as their foundational planning assumptions, the following trends acknowledged by technology leaders around the globe (sources are provided in the Appendix):

1. The arrival of mobile computing devices, including Smartphones, tablet computers like the iPad, and mobile readers, will begin to make laptop and desktop computers obsolete by the year 2014.
    a. College technology plans should recognize that purchases of desktop and laptop computers will drastically decline and begin to be phased out in favor of more flexible computing devices that are unrestricted in their operating system requirements and software/application compatibility.
    b. Software and textbook publishers, in recognition of this sea change, are scaling back on development of educational materials tied to PCs and particular operating environments. Hardware vendors (Dell, HP, Lenovo) will begin to scale back manufacture of laptops and desktops, and are already beginning to make plans to scale back the practice of working with

educational institutions to develop devices to the institution's specifications. Predictions are that by 2014, K-12 school districts will have reduced their hardware (laptop and desktop) purchases by at least 30%. Also by 2014, educational institutions will be purchasing twice as many tablet computers (IPads, etc.) as laptops or desktops.

2. Handheld and mobile computing devices provide access to technology at a more affordable price and with greater versatility than the desktop or laptop.
    a. Low-income students who cannot afford a laptop or Internet service in their homes most often consider a cell phone with internet access a necessity. For one monthly fee they can access the same services, applications, and coursework on their phones, without the investment in a computer or payment of another monthly bill to an Internet service provider. Smartphones are increasing access to information and educational services to segments of the global and national population that have not had this access before.
    b. The prevalence of mobile computing devices is changing traditional notions of the learning environment and the role of the teacher. Formerly, to access and use technology, the student had to either come to the college campus to use a computer lab, or, more recently, have access to a computer and the Internet at home. Instructional resources, course materials and exams, and distance education courses are now accessible anywhere the student has his/her phone. The new technology has untethered the consumer from a fixed computing platform, meaning that the world has now become the potential learning environment for any class.

3. The arrival of mobile computing devices and their anticipated revolutionary effect on the way we use and perceive technology has significant implications for the design and administration of a technology infrastructure on a college campus, requiring a shift in planning, operational, and management assumptions. Support services must also change.
    a. In a traditional technological environment, colleges had a strong incentive to standardize computing hardware, operating systems, and software applications to achieve efficiency in services and infrastructure design. A standard specification for desktop PCs was developed to satisfy the majority of user needs, and a standard operating system (such as Windows) was uniformly supplied. Software applications utilized by faculty had to be compatible with the hardware and operating systems determined to be the campus standard.
    b. To support and adapt to this sea change in technology, IT departments will be forced to move away from the centralization and standardization practices that brought efficiencies in the past. Mobile technologies and their supplanting of the desktop or laptop mean that campuses will move away from providing fixed computing labs and computing devices for students and instructors.
    c. A campus infrastructure will need to be configured with the flexibility to support multiple operating systems and platforms. IT personnel accustomed to tight control of the academic and technical environment are losing that control as the world of software applications and tools explodes in response to the newer mobile technologies.

d. The coming focus on mobile technologies, with most users having access to these devices and purchasing them for their own use, combined with the growing prevalence of tablet computing devices, will diminish the need for campuses to provide laptops and desktops for students, and, ultimately, faculty and staff. Future technology expenditures will shift from being heavily weighted toward expenditures on computers and computing devices, toward a much greater emphasis on infrastructure and support services.

4. As the technical world accommodates the move toward mobile computing, applications, software, and information are being made available for these mobile devices, with a declining emphasis on "fixed" (PC-based) software and applications. Technology developers no longer focus on developing applications that conform to a Windows or Mac platform, but rather that will function on any platform and are globally compatible, in recognition of the diversity of user devices.

    a. Infrastructures and IT leadership will need to transition to a philosophy of decentralization and "device-agnosticism" (not tied to a single device or platform).

    b. As the technical world moves toward a "device-agnostic" environment, campuses will shift from housing software applications on each classroom and office computer to a virtualized environment, first, which houses all applications on servers and permits individual users and classrooms to access all applications from the server. The virtualization of the computing environment introduces new efficiencies in this environment by:

i. Drastically reducing the man hours required from IT services to construct a customized "image" of software applications for each instructional area's classrooms and labs.

ii. Significant reductions in an institution's software licensing costs. By housing all software on the servers in the network operating center, each individual user machine in classrooms and labs does not have to be individually licensed.

iii. Increase student access to courses and instructional materials, while also reducing their textbook costs for many courses by between $50 and $400. Currently, students taking courses which involve the use of software must purchase a textbook bundle which either includes a trial license for the software or a code to access publishers' instructional materials online. In a virtualized environment, course software and applications can be accessed through the student's Smartphone (or a remote PC at home or a public library) without being required to purchase a supplemental license (because they are accessing the virtualized software through the college network, which is already licensed). Many students today cannot afford the software (or frequently even a textbook). Access to instructional resources will increase through virtualization, as will, by extension, student success.

iv. Cloud Computing – As the variety of user devices and their configurations multiply, technical companies and innovators are shifting from supplying licensed software packages to users, to providing the software and applications on their own servers, with users able to access any desired application from the remote “Cloud.” The Cloud is the next logical progression in technology as an outgrowth of mobile computing. It removes the need for institutions to host software and their applications, and instead creates the need for a robust and flexible infrastructure architecture that provides a reliable access point to the “Cloud” (remotely accessed, openly available applications). Nationwide, almost half of colleges and universities have already moved to the cloud for universal applications such as email, no longer providing a campus email utility but electing to use providers like Google’s Gmail.

5. The proliferation of mobile devices and their related applications will create an explosion in distance education offerings, the demand for them, and the applications available to be integrated into this instruction. These technologies, many of which were previously relegated to use in distance education courses, will begin to permeate every aspect of instruction and every delivery mode.
6. The growing prevalence of mobile computing devices dictates the presence of a wireless environment that is robust, reliable, and accessible from all points on campus.

<u>Global Summary:</u>

Technological trends and innovation indicate that plans for educational technology that cover the coming five years must take into account the following trends to be viable and to help guide colleges into the future:

- The growing prevalence of mobile computing devices, which will continue to transform the technical landscape.
- Previously accepted principles of operating efficiency for IT services. A philosophy of standardization will no longer be congruent with the operating environment.
- Future plans for technology support, including the nature of devices being supported and their configuration, requiring a “device-agnostic” approach. Laptops and desktops will become obsolete in another five years.
- The design of the infrastructure and its fundamental purpose, with an initial move toward virtualization. (A layman’s explanation of virtualization is provided in the Appendix to this plan).
- The ultimate transition to “Cloud Computing,” already underway.
- A shift in the distribution of expenditures on technology from computing devices to an emphasis on infrastructure and support services.
- The necessity of a completely wireless environment that is reliable and robust.
- The need for support personnel to engage in life-long learning and training, to be able to provide support and services in a drastically altered environment from the one in which they were hired and trained.

Section X: California Community College System Strategic Plan

The trends toward mobile computing, virtualization and cloud computing are recognized and detailed as operating assumptions in the California Community Colleges Technology III Plan, 2007-2010, written in support of system-wide goals outlined by the Chancellor's office. These trends are acknowledged as heralding changes in instruction, the student body colleges serve, and administrative systems and processes. The report cites the critical need for institutions to address these changes, and emphasizes the connection between technological currency on campuses and the development of a skilled workforce.

With the focus in California on technical companies and innovation, this effort is seen to be even more essential for the state's colleges, its workforce, and continued economic vibrancy. "Technology firms continue to be major employers within the state, and many technology-based occupations remain understaffed due to the lack of skilled workers. These and other forces have placed some unprecedented responsibilities on the community colleges in responding to the state's needs for an educated citizenry (http://www.cccco.edu/LinkClick.aspx?fileticket=q1T2bIwS2Ls%3d&tabid=1224&mid=3309, p. 19)."

The system's technology plan refers to the dramatic changes in today's student's learning and thought patterns that have resulted from the growing prevalence of technology and their own consistent use of that technology since an early age. As a result of this change, today's students, referred to as the Millenials, learn more effectively in a collaborative learning environment that pushes educational institutions to integrate social computing and networking, personal broadcasting, user-created content and educational gaming into their instructional delivery in the traditional classroom. The plan anticipates that the latter three will increasingly influence the educational arena in the next five years. For a succinct summary of the trends affecting instruction in the classroom, which mirror the changes summarized in Section X, see the California Community College Technology III Plan, 2007-2010, available at http://www.cccco.edu/LinkClick.aspx?fileticket=q1T2bIwS2Ls%3d&tabid=1224&mid=3309 , pp. 27-34.

The system plan refers specifically to the Digital High School plan for the state, formulated in 1997, which mandates that all state high schools become completely digitized by 2010. The overwhelming majority of these students who continue to higher levels of education go to the state's community colleges. The system and its technology plan view it as "imperative that the CCC system continue to evolve a robust sustainable infrastructure that facilitates access and student success. Efforts to fund continued connectivity, redundant circuits for continuity in operations, wireless connectivity to Web-based applications, and the incremental costs associated with escalation and inflation for existing systems are critical to closing this gap in ways that will also serve the Millennials." (Technology III Plan, p. 24-25).

While much discussion regarding technology implementation tends to focus on its impact in instruction, it is important for planners to consider the effects on how work is performed in this high-tech environment, and the resulting impact on technology needs. Administrative processes in finance and budget operations, maintenance and access to student records, interface with other educational institutions, marketing and information dissemination, and the heightened focus on accountability reporting all increase the demand for technology and flexibility in technical operations. These functions are all also related to improving student success and evaluating institutional progress toward addressing the achievement gap.

Technology, then, is no longer a luxury or an optional add-on in education. It is an essential investment that an institution cannot ignore. As the CCC System's technology plan indicates, "in this economy, one must be able to use IT to do work. In academia, that 'work' equates to teaching, learning, and/or administration and management functions in support of the educational mission. As such, IT must increasingly become a seamless part of the pedagogies used by instructor and student alike. Robust IT systems can and are used to capture, archive, retrieve, and analyze performance data, such as student learning, teacher effectiveness, and administrative efficiencies, in support of improving the educational system."

"Having data and information to drive decision making is the key to being able to assess, improve, and ultimately demonstrate performance. The issue of what specifically should be measured and tracked over time in order to get at the desired objectives is a difficult one. The subject of appropriate metrics to drive academic institutional excellence is enough to generate many studies and reports, and it undoubtedly has. Regardless of which metrics are selected though, the use of IT will be key in providing timely analysis and allowing for data-based management decisions. (p. 21)."

II. Fullerton College Technical Environment

In addition to considerations of changes in the global technical environment, a technology plan needs to consider the local environment of Fullerton College and the needs and constraints of that environment, as well as the perceptions of local users. Fundamental planning assumptions for the college include the following observations, gleaned from surveys of campus users and past operating practices:

- The college has not had a consistent practice of funding technology purchases on an ongoing basis, through a devoted budget line-item for technical hardware purchases and infrastructure. Instructional departments that are heavy users of technology have had to rely on soft funding sources to purchase technological equipment, often, as a consequence, purchasing equipment that does not fully address needs. Hardware purchases have been postponed for years, with the result that some areas of the college are using computers more than ten years old which are unable to accommodate current versions of Office software and Microsoft operating systems.
- Infrastructure needs have not been addressed for several years, resulting in capacity constraints and "pipeline" restrictions that cannot accommodate the demand for resources that has significantly increased in the last five years. Switches that feed capacity to classrooms are below required capacity to accommodate increased traffic and software capacity needs, and cabling capacity needs to be increased.

- Current FC IT practices, policies and procedures, built on a philosophy of standardization that prevailed in the early years of technology, increasingly conflict with instructional demand for technology and the usage of increasingly diverse applications in the educational environment. Instructors are urged to become more versatile and adaptable in their use of technology, to reach a student population to whom technology is second nature, at the same time that IT practices require standardization. IT practices need to be developed that support instructional innovation and are responsive to instructional needs. The time to address service issues and problems needs to be significantly reduced so that instruction does not halt while waiting for IT support. A manual of best practices for IT departments, operating policies and procedures needs to be developed to ensure uniform application of service and support practices, as well as operating assumptions.

- Inadequate funding and planning for the college infrastructure has produced unreliable network connections and support.
  - Students and instructional faculty, with the necessary increasing reliance on technology in the classroom, need a fully supported network with sufficient capacity and proper configuration to assure, as much as possible, reliable connectivity to all aspects of the network which serve student and faculty.
  - Infrastructure funding and support also affect reliability and connectivity with administrative and student services. Managers and office staff have become accustomed to periodic outages, loss of access to financial systems and student records, and/or remote access to college network and email services.

Section X: Sustainability

Concerns have been expressed college-wide for the last four years regarding the college's ability to sustain its technological infrastructure and replacement of technical equipment, with a growing percentage of equipment of such age that it is unable to be updated to run current operating systems or software applications.

While in recent years the college made a significant investment, with the assistance of the district, in a VOIP telephone system that is integrated into the college's computing network, investment in computing equipment and hardware necessary to support the operating network has not been regular or proportional to the needs. As a result the college's network and its configuration is subject to frequent glitches that result in interruption of service to outside users (affecting distance education students and faculty) and internal users of the network or email, and in bottlenecks in capacity at high usage times. While glitches are to be expected in any technical operating environment, their frequency and duration increase with the age of the infrastructure.

In addition, numerous instructional areas have specialized software needs which require periodic re-licensing and purchases of upgrades to maintain up-to-date instruction and compatibility with industry/user standards. While the college maintains site licenses for applications used by the whole college community (Microsoft Office, for example), applications not used college-wide are generally not purchased with the college's ACT budget and these instructional areas are expected to locate funds to maintain their own software currency and licensing. In many cases these instructional areas do not have budgeted funds or budget capacity to fund these purchases.

The lack of ongoing annual financial support has led to a reliance on temporary, one-time, soft monies to finance equipment purchases. In the past four years, a total of $ _________ (have in my office) in federal VTEA monies have been expended on equipment replacement. While this practice has enabled the college to replace equipment when critical needs arise, it also impedes the full evaluation of actual costs to sustain and upgrade the structure. Soft monies also typically cannot be used for infrastructure needs, which, combined with a lack of regular college funding to support this need, has contributed to the aging of the infrastructure. In addition, VTEA grant expenditures for this purpose are increasingly frowned upon, as the regular replacement of computing equipment is viewed as a college budgetary responsibility. As a result, these expenditures have come under scrutiny by grant reviewers in the state Chancellor's office in recent years.

Many institutions fail to sufficiently fund technology due to a lack of knowledge of its total cost, and an incomplete understanding of technical issues at senior leadership levels. This often leads to a failure to factor in the costs of maintaining, repairing, and improving the performance of the equipment, insufficient training for faculty, technical and support staff, administrative staff and students, and results in service issues and inefficiencies. These represent some of the indirect costs of technology ownership.

Most users also are not acquainted with the structure and needs of the "back-end" of the system which is required to support their interface with and use of the equipment. These aspects of technology ownership, representing additional direct costs, tend to be invisible to the typical user and college leadership, and therefore receive insufficient attention. The table below details some of the direct costs that institutions may fail to consider:

Direct Costs of Hardware/Software
Sub Category
Initial PC hardware and Operating systems cost
Assistive technology hardware and software (10% of PCs)
Operating System and Office Software Licenses
Peripherals (printers, projectors, etc.)
Network Operating System Hardware
Network Operating System Licenses
Switches, hubs and bridges (Hardware and Software)
Wiring (cabling for classrooms, offices. etc.)
NSM Hardware and Software
Servers for hosting applications, network and web services
Sub-Total Direct Costs

(*Note: Chart does not include printers for assistive technology. The printers are estimated at $4000 per printer. One printer per each lab that provided assistive technology would be necessary. Excerpted from the Gartner Group Total Cost of Ownership model, California Community College System Office Technology Plan III. See Appendix X for definitions and guidelines).

Total Cost of Ownership models have gained widespread acceptance in the technical community in recent decades, and provide a means of evaluating the college-wide costs associated with maintaining technical services to faculty, staff, and students. The California Community College System utilizes a model developed by the Gartner Group, long-time advisors to institutions in the field of technical systems and applications. The System office requires the utilization of this model by colleges evaluating their future technical needs and applying for grant funds to upgrade technology. A brief explanation of this model and its templates are provided in Appendix X, and are used as a frame of reference in this strategic plan.

Planning Recommendation: The college needs to make a commitment to upgrading and sustaining the viability and capacity of its technical infrastructure, hardware, and software needs. This commitment should include an annual allocation with a line item in the college budget devoted to making progress toward system sustainability. In addition, the planned hire a grants and economic development specialist should include the exploration of external funding sources to supplement this commitment and potentially provide an large boost to the upgrade of the structure, with the college able to devote more funds to sustaining that investment. (Recommendations 3 and 4 supported by Academic Senate, on page __).

Planning Recommendation: As the college looks to the future and evaluates its commitment to technology, a total cost of ownership model should be considered as a means to effectively project and evaluate the size of a necessary annual financial investment to promote sustainability. This process should recognize that such models provide recommendations for a "typical" institution, and that Fullerton College, like all institutions, is unique. The model should therefore be viewed as a guideline for developing a model that reflects the college's needs, budget condition, and future strategic plans of the college and the North Orange Community College District.

Section X: Fullerton College User Hardware Inventory

Table X below reflects the results of a recent inventory at a snapshot in time of college computing equipment.

TABLE X? Age Range of Fullerton College Computing Hardware Inventory

Age	PCs		MACs	
	Number	Percent	Number	Percent
0-3 years	332	16.4%	90	49.7%
3 – 5 years	1219	60%	58	32%
5 – 7 years	148	7%	33	18.2%
7 – 10 years	263	13%		
10 + years	65	3%		
Total	2027		181	

NOTE: These figures have not been updated to reflect the recent completion of the Natural Science building and the replacement of all technical equipment in this building. Or have they???????

Evaluation of User Equipment Inventory:

The college's approximate inventory (snapshot figure) is comprised of 2027 PCs and 181 Macs, for a total of 2208 computers. This figure is constantly in flux as purchase requisitions for new computers are placed in progress and some computers are placed into the college's equipment surplus process.

PCs: The average age of PCs on campus is 4.3 years. However, 25% of the college's PC inventory is five or more years old. 328, or 16% of the total, are more than seven years old. These figures have recently improved due to the completion of the college's

Natural Science building, and the replacement of all technical equipment for these programs.

The industry-wide standard recommendation for educational institutions to maintain currency in technology is three years. However from a strategic perspective, most institutions also utilize a re-allocation process for their computing hardware to extend the life of their equipment investment. By re-allocating a three-year old computer from a high-end user with needs for higher computing capacity, graphics drivers, or memory to a lower-capacity user with a primary need for word processing, the college extends the life of computer for another two to three years, and also the life of their investment. In a “food-chaining” system of re-allocating computers across campus, a user with these lower power needs may be able to utilize a five year old computer with few problems.

However the maintenance of over-age computers (five plus years or older) leads to higher operating costs for the college, because these older computers require more frequent maintenance and customized, manual installation of older versions of applications. These older computers cannot operate more recent versions of operating systems or software applications which the rest of the campus is using, which results in a need for “work-arounds” to maintain compatibility and efficient operations system-wide. Similarly, as technology on the “new” end of the organization becomes increasingly sophisticated, these older systems may be of an age that they are no longer compatible with the campus standard configuration and/or **network / Web protocols.** When this occurs, they become a niche group of users that require specialized attention and a separate configuration to preserve functionality.

Planning Recommendation: The college should examine the implementation of a documented procedure that will reduce the average age of computing equipment utilized on campus. While considering options, the college should integrate into this plan the projected growing dominance in the next three years of mobile computing hardware and the coincident migration of applications usage "to the cloud" as detailed in Section X.

Macs: Note that the average age of Mac computers is less than three years old. This reflects the relatively recent increase in usage of these computers by instructional areas with high graphic quality and capacity needs. Apple and Mac computers have always had a high graphics focus and user support, and these computers are the industry standard in professions supported by the college's Digital Animation, Photography, Music Recording Production, and Digital Video programs. They are gaining prominence in other industries with similar user needs. As such, Macs represent a niche group of high-end users on the campus.

Because they represent high-end needs and usage and a niche group, these computers do not currently have consideration in a campus-wide reallocation plan. Since the college ACT has had a policy of standardization in the past, support for these users and their machines is not provided, and these programs have invested in hiring and providing technical support from their own budgets.

Planning Recommendation: The decision not to support Macs should be re-evaluated in light of the unintended consequence of operating inefficiencies and higher costs incurred in other operating areas. These costs have not been factored in to the total cost of technology on campus, as they are masked in other budget centers whose budgets have not been accordingly increased to accommodate the additional costs. A further loss in efficiency results due to the fact that, since the Mac s have not been integrated in to the college's PC-based system, the life of the investment in Macs cannot easily be extended by reallocating them to other areas of the college when their useful life for high-end users expires.

Section X: Total Cost of Ownership: Technical Operations and Support Needs

Fullerton College's Academic Computing Technologies unit appears to be understaffed when compared to the Total Cost of Ownership templates for a typical institution shown below and developed by the Gartner Group. These guidelines have been accepted by the California Community College System as an effective tool for technology planning and forecasting investment needs, and are required to be submitted in application for technology grants. It is available at http://www.cccco.edu/ChancellorsOffice/Divisions/TechResearchInfo/TelecomUnitHome/StrategicPlanning/tabid/1224/Default.aspx .

While these are valuable references in technology planning, all institutions are unique, and the templates cannot be applied blindly. For example, Fullerton College operates within a three-college district, with its technical operations being supported by the district Information Technology unit. This means that there may be some operational areas or functions that may be partially shared, with some technical aspects being housed at the district and others at the college. The following charts should therefore be viewed as advisory in nature.

In addition, it is not yet clear what impact the advent of mobile computing technologies will have on an organization's staffing needs. The proportional shift in expenditures, with a larger proportion being devoted to infrastructure support and needs than has been the traditional pattern, does not necessarily coincide with greater staffing needs in this area. In some respects virtualization will reduce labor hours in imaging computers, labs, and classrooms. It may also reduce some demand in communications and applications support. A different organizational structure in Academic Computing may also prove more efficient as technologies change.

Direct cost of management below refers to management of the institution's direct network, system and storage management labor staffing, activity hours and activity costs, maintenance contracts and professional services or outsourcing fees:

Direct Cost of Systems Management	
Sub Category	**Assumptions**
Network and Systems Admin. (Novell, etc. include wiring staff)	1 staff/300 PCs FC inventory of ~2200 computers would equate to 7.3 staff. FC currently employs 3 staff, depending on how duties are defined.
Technical Management	1 / 500 PCs FC inventory equates to 4.4 staff. FC employs one manager of instructional technology services and one manager of system technology (networking). The Director's position has been vacant for almost one year.
Web Administration	1 staff per 12,000 FTES; Equates to 1.4 staff members. FC currently has no staff in this area.
Administrative Systems Support (web, user dev. Applications)	1 @ $85K + 25% (benefits, tax contributions) = $106,250 There is 1 position defined in this area but it is currently empty. Some web services are administered from the district offices.
Sub-Total Cost	

Direct costs of support below include help-desk labor hours and costs, achievement of help-desk performance metrics, training labor and fees, procurement, support contracts and overhead labor:

Direct Cost of Support	
Sub-category	**Assumptions**
Level 1 Support	1 staff / 150 PCs Equates to 14.6 support positions. FC employs between 7 and 9, depending on how roles are defined. It is unclear how mobile computing devices would affect this need.
Sub-Total Cost	

Direct cost of communications support below estimates inter-computer communications expenses for lease lines, server access, and remote access to college servers necessary for distance education students, email communication, etc.:

Direct Cost of Communications Support	
Sub Category	**Assumptions**
Network	$24,000/yr: 1-6,000 FTES $48,000/yr: 6,000-12,000 FTES **$72,000/yr: 12,000-18,000 FTES**

Development support functions below include labor and fee expenditures for application design, development, testing, and documentation. This includes the customization of applications to meet college network configurations and different user needs, and the maintenance of these customizations.

Direct Cost of Development Support	
Sub-category	**Assumptions:**
Application Development	2 staff / 12,000 FTES Equates to 1.4 staff at FC.

In total, using the total cost of ownership model, Fullerton College's ACT department would employ a total of 30.1 personnel. The college appears to be particularly understaffed in the technical support area, with a recommended 14.5 positions and the college employing between 7 and 9 (depending on how existing positions are allocated). Given the additional labor required to maintain an aging inventory of equipment, this staffing deficit may evidence itself in frequent delay in response time to technical issues. It may also contribute to the often cited communication weakness between ACT and other areas of the college.

Planning Recommendation: As the college develops its action items on the plan's recommendations, staffing in Academic Computing Services should be reviewed. The Total Cost of Ownership model can provide guidance in reviewing staffing needs. Staff functions and roles should be reviewed as well. The imminent changes in technology should be factored in to this review, in terms of how these changes might affect staff functions and personnel needs.

Section X: Fullerton College Technology Summary / Recommendations:

1. Fullerton College needs to develop a comprehensive technology plan that provides for the periodic replacement of hardware, with the acknowledgement that hardware and infrastructure needs, along with operating procedures and practices, will change dramatically in the next three years.
2. Fullerton College needs to evaluate the implementation of a virtualized operating environment, which will accrue to the college and its student's considerable savings in operating costs, and introduce multiple efficiencies. The college's Business/CIS division is currently implementing a pilot virtualization program, which could conceivably provide a model for collaboration and "test-drive" of the system before campus-wide implementation.
3. The college needs to develop a computing hardware replacement plan that provides for the replacement of primary computing hardware every three years, and server/infrastructure equipment every five years, to ensure a reliable access to computing applications for faculty, staff, and students. This plan needs to take into consideration the probable and imminent obsolescence of the desktop and laptop computer.
4. A significant investment needs to be made in upgrading the configuration and equipment of the network's infrastructure, on which all technical operations rely. Before this investment is made, an investment in consulting services to evaluate current network and infrastructure configuration should be made, to ensure optimal configuration and operation in the changing environment.

5. The college needs to fully fund distance education operations with the recognition that specialized technical skills are required to administer and support distance education courses and faculty. This includes the investment in at least one full-time technical support person who will also work with faculty in instructional design and delivery.

6. The college needs to develop and support a wireless environment that can be accessed from anywhere on campus, with reliable connectivity that is "device-agnostic."

7. Fullerton College's IT department, in collaboration with instructional, administrative, and student service personnel, needs to develop a handbook of operating procedures, best service practices, and policies that will guide their approach to support and services and establish a service-oriented philosophy.

8. Technological structure and applications should support the growing integration of technical applications available through the Cloud into all learning modalities and delivery modes.

The remainder of this document will address these recommendations, with consideration to the current operating environment at the college, its current inventory of hardware, and the state of its infrastructure.

1. Virtualization

Virtualization is the implementation of technology that allows servers and clients to be hosted on a networked system and accessed remotely. This technology allows highly flexible computer environments to be configured to meet the needs of individual subject matter and faculty members. It also allows off-campus access to computing resources for both students and faculty. The benefits of virtualization include:

a. The ability to create and easily deploy a variety of computer desktop images for demo systems, labs, faculty and staff office systems, and for remote access over the Internet.
b. Reduction of software licensing costs since the licensing follows the user and not the hardware.
c. Access to on-campus computing resources through remote connections which will allow more online classes to be offered and improve student access to computer resources from off-campus.
d. Scalability of resources to meet demands which means that back-end resources can be adjusted to meet the demands of particular situations (for example, increasing storage or processing on demand).
e. Allow the use of various kinds of client systems to access virtual environments, which means that less powerful client computers can be used to run high-end software.

Virtualization requires additional software and hardware, as well as upgrading the campus networking infrastructure.

Preliminary Requirements to Implement Virtualization:

a. Survey current campus networking infrastructure and resources to determine virtualization needs. This will require hiring a network consultant.
b. Upgrade network infrastructure to support campus level virtualization.
c. Acquire virtualization hardware and software.
d. Train ACT personnel on implementing campus-wide virtualization.
e. Roll out virtualization over two semesters.

2. <u>Computer Replacement Plan</u>

In order to ensure a consistent technology platform for the campus, a computer replacement plan must be implemented. This plan will ensure that desktop systems and server systems will be replaced and reused in a food-chain process every three (desktop systems) to five (servers) years. In addition to desktop and server replacements, this plan should include plans to transition to the use of portable devices such as tablet computers, in recognition of the changing technical landscape.

Requirements to Implement Computer Replacement Plan:

a. Survey current desktop and server resources and grade each device for usability based on the current campus software image (for example from 1 to 5, with 1 being useless). A total score by area will be computed based on this usability number.
b. Create a configuration model for replacement computers that includes several categories, with the recognition of imminent changes in technology hardware, including:

   * Demo Station System

   * Open/Classroom Lab System

   * Faculty Office

   * Administrative Office
c. Create a replacement plan by campus area indicating which systems need to be replaced, with the emphasis on those areas with the lowest usability score.

Systems below a certain score will be removed rather than send into the food-chain system.

d. Make an initial purchase of enough new systems to replace 1/3 of the campus systems, remove obsolete systems, and food-chain salvageable systems.

3. <u>Integrating Distance Education, Training, and Future Technology with Academic Computing, and Fully Funding Distance Education Personnel/Technical Needs</u>

   To fully support Instruction, Distance Education must be included in the ongoing technology budgets and be funded to provide on-campus training and support for online classes. Adequate support and technical assistance must be provided for faculty and students. In addition, training must be integrated with campus technology so that Faculty and Staff can effectively use new technology. As technology is implemented on campus, training on the technology must be automatically included or made available. In addition to distance education and training, instructional best-practices and investigation into new technologies should be a part of Academic Computing.

   General Steps to Integrate Distance Education, Training, and Future Technology with Academic Computing:

   a. Create a Distance Education plan to outline the ongoing needs and direction of distance education (reportedly complete).
   b. Create an ongoing budget for Distance Education to support on-campus technical support and course development.
   c. Integrate distance education training with staff development training.
   d. Hire a full-time distance education coordinator, qualified to address technical support issues and provide assistance with instructional design.
   e. Create/upgrade staff development training lab to support new campus technology.

4. Improving/extending Campus Wireless and Portable Computing

As student learning increasingly moves to a mobile environment, a robust campus wireless environment has become a necessity. Students using their own devices in the classroom can benefit from connection to online resources. Faculty can use wireless devices in the classroom to enhance instruction, and administrative tasks can be more flexible when supported by a wireless environment. The campus must establish a robust wireless environment that allows students from any location on campus to access campus and internet resources.

General Steps to Create a Robust Campus Wireless Environment:

a. Review current wireless infrastructure and establish load capabilities and coverage area.
b. Survey faculty, staff, and students to establish what type of wireless infrastructure to develop.
c. Extend wireless coverage campus-wide.
d. Deploy in-classroom wireless hubs to provide in-class coverage (this can be done before the build-out of the campus wireless infrastructure).

5. <u>Create a Future Technology Center that will investigate new technology trends and how these can be used on campus to support instructional and administrative needs, with supplemental funding through a Technology Dynamic Fund.</u>

   Technology and the process for using technology in the classroom constantly changes. In order to ensure that our campus continually makes the best use of technology, an ongoing fund should be established that will foster innovation in this area, and accept proposals for using technology to improve student success both in and outside the classroom. Each year, a shared-governance committee would accept proposals and award enough resources so that the recipients can do an effective investigation of new technology trends and new uses of technology for student success.

   General Steps for Creating Technology Dynamic Fund

   a. Create an ad-hoc committee to establish the guidelines and requirements for the Technology Dynamic Fund. This will include the selection committee's makeup.
   b. Create a shared governance selection committee.

APPENDIX I

GARTNER TOTAL COST OF TECHNOLOGY OWNERSHIP

SECTION D: Total Cost of Ownership (TCO) Guidelines and Categories

Overview: When educational institutions acquire computer hardware/software, they do so often without factoring in the costs to support the equipment and infrastructure. As a result, there is often a lack of support to maintain, repair, improve performance of the equipment, as well as a lack of staff for training faculty, staff, and students. This creates delays and inefficient use. The TCO funding concept assumes a relationship between computer hardware/software and support. It is a method of determining the full cost associated with owning and using computers in an educational environment.

Background: Since 1987, GartnerGroup has counseled enterprises to consider all costs associated with computing when making management decisions about desktop and LAN acquisitions, upgrades, support and administration. During this time, GartnerGroup has created and evangelized the concept of TCO to the IT community. As enterprises have begun to address the significant and rising costs devoted to their IT infrastructure, the message has gained wide acceptance among IT users. As technology suppliers seek ways of differentiating themselves meaningfully, they too have turned to the TCO model as a means of underscoring their value to the customer.

Used as a management tool as part of an enterprise's annual planning process, the TCO model can become part of a continuous process of measurement, simulation and improvement. Because budget decisions are ultimately based on a set of strategic IT goals, most enterprises must be able to determine various levels of TCO based on the decision being made. By using the TCO model, enterprises can:

- Translate IT cost, staff, budget and other metric information into a TCO "chart of accounts" for each organization.
- Compare the enterprise's actual TCO to typical TCO-based external comparative data. The typical TCO reflects the enterprise's unique business type, size, worldwide location, assets, technology and complexity against other enterprises doing similar levels of work.
- Audit the results to highlight strengths and weaknesses in the enterprise's actual TCO.
- Create a proposed environment or target TCO based on improvements to assets and changes to technology and complexity, and compare the target TCO with the actual TCO.

The breakdown of direct and indirect costs used in the GartnerGroup TCO Model include:

- Direct (i.e., budgeted) costs - measure the direct expenditures on IT by an organization (e.g., capital, labor and fees);
- Hardware and software - the capital expenditures and lease fees for servers, client computers (e.g., desktops and mobile computers), peripherals and network components;
- Management - the direct network, system and storage-management labor staffing, activity hours and activity costs, maintenance contracts and professional services or outsourcing fees;
- Support - the help-desk labor hours and costs, help-desk performance metrics, training labor and fees, procurement, travel, support contracts and overhead labor;

- Development - the application design, development, test and documentation labor and fee expenditures including new application development, customization and maintenance;
- Communications fees - the inter-computer communication expenses for lease lines, server access remote access and allocated WAN expenses;
- Indirect (i.e., unbudgeted) costs - measure the capital and management efficiency of IT in delivering expected services to end users;
- End-user IS - the cost of end users supporting themselves (and each other) instead of relying on formal IS support channels (i.e., peer and self support), end-user formal training, casual learning (i.e., non-formal training), self-development/scripting of applications and local file maintenance;
- Downtime - the lost productivity due to planned (i.e., scheduled) and unplanned network, system and application unavailability, measured in terms of lost wages (i.e., lost time).

The GartnerGroup research shows that the initial cost of hardware and software represents only 30 percent of the Total Cost of Ownership (TCO). GartnerGroup and the Telecommunications and Technology Advisory Committee (TTAC) worked at length to determine the TCO model appropriate for the Community College environment.

The cost estimate for the technology using the Total Cost of Ownership model for the Community College is **$3,506 per PC.** Therefore, a TCO computer is one that is funded at a level of support that corresponds to the 19 elements of the TCO model. The TCO model is designed and constructed to be reviewed and analyzed on a continual basis reflecting the ongoing changes and costs as they relate to equipment, software, training, and support personnel. The TTAC will review the model annually to determine adjustments to it as appropriate.

Appendix II

Total Cost of Ownership Model
TCO Computer Categories

Direct Costs of Hardware/Software
Sub Category
PC hardware and Operating systems cost
Assistive technology hardware and software (10% of PCs)
O/S and Office Software Licenses
Peripherals
Network Operating System Hardware
NOS Licenses
Switches, hubs and bridges (Hardware and Software)
Wiring
NSM Hardware and Software
Servers (HDW and SFTW) for web services)
Sub-Total Cost

*Note: Chart does not include printers for assistive technology. The printers are estimated at $4000 per printer. One printer per each lab that provided assistive technology would be necessary.

Direct Costs of Training
Sub Category
Training
Technical staff training
Sub-Total Cost

Direct Costs of Systems Management	
Sub Category	**Assumptions**
Network and Systems Admin. (Novel, etc. include wiring staff)	1 staff / 300 PCs;
Technical Management	1 / 500 PCs
Web Administration	1 staff per 12,000 FTES;
Administrative Systems Support (web, user dev. applications)	1 @ $85K + 25% = $106,250

Sub-Total Cost	

Direct Cost of Support	
Sub Category	**Assumptions**
Level 1 Support	1 staff / 150 PCs
Sub-Total Cost	

Direct Cost of Development Support	
Sub Category	**Assumptions**
Application Development	2 staff / 12,000 FTES
Sub-Total Cost	

Direct Cost of Communications Support	
Sub Category	**Assumptions**
Network	$24,000/yr : 1-6000 FTES $48,000/yr: 6,000-12,000 FTES $72,000/yr: 12,000-18,000 FTES $96,000/yr: 18,000+ FTES

Sources and Resources