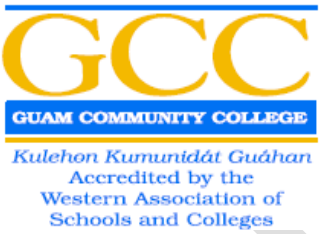
GUAM COMMUNITY COLLEGE



ENTERPRISE ARCHITECTURE

(GCC EA)

Version 2.0

XXXXXXXX 1, 2011

TABLE OF CONTENTS

VISION AND MISSION STATEMENTS

Vision

Guam Community College will be the leader in the Pacific region in the application of technology. The College will anticipate the needs of the local and regional community and provide training and certification to deliver and develop workforce skills. GCC will have a unified enterprise architecture encompassing various platforms and infrastructure.

Mission

Guam Community College is to be a leader in career and technical workforce development by providing the highest quality education and job training in Micronesia.

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INTRODUCTION

Guam Community College (GCC) is located on a 22-acre campus in Mangilao, Guam and offers over 50 courses of study which are job related and prepares students for transfer to four-year colleges and universities with advanced standing in professional and technical degree programs. The College offers a variety of community service and special programs to prepare students for college experiences including English-as-a-Second Language, Adult Basic Education, General Education Development (GED) preparation and testing, an Adult High School Diploma program, and an External Diploma Program and Apprenticeship.

In September 2006, GCC completed Version 1 of its Enterprise Architecture (EA) document, since then, GCC has invested millions of dollars in capital improvement facilities and has seen student enrollment increase three years in a row with 2011 being an all-time high with 2,536 students registering for the Fall semester. This is the highest student enrollment in the school's 34-year history. With new campus facilities and an increasing student enrollment trend, GCC's technology demand to deliver courses and support business operational systems will increase exponentially and drive the need for a more systemic and strategic approach in technology planning to accomplish its mission of "providing the highest quality education and job training in Micronesia."

EA PURPOSE

The purpose of the EA sets the roadmap for documenting all aspects of the organization to ensure services, processes, applications, information, data, technology, locations, people, events and timelines are all aligned with the college's strategic goals and objectives.

The EA is not to be misunderstood as an IT-only document for designing IT systems. The EA is foremost, an agreed to definition of what GCC's information technology environment will look like, and is agreed upon by all GCC departments and governing bodies. Information technology architecture and related set of standards are necessary to ensure the compatibility of the current IT environment with all future IT initiatives.

The EA is not a static document, but in fact, is a living and breathing document that should be revised to meet changing organizational goals and objectives, evolving technology, changing business processes, and growth and expansion of GCC's student population.

The architecture and standards provide a blueprint for the deployment of new information technology applications, all of which must fit within the architecture and the standards.

- The architecture is a description of GCC data and applications as well as the technical environment required to run them, including hardware, supporting software, and networks.
- The standards are prescribed means of doing data modeling, programming, project management, system engineering and testing, documentation, and training.

To realize benefits from GCC's EA, an internal governance structure must be in place to take the EA from being a written roadmap to setting college priorities, planning, developing budget forecasts, and securing funding, to achieve the future EA environment that is in alignment with the college's Vision and Mission statements.

ORGANIZATIONAL GOVERNANCE

GCC established a governance structure which incorporates numerous constituent-based advisory committees, a central Faculty Senate, and a College Governing Council (CGC) that advises the college president. Within this management framework, a College Technical Committee (CTC) representing a cross-section of GCC's business and MIS stakeholders was formed. CTC members are appointed in writing by GCC's President and each member serves on the CTC for one-year. Responsibilities of the CTC include setting the strategic roadmap for IT standards and processes. The committee maintains currency in computer technology and academic applications of computer technology for both students and faculty and also addresses technology planning and distance education needs. The committee recommends action plans to support technology needs and technology users of the College in promoting student learning outcomes. The CTC chair is elected by the committee members and the composition of the committee consists of two post-secondary instructional faculty, a non-instructional faculty and a secondary faculty. If needed, a non-secondary faculty may represent the interests of the secondary faculty if needed. An equal

number of members are appointed by the President and one additional voting member selected by the committee. The CTC derives it authority and responsibility from GCC's Article XII, Participatory Governance. GCC has vested the CTC with responsibility for all IT matters and is designed to serve as the college's primary means of discovering, evaluating, planning, and implementing new and enhanced information technology (IT) tools and solutions. All IT decisions are made through the CTC or its delegated representatives; however, the CTC is an advisory body only that reports and makes recommendations to the oversight chair of Institutional Excellence, who in turn reports to the Faculty Senate. Faculty Senate approved CTC recommendations are presented to the College Governing Council. The Council passes the recommendation to the college president for final disposition. This governance structure is the beginning of a mature IT management process.

EA OBJECTIVES

The overall objective of the enterprise architecture is to promote the values and provide the benefits inherent in a single, cooperatively defined, information technology architectural standard. It is not the intention of the enterprise architecture to impose restrictions. Rather, it is the stated objective to serve the needs of all students, of each participating department, and of all employees. It is believed that enterprise architecture is the best way to leverage scarce information technology resources for the greater good. It is also believed that the efficiencies and cost savings inherent in such enterprise architecture will ensure that all stakeholders will continue to enjoy the benefits of staying abreast of the latest developments in information technology.

EA SCOPE

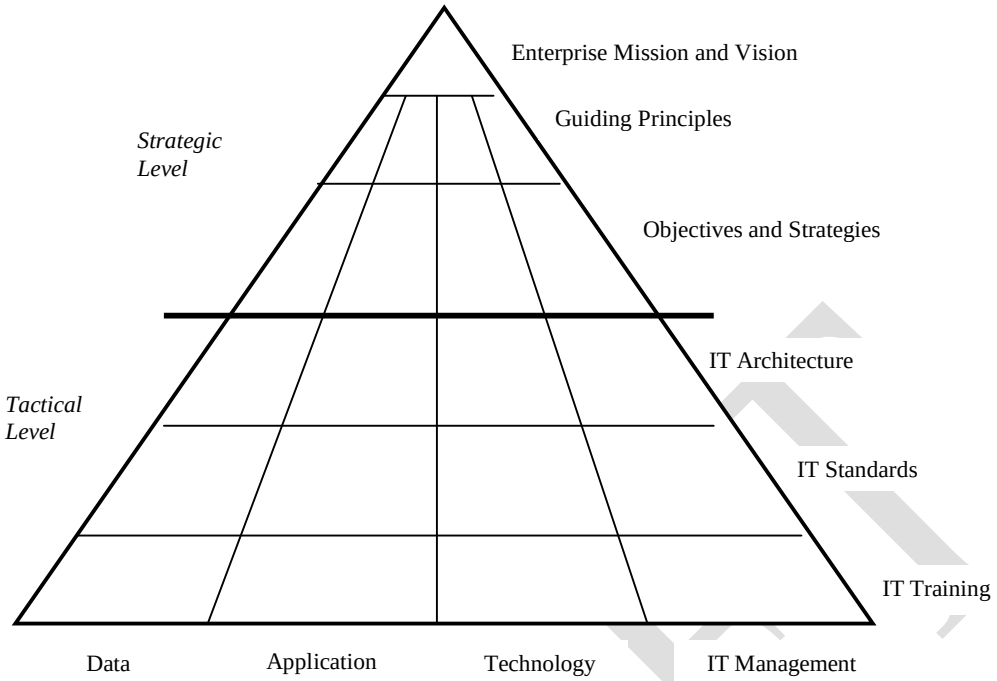
The intent of this document is to define the terms, enumerate the current state and status of all IT assets such as data, application, technological, and staffing, and to propose a preferred future state for each. The future state of the GCC EA will one day be the current enterprise architectural environment. As that happens, the GCC EA must be revised to consider emerging technologies, college policy changes, student trending populations, and other internal and external variables to remain and in continuous alignment with the college's Integrated Strategic Management Plan (ISMP).

The EA is not intended to provide detailed product or configuration information, cost estimates, staffing requirements, project plans, or projected timelines. However, the EA is the basis for the development of all of these follow-on deliverables. The scope of the EA includes all GCC's IT systems regardless of location.

EA METHODOLOGY

The Enterprise Architecture Methodology is pictured in the figure below. The methodology is to divide the EA into two levels: strategic and tactical. Both levels are contained in this document. The strategic level starts with an Enterprise Vision and then explains the general Guiding Principles, Objectives, and Strategies. The tactical level drills down into the specifics of the current architectural environment and proposes the future environment.

The detailed current and future architecture is divided into four aspects: Data, Application, Technology, and IT Management. These, in turn, are addressed by three separate disciplines: IT Architecture, IT Standards, and IT Training. The detailed future vision of the enterprise architecture is articulated in each of the cells created by the matrix. All of these details are contained in this document.



The pyramid is a top-down view of the decomposition of the architecture starting from the Enterprise Mission and Vision.

GUAM COMMUNITY COLLEGE EA GUIDING PRINCIPLES

GENERAL OVERVIEW

Architecture principles are a foundation for the development of enterprise architecture (EA). The architecture principles define the spirit of the EA in that they are an attempt to capture the thinking behind it. Principles have a timeless quality because they define a value system. While methodologies and technology frequently change, organizational values and culture as a rule do not.

GUIDING PRINCIPLES

GCC's overriding guiding principle and shared value is unity - Unity of vision, purpose, and practice.

A guiding principle is to avoid the use of custom built software. The most common type of custom-built software is something that bridges data between two databases or applications. While the initial interface is perhaps easy enough to create, it must have been built with the highest standards for design, documentation, and testing. GCC will own the software and have to maintain it with its own or contracted resources. Such interfaces invariably need change overtime, thus the importance of having them well documented. Whenever either side of the interface changes, whenever a change is made to either database, the interface must change also. It is highly preferable to procure systems that support the other systems already present in the architecture.

ENTERPRISE GUIDING PRINCIPLES

1. Promote a holistic or "college-wide" approach while respecting the unique roles within the institution.

   Rationale
   - To promote a holistic approach will assist all by promoting trust and cooperation throughout the extended enterprise.
   - To reduce redundancy and associated complexity

- To design IT infrastructure with a "college-wide" approach, making its adaptation to facilitate changing business processes easier and quicker.

Implications

- Must spend a little more initially to obtain long-term goals, at an overall cost savings.
- Consistency will make things work better together and ease integration.
- Must accept that decisions could take longer to make, and solutions could require more time to implement.
- Divisions and departments must occasionally concede their own preferences for the greater benefit of the entire College. Trust will be critical to success.
- A holistic approach will assist all by promoting trust and cooperation throughout the extended enterprise.
- Must ensure the participation, input, and feedback from all levels of the College within the extended enterprise.

2. Business requirements and processes (administrative and academic) must drive the development, adoption, and acceptance of the EA.

Context

To ensure the viability of the EA, the EA must accommodate the perspectives of all IT stakeholders (to include but not limited to students, staff, administrators and faculty).

Rationale

- To improve productivity, student outcomes and business processes through the combined perspective of an IT system
- To promote the change of business and instructional processes, in relation to a new technology
- To avoid the costs of implementing technology for technology's sake.

Implications

- Requires good communication between business, academic, and IT professionals.
- Must interact frequently and at multiple levels throughout the institution.
- IT investments will be student-focused and aligned with enterprise/business strategic goals.

3. IT systems should be designed for adaptability and flexibility, so they can be responsive to changes arising from curricular requirements, business processes, community needs, accreditation requirements or legislation.

Rationale

- To enable the infrastructure to support the changes that often occur in business and academic processes within the enterprise

- To make the infrastructure more adaptable to IT changes and IT market forces
- To enable business and academic process improvement
- To make integration of systems easier, and faster, with less process overhaul
- To enable systems to evolve to meet business and academic needs/changes

Implications
- Systems may initially require more time to design and more systemic thinking as transactions cross traditional system boundaries.
- Must expect higher initial costs, but less costly integration.
- System will have a longer life; therefore, return will be longer for the system.
- A system could be sub-optimal in the short term in order to gain long-term optimization.
- Must define performance metrics for flexibility and adaptability.

Challenges
- The CTC does not convene during the summer months which make collaborative decision-making difficult and responsive.

4. To ensure fiscal responsibility with respect to information technology (IT), the College will adopt a formal investment strategy for IT acquisitions.

Context
This investment strategy will clearly articulate the expected life of an IT system. It will consider all phases of an IT system life cycle, including acquisition, support, benefits and associated costs for GCC stakeholders, the diverse communities of Guam, Micronesia, and the Asia-Pacific Rim.

Rationale
- To lead to higher quality solutions
- To enable improved planning and budget decision-making
- To lead to realistic budgeting
- To lead to appropriate system quality decisions (right-sizing)

Implications
- Requires the development of a formalized investment strategy.
- Requires an annual budget, and capital finance planning, processes, and procedures that quantify, audit, and monitor IT allocations and expenditures at the College.
- Must consider what will be the actual lifetime of the system.
- Must create methods for linking IT investments to business and academic needs and aligning with the College's strategic goals.
- Must create methods for linking the IT investment to the strategic planning process.

- Requires more planning and resources to do a formalized investment process.
- Must change the business and academic view of technology to include IT investment strategies.

5. Convergence towards the EA will be encouraged with timing consistent with investment strategy for the enterprise.

   Context
   Convergence towards the EA will take place as new applications are built, technologies are deployed, and old systems are refreshed or retired. Exceptions to the EA may be endorsed in specific cases, where the benefits of consensus for a specific technology solution outweigh the adoption of the EA.

   Rationale
   - For EA to be adaptive and to be able to evolve to accommodate changes in business, academic and technology requirements
   - To avoid "cold turkey" conversions, which are very expensive
   - Convergence over time preserves investment while promoting the benefits of the EA.

   Implications
   - Delayed convergence can reduce the benefits of the EA.
   - Requires a realistic and attainable approach to migration to the EA.
   - Requires an explicit transition strategy for existing systems once a target technology is identified.
   - Allows for premature termination of a system, where it makes sense.
   - Does not allow for waiting forever.
   - Requires a business case for exceptions, an exception process, and an exit strategy.
   - Must define temporary or permanent exceptions, and exit strategies for temporary exceptions.
   - Requires funding to get out of obsolete technology.

6. The EA may identify more than one target technology solution, as a single solution may not be applicable or feasible in all situations. When more than one target technology solution is endorsed by the EA, one bundled solution or program should be designated as the primary target for convergence.

   Context
   The EA should reflect the desire to achieve convergence within the college. However, there may be limitations towards convergence of a single solution. Alternatives may be necessary to meet business and academic needs. Therefore, endorsing primary and secondary technology choices may be necessary to fulfill the need.

Exceptions to the EA may be endorsed in specific cases, where the benefits of consensus for a specific technology solution outweigh the adoption of the EA. In some cases, a lighter-weight solution may be a primary solution, preferable to an alternative, more robust solution.

Rationale

- To reduce technology solutions from many to two or significantly fewer, when a single solution is not feasible
- To avoid forcing higher cost when one size does not fit all
- To reduce complexity but fulfill a business or academic need by using primary and secondary solutions

Implications

- Requires the development of impartial rules and decision criteria to distinguish when unique requirements should take precedence over the college-wide approach.
- Must recognize that it is generally more costly to support two systems rather than one.
- Must recognize that designing a repeatable methodology for endorsing primary and secondary technologies may be difficult.
- Must recognize that migration strategies are more complex when primary and secondary technology choices exist.
- Must focus investment on primary technology choices.
- Need to address the impact to the business, academic and IT areas.

MANAGEMENT AND ORGANIZATION PRINCIPLES

1. The management of the EA will be open and transparent to all stakeholders within the enterprise.

Context

The College Technology Committee (CTC) is a vital and important component in the development and management of the EA. Communication needs to be open, honest, frequent, and bi-directional between stakeholders and CTC.

Rationale

- To engender trust between all parties
- To encourage buy-in from the stakeholders, resulting in faster and more complete adoption of the EA

Implications

- Must have buy-in and support from the College Governing Council, and from the established working groups and technology domains chartered by CTC.
- Requires a communication plan that must be followed.

- Open review periods will be built into the EA processes.

2. The processes for selecting technology must be open and transparent.

   Context
   IT technology decisions must consider input from stakeholders and be open, transparent, and well documented. This requires allowing time for necessary consideration of issues by stakeholders, technical staff, and management. Once a decision has been reached, unnecessary, unproductive debate should not continue.

   Rationale
   - To lead to decisions being made in an open manner that will stand up to later scrutiny and audit
   - To allow stakeholders and technical staff sufficient opportunity to identify important information regarding potential technology investments
   - To ensure that decisions are made according to appropriate investment strategies
   - To encourage the necessary analysis of issues without becoming bogged down in details
   - To avoid unproductive heckling and back-biting after decisions are made
   - To avoid playing favorites with particular vendors or technologies
   - To promote a healthy IT culture where the best overall solutions are identified and implemented

   Implications
   - Decisions must employ and be guided by EA principles
   - Decision-making processes must allow ample time and opportunity for productive debate
   - Decisions must be well documented so that all parties know when the time for debate has ended

3. Promote formal methods of IT systems engineering.

   Context
   Systems engineering includes all aspects of IT - application projects, infrastructure projects, and hardware projects. However, GCC's current MIS staff and capabilities defer IT systems engineering to industry. Systems analysis and design activities are developed through out-sourcing. GCC will require vendors to utilize an industry-standard, Systems Life Cycle (SLC) or Systems Development Life Cycle (SDLC) methodology by which systems being developed for GCC can be monitored, tracked and measured.

   Rationale
   - To lead to measurement points that, in turn, lead to benchmarks
   - To enable improved quality assurance
   - To enable repeatability and consistency
   - To lead to right-sizing

Implications

- Must minimize impacts upon the college.
- Must develop definitions of system engineering processes.
- Must agree on system engineering practices and methods.
- Must develop training in system engineering practices and methods.
- Must identify the formal methods for particular areas of technology.
- Must follow up for quality assurance.
- Must confirm that ROI is what was expected.
- Must use a disciplined, repeatable approach to development.
- Need a resource that will identify and document principles.
- CTC must develop the formal processes.

4. As new contracts and outsourcing agreements are established, these contracts and agreements will reflect and incorporate EA principles.

   Context
   This is one of the mechanisms by which we keep EA aligned with operations. Outsourced work should not lead to exceptions to the EA just because they are outsourced.

   Rationale

   - To be successful, the EA must be integrated with all facets of IT system design, planning, and acquisition.

   Implications

   - Requires EA training for non-IT professionals in areas such as procurement.
   - Need partnerships and good communications between program areas, procurement, contract management, and IT departments to obtain the benefits of EA.
   - Must include EA-based requirements when IT procurements are part of non-IT contracts.
   - Must change the view of institutional investments to include IT requirements.
   - Must audit IT procurements and provide feedback mechanisms for EA.
   - Must include EA-based requirements in procurement documents and contracts.

5. The success of the EA will depend upon consensus and trust among the stakeholders within the enterprise.

   Rationale

- To have a balance: divisions must be ready to act unselfishly, and the enterprise must mitigate the burdens that solutions impose on divisions.
- To be fair: divisions that bear the costs for major initiatives that benefit the enterprise ought to be compensated in some manner.

Implications

- Achieving consensus may sometimes require recompense to make stakeholders "whole" when they are negatively affected by the implementation of the EA for the greater good of the enterprise.
- Must identify what the compensation will be, and how it will be funded and factored into the total cost of the project.
- Must manage costs and benefits so that overall equity is achieved across the enterprise.
- The return on investment (ROI) for each project must identify its costs and savings.
- Compensation to a division acting in an unselfish manner should be factored into the total cost of the project.

6. The EA will promote technology equalization among stakeholders, as not all entities within the enterprise are funded at the same level.

Rationale

- Information technology automation often reduces program costs and provides rapid service delivery mechanisms; however, not all new programs have adequate funding for information technology
- When collaboratively constructed to reflect the vision and mission of the institution, project and programs in support of GCC's IT infrastructure are justified for the purpose of seeking funding and support

Implications

- Must develop funding mechanisms to support this type of initiative
- Must develop processes to promote cross-division sharing of technical expertise
- Must perform gap analysis to find opportunities for technology equalization

7. Training programs and consulting services must be provided to stakeholders to promote convergence and the effective application of the EA

Context

Consulting services may take the form of mentoring staff, assisting project teams in defining their business/academic and technical requirements; providing project management guidance; and providing procurement, acquisition, or contract/vendor management support.

Rationale

- A well-trained MIS staff is more important than the contents of the EA

- Every effort should be made to maintain GCC's MIS staff with current technology training to equip them with technical skills needed to maintain GCC's ever-growing and more complex IT environment
- Training and an internal outreach campaign to promote GCC's EA and its purpose will make for more informed long-term IT decisions
- Train and promote the EA as a roadmap

Implications
- Requires the development of a comprehensive training program
- Must foster mentoring
- Must identify how training and consulting will be funded and managed

8. The EA should encourage professional development for permanent (FTE) staff.

Rationale
- Staff is our greatest resource
- To reduce dependence upon long-term contracted staff

Implications
- Must ensure that funding designated for technical training is not eliminated in times of fiscal crisis
- Must include professional development plans in annual performance reviews
- Must make a commitment to staff to provide opportunities for professional growth
- Must ensure access to cost-competitive training alternatives
- Must ensure that succession and knowledge transfer plans are developed and implemented for both permanent and contract staff
- Must have greater opportunities for combined training

TECHNOLOGY PRINCIPLES

1. EA technology choices will be based on criteria including extensibility, interoperability, flexibility, adaptability, portability, and appropriate scalability.

Context
The principle applies to how we select a target technology for the EA.

Rationale
- To more quickly adapt to changing business and academic requirements.
- EA technology choices will promote the integration of technologies based upon interfaces that utilize open standards where available.

Implications

- Criteria for the selection of EA target technologies will require evaluation with respect to extensibility, interoperability, flexibility, adaptability, portability, and scalability.
- EA technology selections must balance division versus enterprise interests and needs.

2. Reduce complexity and enable integration as much as possible to realize business process improvements within the enterprise.

Context

Customization taken too far increases cost and reduces adaptability.

Rationale

- Complex application systems with many data and transactional functions are difficult to manage, making change risky.
- To avoid dependency failures resulting from applications that are tightly coupled
- To implement applications that are accessible, perform well, and account for network and other dependencies

Implications

- Must promote and facilitate component-based applications.
- Must keep to a minimum the number of vendors, products, and configurations, allowing for maximum flexibility in implementing changes.
- Must avoid overly complex configurations of components and discourage undue custom tuning, or customization of hardware and software based on transient, local, or other conditions.
- Must maintain configuration discipline, sacrificing performance and functionality in some instances.
- Must account for resource constraints.

3. Support pervasive standards and technologies under appropriate conditions.

Context

Using pervasive standards makes sense if:

- Reliance upon a single vendor is proactively managed
- Market forces are considered
- Cost of a pervasive proprietary standard is balanced with the cost to migrate to an open standard in the future
- The cost to migrate to interfaces that employ open standards is considered

Rationale

- To avoid dependence on weak or under-performing vendors
- To allow the enterprise to influence and stay current with industry standards and trends
- To encourage flexibility and adaptability in product replacement
- To avoid dependence on proprietary standards that become isolated

Implications

- Must establish criteria to identify weak or under-performing vendors and products.
- Must assess the architectural fit of proposed solutions.
- Modify work practices and business workflow to increase standards compliance.
- Must manage dependencies on proprietary vendor technologies.

4. In order to maximize integration throughout the enterprise, systems should incorporate standards that promote system interoperability.

Context

Where applicable, incorporate best practices based upon open standards, best practices from like organizations, or pervasive standards based upon a vendor's or provider's market position.

Rationale

- To have systems that include application interfaces based upon open standards
- To promote application module reuse
- To support leveraging innovations developed by other enterprise entities

Implications

- To avoid reinventing the wheel, must research what is currently within the marketplace and how others approach similar business issues.
- Must define what we consider to be an open standard application interface.
- Must be careful not to constrain innovation.
- Must have a component repository in order to identify opportunities for application module reuse.
- Must look for alternative funding sources that will foster innovation.
- Must write modules that are reusable.

5. Use open source where a sound decision model and investment strategy is present.

Rationale

- Open source is a viable alternative to commercial, off-the-shelf technology products and should be considered when making a technology selection.
- Open source applications can provide innovations that are not available in the commercial marketplace.

Implications

- Training and documentation may be limited, thereby increasing costs.
- Product technical support may be limited, thereby increasing costs.
- Must consider whether the migration cost might be high even though initial costs might be low.
- Must consider how well supported a solution is in the industry.

6. Approach the development of systems from a cross-functional, horizontal institutional perspective and implement systems in such a way that promotes technology reuse.

Rationale

- If institutional services are thought of at a higher level, systems can be designed with reduced complexity and designed to promote technology reuse.
- To achieve high-efficiency development and to lower costs of support, training, and testing through the creation and reuse of standard elements

Implications

- Requires a different level of abstraction than what government traditionally uses.
- Might run into “turf” issues.
- Might find difficulty funding something from a functional rather than an agency perspective.
- Implementation requires a high degree of communication and integration across the enterprise.
- Must create incentives for participation in the component repository.
- Must make contributions to and use of the component repository easy.

APPLICATION DELIVERY PRINCIPLES

1. Promote application consolidation, standardization, and integration where significant benefits can be realized through the sharing and reuse of data, information, and applications.

Rationale

- To avoid the creation of additional silos of data and applications.
- To avoid redundant efforts within the enterprise.

Implications
- Requires communication and knowledge of activities within the enterprise.
- Requires a shared application portfolio.
- Requires a component repository.

2. Embrace a formal methodology for IT portfolio management within the enterprise.

Context
IT portfolio management comprises a number of sub-disciplines, including IT asset management (ITAM), application portfolio management (APM), project portfolio management (PPM), and application component management.

Rationale
- To have an accurate inventory of systems applications and data within the enterprise
- To identify opportunities for sharing and reuse
- To strengthen management of IT investments

Implications
- Must view IT portfolio horizontally and vertically for opportunities.

3. The goal for the design and implementation of systems should be of adequate technical quality to meet the business and academic requirements, and not excessively more.

Context
Systems should be designed and implemented to be good enough to meet the need, without superfluous features and capabilities, lest more effort be spent on the extra functionality than was required for the necessary functionality. Systems should be designed with sufficient foresight into future use of the system so as to provide adequate flexibility and adaptability to changes.

Rationale
- To avoid unjustified complexity and cost

Implications
- Must determine how to know when a system is good enough.
- May require business process reengineering.
- Requires scope management.
- Must develop a good business case before designing a system.

USER INTERFACE PRINCIPLES

1. The enterprise information technology systems must be accessible to all GCC constituencies.

   Rationale
   - The enterprise entities have a responsibility to provide services to all users and address their specific access requirements.
   - To be responsive to the increasing diversity of the College.

   Implications
   - Must pursue "universal design" within the context of technology, which includes the design of products, systems, processes, and environments.
   - Services must be widely accessible without being cost-prohibitive.
   - Must comply as necessary with Section 508 of the Americans with Disabilities Act (ADA).

2. Support appropriate client delivery channel preferences for accessing enterprise services.

   Context
   Systems must be designed with the knowledge and understanding of the population the system will be serving.

   Rationale
   - To ensure that guidelines for user interfaces are not constrained by narrow assumptions about location, language, systems training, or physical and cognitive capabilities

   Implications
   - Products and services may be accessed in a variety of ways, but must be available to users in a consistent, accessible fashion.
   - Strive for a common look and feel, and consistent service, regardless of choice of delivery channel.
   - Must comply with standards for privacy and security.

SECURITY PRINCIPLES

1. IT systems must be implemented in adherence with government security, confidentiality, privacy policies, and laws.

   Rationale

- To enhance public trust
- To protect government assets
- To enable compliance with requirements for public funding and grants
- To protect privacy of students, GCC employees, and other partners

Implications
- Must identify, publish, and keep applicable policies current.
- Must periodically audit/follow up on IT systems (e.g., for Health Insurance Portability and Accountability, HIPAA).
- Must formulate minimum standardized security policies.
- Must allot sufficient time and resources for security policy development.
- Must consider indirect implications of security policy (e.g., staffing to perform audits or check for vulnerabilities).

2. Data must be protected against unauthorized access, denial of service, and both malicious and accidental modification.

Context
Data includes paper records, scanned images, printouts, microfiche, as well as digitally stored information. Sensitive and confidential information should not be accidentally provided or published.

Rationale
- To minimize improper use or loss of data, either of which can have serious business and legal consequences
- To minimize security violations, which impair integrity and jeopardize the viability of government
- To limit opportunities for unauthorized access, so that people are less likely to do inappropriate things

Implications
- Must implement approaches/policies to minimize improper use of data.
- Must implement approaches/policies to minimize security violations.
- Must establish follow-up procedures for security alerts.
- Must regularly examine logs and alerts and execute follow-up procedures.
- Must not secure data to the point that responding to open records requests becomes prohibitively expensive.
- Must consider implications of defining a Resource Description and Access (RDA).

- Must design and account for Open Records requirements.
- Must provide staffing and resources to perform the functions and duties outlined above.

3. There must be accountability for security, which includes the appropriate design and use of audit functions and system monitoring tools.

Rationale

- To enhance public trust
- To have accountability, there must be auditing
- To avoid data loss or data corruption
- To ensure data is credible
- To identify inappropriate access
- To prevent security breaches, which have harmful and expensive consequences

Implications

- Require monitoring compliance.
- Must design audit functions and cross-checks into systems.
- Must provide resources to monitor. Monitoring is resource-intensive.
- Must define processes for following up if potential security problems are found.

4. A well-defined security policy promotes sharing by removing uncertainty.

Rationale

- To enhance public trust.
- To provide a clearly articulated policy for use of information.
- To prevent destruction of and avoid mishandling of security information (e.g., chain of custody for evidence).

Implications

- Must make security, confidentiality, and privacy requirements clear.
- Additional expenses may be required.
- Need training to comply with policies.
- Must consider implications of defining an RDA.
- Must obtain advice from legal counsel as appropriate.
- Must institute policies that ensure appropriate background checks for employees.
- Must provide education for staff that works with sensitive or confidential information.

SYSTEM MANAGEMENT PRINCIPLES

1. IT must plan, design, and construct appropriately for growth and expansion of services across the enterprise.

   Rationale
   - To be more cost effective
   - To reduce maintenance costs
   - To enable quicker response to growth and change

   Implications
   - Must make a culture shift towards planning for adaptation (e.g., plan for systems to adapt).
   - Must develop processes to collect information and ways to predict growth from historical trends.
   - Must promote capacity planning.
   - Must recognize the tradeoffs between the increasing high costs of labor and decreasing costs of technology.

2. Formal methodologies for IT change management must be established and followed.

   Rationale
   - To improve the quality and availability of our systems
   - To ensure repeatability and consistency of system management processes

   Implications
   - Minimizes negative impact upon partners.
   - Must agree on practices and methods and follow them.
   - Must develop and document well-defined system management processes.
   - Must develop a process to monitor for compliance and follow that process.
   - Following system management processes may be cumbersome and slower in the beginning.
   - System management requires advance planning.

3. Promote the use of common systems for IT problem resolution.

   Rationale
   - To enable improved quality assurance and system availability
   - To enable the development of a knowledge base for problem resolution

- To provide communication to our users when problems occur

Implications

- Staff must use problem resolution systems.
- Problem resolution systems must be efficient for the staff to use.
- A view of the problem resolution system should be available to users.
- Must establish and monitor performance metrics for IT problem resolution.
- IT problem resolution has to be more general than would be appropriate for any individual division. (For example, rights management services [RMS] would need improvements if it were to be an enterprise solution for IT problem management/resolution.)

4. Implemented infrastructure must be robust, responsive, and reliable with appropriate redundancy.

Context

Infrastructure must be appropriately scalable and services must be structured appropriate to the differing needs of divisions. Appropriate redundancy requires balancing the investment made for high availability against the defined business/academic needs (i.e., to seek right-sizing). Robustness means that the infrastructure design must take into consideration likely points of failure and provide backup and redundant components where required.

Rationale

- To adequately protect against system failure while not wasting resources
- An enterprise approach would be the best way to leverage the necessary IT capital investments to ensure high availability.
- To avoid excessive infrastructure and support service costs
- To leverage economies of scale where appropriate

Implications

- Need to consider cost, risks, time redundancy, and the context (e.g., disaster recovery is different from business continuity).
- Must define and discover business requirements for system availability and successfully test against those requirements.

5. Service providers must address and facilitate business continuity, security, and disaster recovery. These services should be provisioned in a manner appropriate to the criticality of the data and applications involved.

Rationale

- The enterprise provides many essential services that, especially in times of crisis, must continue to be available upon demand, and recovery must occur within a compressed timeframe.

Implications

- Must identify and prioritize critical business/academic functions.
- Must ensure that communications systems are available, especially in times of crisis.
- Must define acceptable recovery times.
- Must develop and test disaster recovery and business/academic continuity plans.
- Must periodically review and update test disaster recovery and business/academic continuity plans.
- Must balance costs against risks.
- Must promote awareness in order to provide funding.

DATA MANAGEMENT PRINCIPLES

1. Each individual data item has a single steward or authoritative source, clearly defined locations, and is accessible. Authoritative data must be accessible and available for reuse by any entitled systems or business/academic processes.

   Rationale

   - Reducing duplication requires that there be an authoritative source for information about that data
   - More effective decision-making requires increasing the integrity and relevance of data, which requires having an accurate inventory of where the data is stored.
   - Data is a strategic asset that must be shareable and accessible to gain maximum value.

   Implications

   - Must have time and resources to identify and specify authoritative sources.
   - Must establish institution-wide procedures to manage data access and ensure data security and integrity.
   - Must define stewards and their role.
   - Need a consolidated metadata repository for the enterprise.

2. Data stored in information repositories within the enterprise should be widely available and accessible by all entities within enterprise.

   Rationale

- Information that is shared will maximize the effectiveness of business/academic decision-making.

Implications

- Must create and define standards and processes for unifying data and information management.
- Must establish data warehouses to facilitate information availability for decision-making.
- Need a consolidated metadata repository for the enterprise.
- Must provide resources to establish and maintain a single metadata repository.
- Must have an access mechanism for information repositories.

3. Data is an asset that must be managed for the benefit of the enterprise. Data must be shared to the maximum degree possible, without jeopardizing security and confidentiality.

Rationale

- The value of information is not always realized when it remains in isolated pockets.
- Required security and privacy cannot be sacrificed and may sometimes result in the inability to publicly share information.

Implications

- Must restructure data for easy access and management.
- Must organize business/academic systems and databases according to subject matter, not by department, division, or unit.
- Must maintain data in its most appropriate format.
- Can share data by integrating systems rather than by sharing data directly.
- Data warehouses must be multimedia-capable to access and manipulate all forms of data stored in them.
- Must design network infrastructure to efficiently and cost-effectively transmit all forms of data adequately to meet business and performance requirements.
- Must make data and applications accessible via a variety of media.

4. Data is collected, protected, and maintained in accordance with appropriate standards and guidelines.

Rationale

- The enterprise must comply with applicable policies, statutes, and federal requirements (e.g., Family Education Right to Privacy Act, FERPA).
- Data is more likely to be shared when the standards and guidelines for sharing and protecting that data are documented and understood.

Implications

- Must provide training and education so that individuals are aware of standards.
- Must have communication plan to build awareness.
- Must define and document the appropriate standards and guidelines.

5. Records in electronic format must be preserved and maintained, and remain accessible for their designated retention period.

Context

Records must be appropriately disposed of once the designated retention period has expired.

Rationale

- Proper record maintenance is statutorily required.
- Keeping records longer than required is costly and wastes space and resources.

Implications

- Must provide resources for records identification and disposition.
- Must establish policies for record retention.
- Must establish systems to automate the record retention processes.
- Must establish an audit process.
- Must establish a process to destroy records in an appropriate manner.
- Must define and implement a process for monitoring records handling.
- Must create a communications plan to promote awareness of policies for records retention and disposition.

GUAM COMMUNITY COLLEGE EA OBJECTIVES AND STRATEGIES

General Overview

GCC's information technology objectives are to fully support the college's mission statement of:
"Guam Community College is to be a leader in career and technical workforce development by providing the highest quality education and job training in Micronesia."

- It will deliver integrated enterprise information systems and infrastructure that improve public access to GCC functions and information, streamline business processes to simplify College-public interactions and reduce costs, and meet the legal and business needs of the College.
- GCC will create and operate services on-line available to the diverse communities of Guam and Micronesia
- GCC will develop cost-effective means for providing 'niche' training and services, and for providing training and education not in the College curriculum.
- GCC will provide a unified, secure, efficient and reliable IT infrastructure to address current and future needs.
- GCC will provide sufficient and cost-effective bandwidth to meet current and future needs.

THE PRESENT

CURRENT GCC ARCHITECTURE ASSESSMENT

CURRENT DATA ENVIRONMENT

General Overview

The current picture of the Data Environment is now mostly integrated. While there is some data existing in separate systems such as the COMPASS, Simply ID, Library's Symphony, TracDat, and specialized academic systems (PLATO MATH, CHOICES, CASAS) the real problem is in fully integrating all and in maintaining the Integrated Database Management System (IDBMS) with considerably insufficient resources in manpower, overall system capacity, and in money for desperately needed hardware and software upgrades and maintenance.

Manual Data Entry

Manual data entry or sharing is not a real concern anymore due to the implementation of the Sungard BANNER system and the MyGCC portal in which most critical operational or administrative and academic activities are now using an integrated system. The MyGCC portal, through its single-sign-on feature, allows students and employees to access the database for self-service applications such as registering for a class or checking a departmental budget. This system now allows for greater accuracy and consistency of the data being used that comes out of an integrated database versus the fragmented systems of previous years.

Pseudo-Applications

A former concern that is no longer a major issue is in regards to the risk of using other data gathering and reporting tools or applications in the fulfillment of an office's mission. More so now than ever, many standard internal and external reports are coming out of the IDBMS with the use of ORACLE Discoverer and ODS (Operational Data Store) than from other forms such as those created and maintained using applications like Microsoft Excel, DBASE, Quattro Pro, or even Microsoft Word.

Information can now be gathered in the usage of the portal by individual student logins and their activities; however, this only relates to portal activities. Lab workstations are still not issued

unique accounts and are not being captured. Discussions with the College Technology Committee (CTC) continue with regards to this practice and may change in the future as stricter security policies are implemented or become necessary, especially as it relates to becoming more compliant with the Payment Card Industry (PCI) or federal mandates.

Records Management

The college has institutionalized a document scanning and capturing system as part of the overall solution to address the paper-based driven process into a more paperless environment. Together with the implementation of the all-in-one XEROX scanning-printing-copying-faxing solution, GCC now has in place the SCAN XTENDER and WEB XTENDER Banner Document Management System (BDMS) that allows different users and sections of the college to electronically archive documents for safe-keeping, storage, sharing, and retrieval. Despite the training provided to key personnel, mainstream usage of this system is not yet realized, but more and more users are discovering the benefits of moving into or using this solution.

Data Formats:

- **Additional formats not previously included:**
    - Video
    - Audio other than voice
    - Film/Negatives
    - Online Contents

Data Users:

- **Additional users not previously included:**
    - Board of Trustees Members
    - Foundation Board Members
    - Anonymous Patrons
        - Library
        - Online visitors on GCC websites
        - Guest and customers at functions and events
        - Bloggers
    - "Artificial Users"

- BOTS (automatic or programmed content/data “harvesters”)
- Spammers / Phisers
- Hackers
- Drones / Hoverers
- Scanners/Sniffers (Wired & Wireless Network prowlers)

Data Architecture and Standards Justification

These areas of improvement support the need for the architecture and standards recommended in this document.

Opportunities	Comment
Most databases are not integrated, cannot directly share information or store common data in a single place.	SUNGARD addressed most of this finding.
Manual entry of duplicate data from one database to another is diminished.	Manual data entry is prone to error and means that the data is not only stored in two places but was entered twice.
Not capturing data from IT users (via unique individual logins) on their usage patterns.	This is vital important that is necessary for a properly functioning IT environment.
Official data is derived from the databases but not stored in the databases.	Official databases become repositories of data but cannot provide the final answers.
Duplication of data in different media within the same organizational unit has been reduced. BDMS addresses most of these issues.	BDMS addresses most of these issues. More on-line forms are becoming more prevalent.
Records Management: Wide spread use of paper forms to capture data that then must be entered into a database.	Need to eliminate the use of paper forms and use data entry forms that are accessible to the originating person.
Records Management: Those paper documents which must be retained and stored should be digitized and stored electronically.	By imaging/scanning the original paper documents they can be stored electronically. Then, with legal authorization, the paper copies may be discarded.

CURRENT APPLICATION ENVIRONMENT

General Overview

Guam Community College has a large investment in applications primarily in the Administrative Services and Business & Finance Departments. It is noteworthy that the college has very few applications custom built by, or only for, the college. However, many of the applications are very old in technological terms and in need of significant enhancement or replacement.

SUNGARD

The two largest applications are NIAS and Dynalogic. A new SUNGARD application will replace both of these applications in the near future. This new system effectively addresses the challenging problems associated with NIAS and Dynalogic. Both are extremely old technologies built upon outdated and cumbersome system and database design paradigms. The two systems contain considerable duplicate data but share data with each other very poorly. Both are poorly supported by query and reporting tools. These last two points have led to the widespread use of user-built MS Excel and MS Access queries and reports. While these user-built application add-on tools are necessary, they also increase staff workload unnecessarily. A modern application such as SUNGARD should provide advanced query and reporting capabilities. If so, these user-built tools will no longer be necessary.

By comparison to the current NIAS / Dynalogic situation, the SUNGARD application is a single integrated database application combining NIAS and Dynalogic functionality into a single repository. It is built upon the latest hardware and operating systems using state-of-the-art system and database design architectures. It should serve the college well for the next 5 to 7 years.

Other Applications

NIAS and Dynalogic are only two of the antiquated systems due for replacement. Cougar Mountain is the bookstore's point-of-sale and inventory software. While the current version is still supported by the vendor, it is a suitable candidate for replacement. It is a stand-alone application not useful as a networked application and will not interface with the SUNGARD

application except through manual data entry (duplicated effort and data) or the creation of custom interface software. SUNGARD needs to integrate with the bookstore system for purposes of properly crediting book purchases to a student's funding source. Unfortunately, SUNGARD does not contain a Bookstore module. In its absence, other Bookstore applications must be found that will easily share information with SUNGARD.

IT Applications

Another finding is how few applications are available to Administrative Services and MIS. In the case of MIS, four important and time consuming tasks are being performed manually. This manual effort could be greatly reduced if MIS were provided with the proper software applications.

Specifically, MIS' administration of email is a manual task with support from a few tools, but it is not as automated as it could be. The need for MIS staff involvement with this activity should be minimal and on an exception basis. Likewise, the administration of unique student logins is hampered by the absence of a robust software application to automate this requirement. Third, the complex GCC network does not enjoy the benefits that Load Balancing software would provide. And lastly, the work of creating PC hard-drive images and re-imaging, or cloning, PC's in offices and labs is a highly manual process. Yet, mature software applications exist that could greatly automate the process and greatly improve staff efficiency.

The adoption of any new applications is not a simple matter of procurement and installation. The introduction of new applications mandates more user and technical training, new policies and procedures, revised job assignments and skills requirements. The replacing of old applications or the incorporation of new ones must be a thoroughly planned undertaking. Each new or replacement system implementation is a major project undertaking that will require the active support of all those involved.

GCC should undertake the replacement of old systems and the adoption of new ones. Over all, the applications environment is stagnant and antiquated.

Distance education (DE)

In July 2010, GCC adopted a Distance education policy to deliver educational services either through instruction or support services to students who are not physically co-located with the individuals providing the service. The platform GCC currently utilizes to support DE is the Moodle Course Management System, a course management system designed to help educators deliver quality online courses. Moodle is open source software and is used all over the world by universities, schools, companies and independent teachers.

DE includes the use of computer and Internet-based educational services as well as video and audio services. Institutions use Internet technologies to bring students educational programming in either synchronous (students and the service provider are interacting on line at the same time) or asynchronous modes (students and the service provider not interacting on line at the same time). Educational interactions delivered through these means may occur on campus as well as off campus. DE can be a convenient, flexible, and effective means of providing education. Nearly half of all the college students in the country are of the age group once thought of as nontraditional. They are working adults or adults seeking first educational credentials or retraining. Many working adult students with multiple demands on their time find DE to meet their needs better than campus-based education and is also an opportunity for the College and the students to contribute to environmentally friendly practices. Courses that run through DE reduce the use of paper and copying, as resources are available digitally. In addition, students commute to campus less frequently than traditional courses, lessening the use of gas and related emissions into the environment. In addition to working adults, the traditional-aged college students come to campus with extensive experience using digital technologies in their personal and school lives. For these students, DE involves the use of Internet, web casts, text messaging, and other digital media is comfortable and familiar. As technology continues to expand world-wide, participation in DE assists students in preparing for the workforce.

GCC currently delivers limited courses through DE using a hybrid of several applications illustrated in the table below:

ed2go extend your reach	Easy-to-use instructor-led courses and certificate programs that is informative, fun, convenient, and highly interactive. Accounting, Business, Computer, Grant Writing, Test Prep, and more.
CAREER TRACK TRAINING 650+ ler online	Career Track Training – Online Certificates and Courses in Customer & Technical Support Training, Technical Writing, Functional Specialties in Human Resource Management, and more.
GATLIN Education Services www.gatlineducation.com	Gatlin's online career training courses are designed to provide the workforce skills necessary to acquire professional caliber positions for many in-demand occupations. Gatlin offers over 79 online certificate programs in the Allied Health, Computer-Internet, Business, Technical and Construction industries.
UGotClass Online certificates and courses	LERN-Get skills for the 21st century. Demonstrate your knowledge. Boost your productivity and your organization's bottom line.

Application Architecture and Standards Justification

These areas of improvement support the need for architectural standards recommended in this document.

Opportunities	Comment
Existing systems do not combine or present information in the way necessary to satisfy many reporting and management requirements.	This drives users to create MS Excel and MS Access reports. Unfortunately, there is important additional and derived information that then only resides in pseudo-application and not on the parent systems.
There are several useful applications not currently in use: • A much more automated email administration system • A highly automated network/PC User Login system • A network Load Balancing application • PC-cloning application	With the addition of these automated systems, GCC will enjoy additional functionality for all of its users, reduced workload in MIS, increased efficiency of existing resources (personnel and technology).
There should be, as much as possible, a single login application for GCC. Users should be able to access their applications without having to login to each one separately. The application should allow for the capture of information in one place and shared throughout.	A single login procedure should be developed (perhaps through the use of portal software). Additionally, a student's name and address should only be entered at one point in the virtual application rather than once per application.
Applications should be treated the same as PC hardware and have their own replacement plans.	Application lifecycles are typically longer than PC hardware lifecycles, but either they must be constantly kept up to date or replaced after a reasonable length of time
Many different types of user interfaces such as	Increased end-user support costs in the area of

Windows 98 and Unix.	training due to diversity of interfaces.

CURRENT TECHNOLOGY ENVIRONMENT

General Overview

The current Guam Community College technology environment is typical for the size and complexity of the functions it serves. To its credit, all systems are on currently available and supported hardware, software, operating systems, and networking protocols. Much work has been done over the past several years to improve technological connectivity on campus and to the internet. The primary hardware platform in use is the Windows-based PC computer. There is evidence of many state-of-the-art technologies in use on campus. Devices such as Electronic Whiteboards, Video and Audio Teleconferencing, Digital Cameras, and multimedia presentation devices are in common use.

Technology Replacement Plans

Commendably, there is a plan for the orderly replacement of aging hardware. Each piece of new equipment, for example, has an expected lifecycle, a length of time before it is obsolete. This lifecycle is on the order of five or more years for a server computer, but three to five years for a PC. Printers and other peripheral devices have even shorter lifecycles. Each year, the plan calls for the replacement of the oldest equipment and software. With this yearly replacement plan in place, the users are assured of always being supplied with current technology. Some will be newer than others, but all will be replaced in accordance with a plan instead of as an emergency procurement.

However, even in the midst of these positive outcomes, there are many different technologies in use with more being added. Each of these technologies requires specialized training to be able to use and support, may require separate maintenance contracts, and skilled staff.

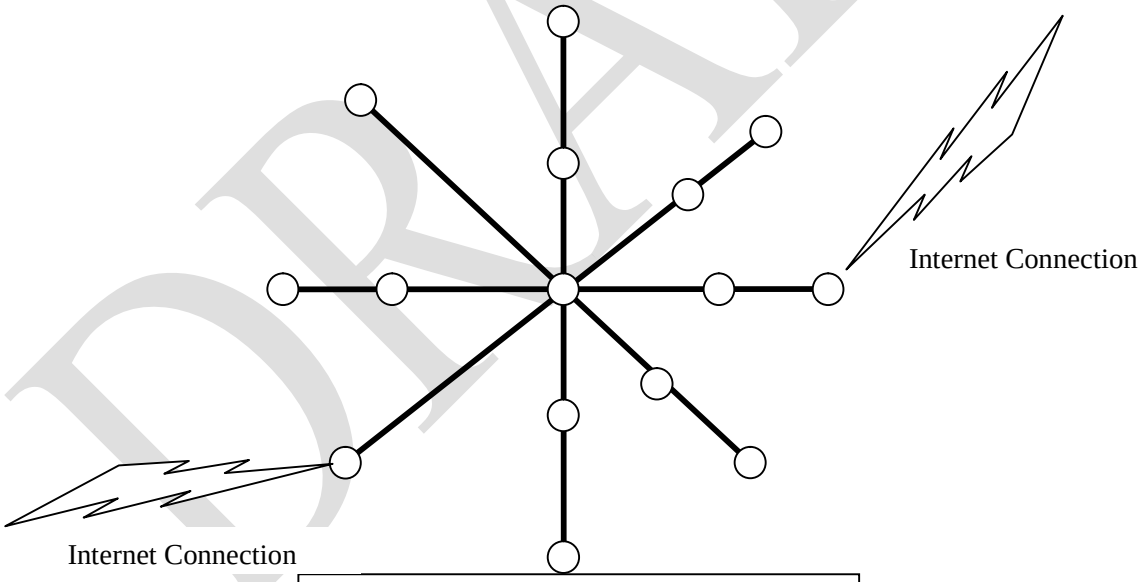
Technology Support

There are two types of technology in use on campus. There is technology intended to (1) serve the needs of GCC employees be they faculty, staff, or student and (2) technology specific and unique to a class or curriculum. While the more prevalent GCC-wide technology is carefully controlled, the opposite is true of technology used to support a particular class or curriculum.

The benefit of this arrangement is that teachers have the latitude to introduce new tools and technologies into a classroom setting without having first to place it under the strict controls of the enterprise architecture. However, the teacher in this case is fully responsible for the installation, use, and removal of these ad-hoc technologies. In this way, course instruction is best served without adding new burdens to the rest of the IT structure. Of course, should a class or curriculum need a new technology as a standard part of all future classes, then it must first be placed under the appropriate controls in the infrastructure.

Networks

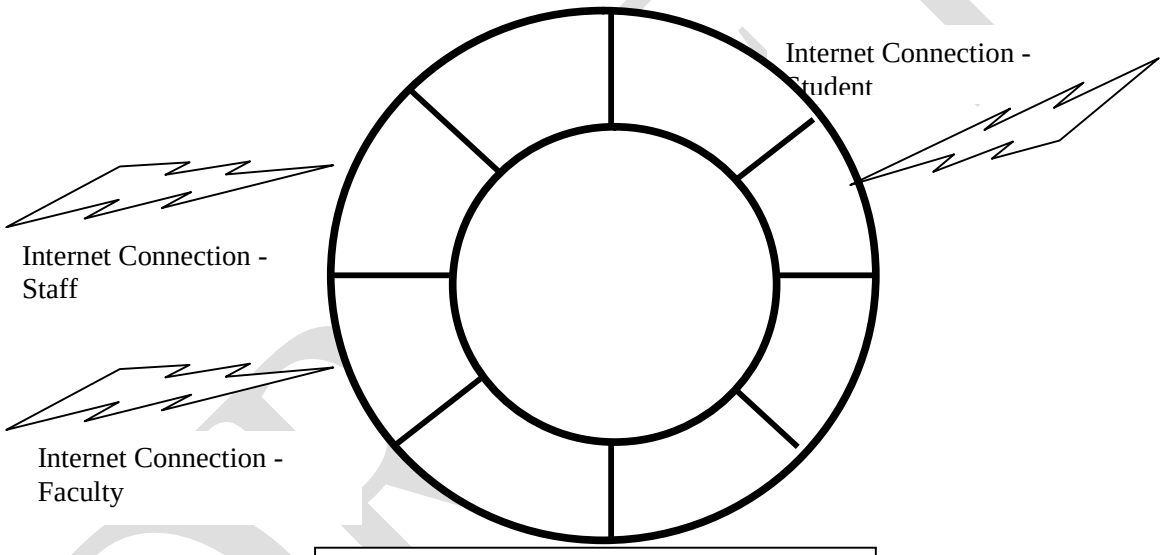
The present networking topology is a Star design. It is an easy to create network. All that is needed is cable running from an existing node. There is no redundancy of connections for the nodes, and should one node be removed from the network, all nodes further down the network, from that node are also removed from the network.



STAR Topology
With 2 Internet Connections

The best thing that can be said for such a design, other than the fact that it is easier, quicker, and less expensive to implement is that it is not wasted effort when a more sophisticated design is desired.

That better design is a Double Ring design. Building upon the existing network, a Double Ring network will provide a vital redundancy for the network users. Lines currently running between nodes are utilized. The difference is that each line does not begin at a single point but begins with a ring. The same is true for the end of each line, as is shown in the drawing below. Now when a node is off-line for whatever reason, all other nodes remain on-line. Should even a cable be damaged in a portion of the network users will continue to have access via this redundant capability. Additionally, should certain portions of the network be slowed by traffic flow, the network can still provide adequate serve to the rest of the users.



Double Ring Topology
With Three Internet Connections

While a Double Ring design is a much preferred solution for GCC, two other technology improvements are necessary in order to make it the highly efficient foundation of the college's infrastructure of the future.

Presently, GCC has two high-speed internet connections. One is a 20 Mbps line through GTA and then to the internet service provider. The other is a 10 Mbps fiber-optic cable directly to internet service provider, MCV. It would be beneficial to have a dedicated line for each of the major user groups on campus: Faculty, Staff, and Students. With this third additional capability, each constituency is assured of the best possible responsiveness from the internet service

provider. Should one of the internet connections fail for any reason, GCC would be able to effectively share the remaining two.

The other necessary addition to the current network is Load Balancing software. This software monitors and manages the network automatically. It keeps track of problems, bottle-necks, outages and such and automatically reroutes traffic to keep the network operating as efficiency as possible. Not only is it impractical to attempt to do this manually but it is not cost effective to do so. Trained IT staff should be doing only those things which automated tools cannot do.

With the implementation of a Double Ring network design with three internet connections and the presence of Load Balancing technology, no longer would a problem in one area of the network have any detrimental impact upon the other areas.

PC Imaging

The number of PC's and the variability of their hardware configuration pose a significant challenge. There are 1,500 PC's in the environment. New ones are added regularly to replace obsolete ones, in accordance with a planned replacement schedule. Occasionally, new PC's are added to the total number. For each of these PC's there is a standardize hard-drive configuration of software and settings that must be applied. This standardized configuration is known as an "image." PC's used for different purposes have different images. Those used by staff differ from those that are setup for students in a lab. Therefore, there are numerous standard images.

What makes the process more cumbersome is the variety of hardware configurations. A slight difference in one of the PC's internal components can mean a revised image must be created. Thus, there are standard images for each functional use but scores of additional versions of these images caused by hardware differences. A conservative estimate is that there are upwards of 150 different images. It requires approximately 1.5 full-time equivalents to create new images and to image and re-image computers.

There are several factors as to why this imaging process exists. One of the factors is a policy which states all software that comes with a purchased computer is replaced with site-licensed

software. Rather than tracking the software licenses on each computer, the extra step is taken to remove these licensed products. Once imaged, all PC's are covered under site-licenses. This makes it easier to know what computers are licensed but at a considerable cost.

What must be addressed is the creation and maintenance of 150 different images. Currently, it takes about a calendar week to create and install a new image on a new PC. This is a time consuming process for someone who just wants a computer for MS Office and Internet Explorer. Additionally, the process of re-imaging computers should be highly automated over the network.

The current suite of software on a lab image is:

Certiport (Loaded on I.T. Academy labs TC1106 & TC1221 only)	Micropace Pro 2
CheckPro	Office 2007 SP2
DDC315o03	PAN (TSA, CBP, USPS, FBOP, FBI, GPO, Qwest, Jones-NCPI, JC Penney) Web base TC1106A only)
Dreamweaver 4 (Loaded on D8 only)	Pearson VUE application (Loaded on testing lab TC1106A only)
GradeKeeper	Power DVD 6
Hill Crest Medical Center	Prometric application (Loaded on testing lab TC1106A only)
Impatica	Quickbooks 2009
Integrated Pro	VH Dissector Lite (Loaded on AH3114 systems only)
Keyboarding	VH Dissector Pro (Loaded on AH3114 systems only)
KRYTERION/HOST, AMP, WGU (Web base on TC1106A only)	Visual Basic 6
LaserGrade (Loaded on testing lab TC1106A only)	Visual Basic Express 2010
Math (Web base)	Windows XP SP3
Medical Terminology	Word Perfect Office 12

Email

MIS' administration of email is a manual task with support from a few tools. It is not as automated as it should be. The need for MIS staff involvement with this activity should be minimal and on an exception basis. An investment should be made in technology that allows email users to setup and manage their own email accounts.

Student User Ids

Likewise, the administration of unique student logins is hampered by the absence of technology to automate this requirement. The need for MIS staff involvement with this activity should be minimal. Through the use of the proper technology user accounts can be added, modified, and removed more easily. Student accounts can be created by faculty or staff, depending upon circumstances. The lack of technology should not preclude or limit the implementation of this service.

Technology Distribution and Proliferation Table

Type	Quantities	New in Last Year
Windows PC Computers	1500 Desktop and Laptop	
MAC Computers	57	
Servers	> 23 (+ 13 more with SUNGARD)	
Printers	107	
Scanners	51	
Windows OS	1500	
MAC OS X	57	
SCO-Unix OS	1	
Redhat/Linux OS	2	
Netware	5	
AS400	1	
PC Cloning (imaging)	> 150 Clone images	
Wire and Wireless Networking	315 Devices (routers, switches, hubs)	
Internet Access	2 high-speed lines	Fiber-Optic
APACHE	1 Server	
Online Storage Servers		
KBM		
UPS	Hundreds	
Webcams		
PDA		
Electronic Whiteboards	14	
Multimedia Projectors	100	
Audio Teleconferencing	1	
Video Teleconferencing	5	
Visual Presenters	50	
Digital Still Cameras	120	
Digital Video Cameras	40	

Audio Sound Systems – Surround Sound	6	
Audio Sound Systems	15	
VCR Players	50	
DVD Players	35	
VCR & DVD Players	15	

Technology Evaluation Table

This table shows the evaluation of technology in one of four states. Technology can either be **Emerging** (*not yet important or available but will be*), **Current** (*important and available now*), **Aging** (*available now but becoming less and less important with time*), or **Obsolete** (*no longer important*).

The vast majority of GCC's technology is current or will be once the SUNGARD system removes the need for Windows 98.

Technology Architecture and Standards Justification

These areas of improvement support the need for the architecture and standards recommended in this document.

Opportunities	Comment
The GCC network is unable to adequately serve the needs of the college.	The network must be redundant and segmented with an expanded access to the internet.
The GCC network is not equipped with load balancing software.	MIS staff must constantly monitor the network and take personal action to remedy problems.
Heterogeneous computer hardware configurations make it difficult to maintain hard-drive "images" for ease of restoring corrupted computers.	It takes upwards of a week for a newly arrived PC to be ready for deployment. While there are many reasons for this, a principle cause is the variability of hardware components.
There is a mixture of old and new operating systems because certain applications will not run on the latest OS or because of employee reluctance to change. (Windows 98, Windows XP in particular)	The number of outdated technologies support on campus must be reduced. The definition of "outdated" should be, at a minimum; the vendor no longer supports the product. GCC should not be carrying on business functions on unsupported technologies.
GCC is well equipped in many of the latest technologies.	Thanks to the initiative taken by MIS, CTC, and other faculty related groups.
Student Login Ids are not provided.	Being able to track technology utilization is necessary for future planning. Student logins would greatly enhance policy enforcement.
Technology at the high school level leaves room for improvement. Classes are being offered in technology skills or using PC's and the internet; however, the reliability of the infrastructure is inadequate.	Determine realistic goals and objectives for courses offered at the high schools and then take necessary steps to meet those goals.

CURRENT IT MANAGEMENT ENVIRONMENT

General Overview

The current Guam Community College Information Technology (IT) Management environment has been steadily improving over the past five years. The size of the MIS organization has grown to ten full-time employees. Yet this growth has barely kept pass with the expansion of the overall IT environment and the level of centralized control undertaken. The number of computers and other IT technologies on campus has grown at a more rapid pace than MIS has been able to match. It has insufficient expertise in some technologies while being well positioned in others, particularly in the number of people trained in networking. This lean toward network skills is illustrative of the types of problems most often encountered. When a single PC or printer has a problem, only a few people are impacted. When the network is down, this has the potential to impact large segments of the college population or in a catastrophic network outage, the entire college is impacted. Therefore, MIS has justifiably focused considerable attention on preparing and responding to networking problems.

Low Tech

Unfortunately, this growth in the size and complexity of the IT environment is now causing a new set of problems. With MIS staff virtually consumed by networking, PC troubleshooting, and PC imaging issues, it does not have the capacity to delve into new issues of critical importance to GCC, or to address lingering problems. For example, MIS lacks the capacity to undertake important GCC issues such as creating and maintaining individual student logins, developing a more robust means of creating PC hard-drive images and of maintaining these images on the 1500 PC's, implementing an automated rather than a manual administration of campus email, and taking over management of the Mac labs. MIS does not need more staff until it is allowed to more fully automate many of the tasks it is currently doing. This will release MIS staff from tedious work and allow them to gain and use more advanced technical skills. At that time an assessment as to the proper MIS staffing level can be conducted.

Decision-making

As a matter of historical fact, until very recently most IT decisions were more or less the exclusive domain of MIS. MIS functioned in a strong, centralized control model. It was ultimately held accountable by GCC senior management for IT problems and solutions. Perhaps at a time in the past this was a warranted and viable IT management model. However, with the size, complexity, diversity, and increased ease of use of many technologies today, a centralized MIS controlling model is no longer desirable. What is preferable is to apply centralized control over those things, and only those things, that require such control. Yet, where opportunities present themselves to place control in the hands of others who are closer to the technology's use, these opportunities should be enthusiastically embraced.

For example, MIS should continue to provide oversight and guidance on the hardware and software standards for PC procurement. MIS should not be the one to decide whether MS Word will be the GCC standard or not. MIS should have control over those servers and networks necessary to support the SUNGARD infrastructure. The decision for or against SUNGARD was not MIS' decision alone.

MIS should continue to maintain a centralize control over the GCC infrastructure. An infrastructure is the bedrock suite of technologies and standards upon which the rest of GCC can add the technologies it needs. What is important to have in place is a means whereby necessary changes to the infrastructure are planned with sufficient lead-time to accommodate the addition of new technologies. In the past this has been a less than straight forward process.

Customer Service and Support

Technology users value two things most highly. They want the ability to use technology without having to worry about its availability. And they want to receive help when they need it. So long as things are working smoothly, users would rather not have to think about how or whether technology works. They just want to use it. When the technology stops working they want immediate help.

Customer Service and Support (CSS) has become a discipline in recent years with a set of guidelines and standards established. Best practices have been developed that satisfy the user's needs in ways that are cost effective to the supporting organization. Principle among these best practices is the use of automated control and tracking systems. These systems are indispensable to a properly run CSS mission. They enable and enforce problem capture, prioritization, assignment, accountability, trends analysis, and feedback.

An important characteristic of a mature CSS environment is the existence of, and adherence with, a Service-Level Agreement. Each person calling for assistance should know how quickly their problem will the taken up. Not all problems are equal. Some are critically important to the operations of the college while others are not so important. The Service-Level Agreement defines different thresholds of importance and assigns to each a priority. This priority, in turn, stipulates how quickly the problem must be dealt with. With this agreement in place, users can be assured of timely resolutions to their problems.

GCC should adopt two such systems. First is a Help Desk system used by dedicated MIS technicians providing first and second echelon support to users with problems. GCC has an IT Help Desk Standard Operating Procedure that helps establish end-user roles and an escalation process for requesting MIS support. Second, is a management tracking system used by the College Technology Committee (CTC) (See the CTC-TS Standard Operating Procedure). With this system in use the CTC can manage its business with speed and accuracy.

Performance Management

GCC should implement these CSS best practices for one other important reason; performance measuring. As the college moves closer to performance based budgeting it is incumbent upon each functional unit to identify measurable outputs from its work processes and to equate these outputs to budget dollars. What is needed most is a way to measure (count) process outputs. These counts are a natural byproduct of systems such as the Help Desk system. All work must be measured. When all work is tracked in a database the measures are automatically captured.

Project Management

Prior to the decision to implement the SUNGARD system, there was perhaps, little need for a commitment to project management. The assessment of IT skills shows that even those who are now tasked with project management responsibilities have received insufficient project management training. Of all of the IT technologies, project management is the most difficult to learn and master. Project management, or rather the lack of it, is also the single most important cause for project failures. Project management is an infrastructural technology just like networking. It is a skill upon which other technologies can build and be successful. GCC should permanently adopt project management training, methodologies, standards, and tools as part of its core values and a key component of its infrastructure. The practice of project management must become pervasive. Therefore, staff and faculty members who are assigned to work on a project must be trained in this discipline. It is not enough to have a trained project manager, project team members, likewise, need to understand the methodologies and their role in achieving project objectives.

IT Management Distribution and Staffing Level Table

GCC's MIS staff of ten individuals is challenged with over 325 different systems, applications, databases, and servers, to maintain, monitor, upgrade, and replace. To efficiently utilize and track the proficiency of the MIS staff, a MIS Tasks, Roles and Responsibilities matrix is used to track individual specialties and identify areas for training opportunities.

Ten years ago, GCC had a MIS staff of less than ten individuals maintaining approximately 300 PCs in its inventory. Today, the inventory of PCs has increased to over 1500 while the MIS staff level has remained at ten for the past five years. In 2006, MIS was augmented with IT personnel from other departments; however, those staffing levels dropped off as a result of reorganizations. However, there are personnel within the college who are not part of the MIS staff that do assist in keeping some computerized areas operational. For example, MIS does not handle computerized areas where instructors are supposed to maintain their own environment and MIS only gets

involved when these locations require network or other resources and expertise beyond the instructor's realm or level. The computerized labs for the CISCO Academy, Microsoft IT Academy, VISCOM (Mac Lab), and Lab Room D7 for the Computer Science Department are handled by certain instructors with IT knowledge. The primary MIS support for these locations is making sure they have network and Internet access and approving technology purchases. While this is an admirable gesture on behalf of these individuals with IT backgrounds, the IT work they perform is outside the normal scope of their duties and responsibilities. MIS will ultimately be held responsible for all IT support in these areas if these individuals choose to defer this work to the MIS department.
This presents challenging times for the MIS Manager.

This table shows the IT Management distribution and staffing level situation.

Department	**# of IT Staff**	**# added in last 5 years**	**# lost in last 5 years**
MIS	10	0	0

IT Management Architecture and Standards Justification

These areas of improvement support the need for the architecture and standards recommended in this document. The term "staff" does not mean only MIS personnel but staff fulfilling IT roles regardless of organization.

Opportunities	Comment
Applications and technology continue to proliferate.	IT staffing levels and skills are not keeping pace.
New applications and technology are more complex.	IT staff training is not keeping pace.
Insufficient training in critical skill areas.	Many IT staff members have not been formally trained in the important skills required of them.
Level of Service Agreements not established between IT support staff and users.	Users are not assured of a timely resolution to their work request.
Insufficient capture and control of MIS customer service and support work. Work is being done without any written record of it.	There is no Help Desk function, no database for tracking all work requests, and no means of quantifying how much work is being done.
Analysis of work requests is not conducted.	Unable to identify systemic problems but rather continue to address each problem individually.
GCC should be allocating budget and resources in accordance with performance measures.	The easiest place to begin this discipline is with IT. The ability to measure performance and equate it to dollars is an important tool that will enable more accurate budgeting.
The MIS staff is too heavily relied upon for even the simplest technology problem.	Users need to be trained to handle a defined set of routine problems in their workspace.
Communication between IT staff and users is unstructured.	Users should be made aware of upcoming IT staff activities in their areas before the work begins and should be notified of the outcome of the work. All such communication should be in writing.
Little if any IT strategic planning has been	The creation of the GCC EA goes a long way

done. Most decisions are Tactical and reactive.	toward answering this finding.
IT staff skills are too highly focused on low-level technology; networking, PC troubleshooting, PC hard-drive imaging.	IT staff need to be trained in and begin to practice some of the higher level technology skill sets; systems analysis, project management, quality management, capacity planning, research and development, and the like.
GCC should greatly expand the use of work-study students, part-time employees, volunteers, and third-party providers.	Most of the most tedious, low-level, re-active technical support issues can be done by these types of individuals, freeing up full-time employees to work on more complex issues.
More IT staff should be trained in how the technology is used so they can more readily relate to user problems and can offer greater assistance.	What is needed is an emphasis on the Human – IT connection. Users do not know IT. IT staff does not know what users do. IT staff should be trained in applications enough to be able to understand how Users do their work.
IT staff should be trained in all of the common disciplines and not only in those that cause the most problems. IT staff will never be able to lead in technology innovation if they do not have the training and skills of these other disciplines.	GCC should invest in training people in the areas of systems analysis and design, quality assurance and testing, customer service and support, database administration, applications specialist, and project management.
All IT staff should be involved in planning sessions about the future of technology at GCC.	Such involvement will provide more and better ideas and will help to communicate GCC's IT goals to the employees.
The College Technology Committee must be given sufficient influence over IT decisions to be effective. If the majority of its decisions are ignored or overturned, the CTC will cease to be effective.	The CTC must have several early successes. It must demonstrate that it is respected and its recommendations are taken seriously.

THE FUTURE

FUTURE GUAM COMMUNITY COLLEGE ARCHITECTURE

INTRODUCTION

The future architecture will be described in four areas used in the current assessment sections of this document: data, application, technology, and IT Management. For each area, the IT Architectural boundaries and constraints will be spelled out, as will the new supporting IT Standards and IT Training.

- Where there is considerable redundancy of data, the future will show an environment where Data is stored once, in one location, and shared by all.
- Where there is a problem with the proliferation of technology or applications, the future will show a world where there is widespread commonality, or at least a severely limited number of choices.
- And where the staffing levels, training, skills, and expertise of the IT Management function is dangerously at risk, the future vision will show an organization that is properly staffed, adequately trained, highly motivated, and expertly managed.

As is obvious from the above, it is nearly impossible to completely separate Data from Application, or Application from Technology, and, of course, IT Management must be involved in all three. Therefore, in order to maintain a clear view of the way ahead, recommendations for the future of each of the four components will be expressed as three types of requirements: IT Architecture (Data, Application, and Technology), IT Standards, and IT Training. In the end, the GCC EA will identify the future Architectural constrains, the future Standards in force, and the future Training (and staffing) requirements.

IT Standards are documents that spell out policies, guidelines, checklists, procedures, rules and regulations, roles and responsibilities, accountabilities, lists of Do's and Don'ts, requirements, processes, methodologies, and programming protocols. These standards also may be supported by tools that help to implement and/or evaluate compliance.

IT Architecture is the hardware, software, networking, operating systems, communication protocols, tools, devices, and the like that will make up the Guam Community College Enterprise Architecture. The components of architecture are those things that usually require a purchase order to obtain. The IT Architecture mainly speaks to those things that will have part numbers, serial numbers, licensing agreements, and user manuals. The IT Architecture in this document does not provide this level of detail, of course, but it is the necessary guidance for selecting the appropriate types of these products.

IT Training means formal training. It is training on components making up the IT Architecture: software, hardware, applications, and technologies. It is training on IT Standards so individuals are aware and know how to be in compliance. And lastly, it is training in the principles and disciplines of IT Management proper.

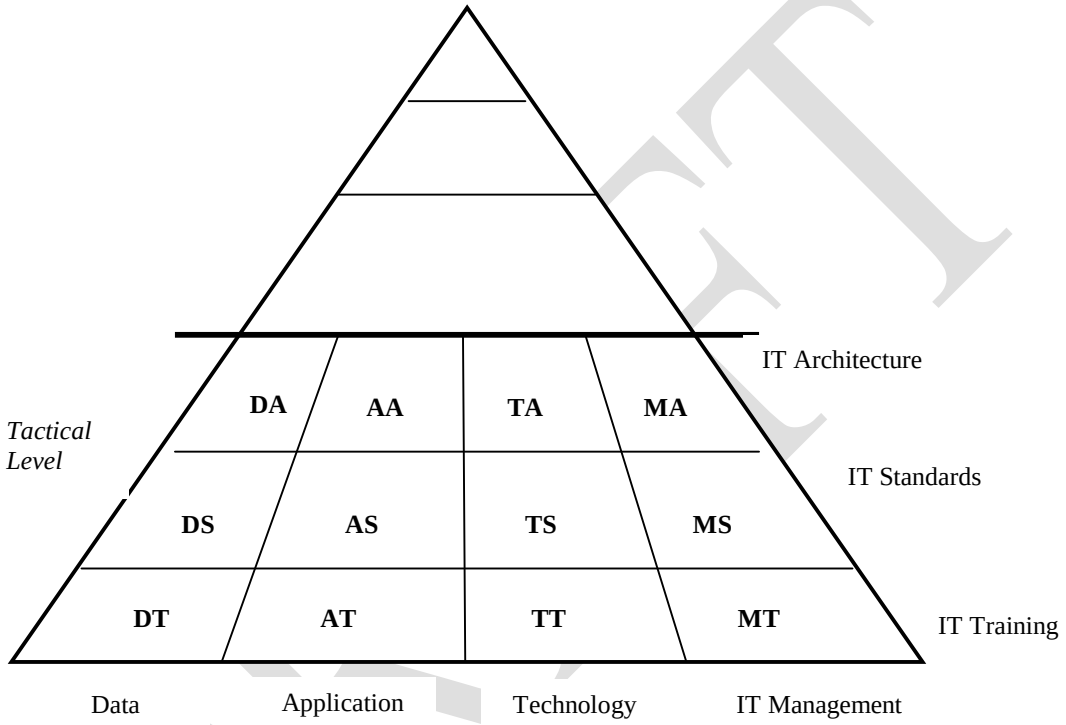
With the future expressed in these three planes, it will be a simple matter to move forward with the necessary implementation plans. Of course, each implementation will require detailed planning, staffing and funding, agreement with all stakeholders, strong project and configuration management, and a long-term commitment.

The GCC EA is a diagnostic document, identifying the problems facing Guam Community College. It is a justification document, spelling out the potential impacts of the problems left unresolved. Finally, the GCC EA is a prescriptive document, showing which problems must be addressed immediately.

In the prior sections, the problems were clearly identified. In the remaining sections of this document, their solutions will be defined in terms of IT Architecture changes, IT Standards changes, and IT Training changes. Also, the relative severity and priority of the problem will be judged. With this information, informed decisions can be made about how best to implement the new solutions that the Guam Community College Enterprise Architecture needs.

Future GCC EA Reference Labels:

Each Future requirement will use a referencing system. For example, the reference for those requirements that have to do with the Data IT Architecture will start with a "DA" and those for Technology IT Standards will start with a "TS."



FUTURE DATA ENVIRONMENT

Data IT Standards (DS)

In the future, the Data Environment will comply with these standards.

DS001	**Ownership**	All data is owned by Guam Community College. Therefore, it need only be captured once and stored at one location, but shared with the rest of Guam Community College. The place at which the data is first captured and stored will be called the Data custodian.
DS002	**Custodianship**	A Data custodian will be the most logical department for the capture and preservation of a type of data. This will mean that only the assigned data custodian may change, add, or delete the data assigned to them. It also means that access to this data will be available to all who need it. There will be more than one Data custodian due to the nature of the data.
DS003	**Formatting**	All Data will comply with a data formatting standard. These standards will include such things as data type, data length, data display format, and data validation rules.
DS004	**Collection**	Data will be captured once, as close to the source as possible, then shared. This collection point will most often be with the Data custodian.
DS005	**Sharing**	Data will be accessible by all authorized users, both internally and externally.
DS006	**Duplicating**	Data will be stored once. The duplication of data will be allowed only under the most pressing of circumstances and will be allowed only until the circumstance can be resolved. The long-term duplication of data is a serious matter that will not be tolerated.
DS007	**Storage**	All data that can be stored electronically will ONLY be stored electronically. It is a violation of the Duplicating standard to maintain duplicate copies of data in any form, including filed hardcopies.
DS008	**Security**	Data security is the highest priority and the prime standard. No other standard shall be used as grounds for jeopardizing the security, integrity, and privacy of data.

DS009	**Business vs. Technology**	Data will be managed in accordance with business needs and not technology constraints. Decisions as to whether and when to dispose of old data or to archive it will be based solely upon the dictates of the business. This also means that data will be disposed of or archived as soon as there is no longer a business need for it.
DS010	**Safety**	All Data will be properly protected from loss and corruption. At a minimum, regular backups will be made of all data regardless of its location (server or desktop). All backups will be conducted in accordance with an approved Data Safety and Recovery procedure that will stipulate the frequency and type of backups performed. The procedure will also describe the frequency for testing the recovery of a database after a simulated failure.

Data IT Architecture (DA)

The following architecture is not in place. In the future, all databases and repositories will comply with these standards.

DA001	**Data Security**	Nothing is more important than the security, integrity, and privacy of the data contained within the Guam Community College Enterprise. Yet, consolidating data and making it highly available presents some architectural challenges. While the data must be easy to access and use it also must be completely secure and private. Only the proper person should be able to view or change their own personal data. Yet, this person should be able to view and change their personal data when relative ease. This level of functionality and accommodation will require a considerable investment in the Data Security Architecture.
DA002	**Relational Database**	The way data is stored, managed, and accessed electronically is an important cornerstone to the information architecture. The information models are characterized by the use of relational database technology to facilitate the deployment of several architectural models, client/server, data warehousing and decision support models. Data will be stored in a relational database which has tabular or matrix structures. The data is grouped into tables with rows and columns that have a relationship to each other. Relational approaches to data provide better performance, flexibility, security and management opportunities.

DA003	**Enterprise Data Dictionary**	The data being collected within Guam Community College is plentiful and varied, but at the same time there is a substantial amount of duplication. To help reduce the duplication of data or allow for access (sharing), an enterprise data dictionary will be developed to establish and maintain data standards for data at the enterprise level. This means defining how data is captured, stored, and presented. For example, is there a single Student Name field or several fields (First Name, Middle Name, Last Name, Suffix, or Prefix)? How long should the Last Name field be (20 or 50 characters)? Once the Enterprise Data Dictionary is in place then all applications will be able to use the shared data (See DA004), knowing where to find it and how to use it.
DA004	**Enterprise Database**	Some types of data are extremely common and therefore duplicated within every stand-alone system in the GCC Enterprise. The obvious example of this is the Personal Name and Address data. There is no reason for this duplication other than convenience for the various applications using it. Yet, the storing of this common information, everywhere, wastes costly resources. Further, the existence of these many redundant sources of same data causes confusion. When someone changes their address, they must tell the change to each application they come in contact with. In short order, the various databases have different information about the very same person. Should one application wish to reference the person in another application, the disjointed data causes problems. The existence of a single Enterprise Database, as defined by the Enterprise Data Dictionary, accessible by all applications, solves this problem. There may be other domains of data than Personal Name and Address data that would benefit from incorporation into the Enterprise Database as well.

DA005	**Data Location Transparency**	With the future direction of greater access to governmental information via the web, it becomes important to address the Data Location Transparency issue. What is needed is a simplified access application that provides a "view" of a financial data, for example, while also showing other pertinent information without having to gain access to several applications. A simplified view of data is possible with a Data Location Transparency architecture. It shields the user from having to know where data comes from. Any web-based solution that does not provide this must be considered an obsolete solution from the very start.
DA006	**Data Availability**	There is a risk in having an Enterprise Database which contains vital information that all other applications need. That risk is to its constant availability. A single Enterprise Database is also a single point of failure that must be addressed as part of its initial creation and implementation. What is needed is an instantaneous or near instantaneous fault recovery architecture. If the computer housing the Enterprise Database should suddenly loose power or its network connection, the architecture must be able to sense this failure and immediately route to a backup Enterprise Database. This type of survival architecture ensures that the gains won by implementing the Enterprise Database are not lost the first time there is a catastrophic failure of that database.
DA007	**Safety**	All Data will be properly protected from loss and corruption. Database backups will be accomplished via the network at prescribed times of lowest user activity. The backup media shall be stored in a remote physical location away from the college.

Data IT Training (DT)

The following training requirements are not in place. In the future, all data staff will be fully trained and highly skilled in these areas.

DT001	**Data Security**	Data staff shall be highly trained at securing, preserving, safeguarding the integrity of, and protecting the privacy of all data.
DT002	**Data Modeling**	Data staff shall be highly trained in understanding the data needs for all GCC applications, their inter-relationships and dependencies, and able to model the most logical and efficient data structures.
DT003	**Database Design**	Data staff shall be highly trained in designing and implementing self-validating, space efficient databases that still offer high performance, impeccable security, and easy access.
DT004	**Data Performance**	Data staff shall be highly trained in implementing databases that perform well, able to satisfy the conflicting needs of rapid access with robust security safeguards.

FUTURE APPLICATION ENVIRONMENT

Application IT Standards (AS)

The following standards are not in place. In the future, all applications will comply with these standards.

AS001	**Simplicity**	All new and modified applications will be easier to use, support, and maintain than their predecessor.
AS002	**Common User Interface**	All new and modified applications will present a common look and feel to avoid confusion and reduce user training. To the greatest extent possible, the user interface of choice will be a web browser.
AS003	**User Focus**	All applications will be of the highest quality, responsive to user demands, adaptable to changing user needs and easy to use. The purpose for the application is to make the user more productive. Therefore, all new and modified applications will place a premium on the user's needs.
AS004	**Methodology**	A common application selection and implementation methodology will be used throughout GCC to manage the selection, procurement, and implementation of new applications. In the rare case when GCC undertakes to build a custom application on its own, a common system development methodology will be used.
AS005	**Openness**	All applications will adhere to industry standards for Openness. Overly proprietary applications will be avoided.
AS006	**Security**	Data security is vital but not enough. All applications will also be protected from unauthorized use while still being user friendly and easily accessible by authorized users.
AS007	**Buy versus Build**	The preference will be to Buy rather than Build any new applications. The preference will be to buy vendor produced enhancements and improvements in existing applications rather than to build custom ones.
AS008	**Office Automation and Utility**	GCC will select and mandate a single set of office automation applications such as word processing, spreadsheets, query/reporting and graphic tools, as well as common utility services such as electronic mail, messaging, and file transfer throughout the technology infrastructure.

	Services	
AS009	**No Early Adopter**	GCC will not be an early adopter of new, emerging applications or technology. The standard shall be to never purchase anything newer than the 2nd version or release of a product. While the college as a whole is limited by this standard nothing in this standard precludes research and development activities or restricts experimentation in a classroom setting.

Application IT Architecture (AA)

The following architecture is not in place. In the future, all applications will comply with this architecture.

AA001	**Primacy of the GCC EA**	The GCC Enterprise Architecture is the foremost determiner of what applications may be added into the architecture. The availability of special funding or grants to procure specific applications does not mean that it will be approved for use. All new applications must be compliant with the GCC EA.
AA002	**Access Portals**	As much as possible, the preferred method for full compliance with the standards shall be to provide access to existing applications through web-based portals. This will leave the individual applications undisturbed while still enabling the realization of the future architecture. As applications become obsolete they can be replaced without significant changes to the user interface (i.e. the portal).
AA003	**Wireless**	All new or modified applications shall incorporate wireless technology to the fullest extent possible.
AA004	**Portable**	All new or modified applications shall be compliant with, and take full advantage of, the portable workstation technology requirement.
AA005	**Single Solution**	No applications shall be purchased/built (to include MS Excel and MS Access programs and reports) to improve functionality without first determining that an acceptable solution does not already exist in a GCC application.
AA006	**Openness**	All new applications shall have the capability of being accessed via the web by any authorized user.

Application IT Training (AT)

The following training requirements are not in place. In the future, all application staff will be fully trained and highly skilled in this area.

AT001	**Requirements Definition**	Application staff shall be highly trained at defining application requirements that can be used for procurement purposes or for application designs.
AT002	**Web Programming**	Application staff shall be highly trained at programming websites using skills such as HTML, DHTML, XML, MySQL, PERL, PHP, ASP, JAVA, CGI.
AT003	**Connectivity**	Application staff shall be highly trained at analyzing, designing, and building database and application connectivity and interface software.
AT004	**Portal Development**	Application staff shall be highly trained at developing information access portals, via the web, to allow all users access to applications and authorized data.
AT005	**Wireless & Portable Development**	Application staff shall be highly trained at developing and defining (for procurement purposes) applications that take full advantage of portable and wireless computing devices.
AT006	**Programming**	Application staff shall be highly trained at designing application solutions that will be modular, shareable, and re-useable to the greatest extent possible.
AT007	**Application – IT Interface**	Application staff shall be highly trained in the business functionality and capabilities of GCC applications and not just in the underlying infrastructure. They will know how the users do their jobs so as to reap all the benefits of the application.

FUTURE TECHNOLOGY ENVIRONMENT

Technology IT Standards (TS)

The following standards are not in place. In the future, all technology will comply with these standards.

TS001	**Connectivity**	All GCC facilities, offices, and locations shall be interconnected via the GovGuam Wide Area Network.
TS002	**Security**	All technology assets shall be physically protected from unauthorized access or loss.
TS003	**Network**	The GCC network shall be highly available and reliable, responsive, redundant, and transparent to the user.
TS004	**Automation vs. Manual**	GCC shall maximize the use of automated tools for performing routine tasks. A premium shall be placed on the IT staff's skills and time. Whenever a task can be done with an automated tool it shall be.
TS005	**Policy vs. Technology**	GCC shall strive to have no policy that causes undue manual work on the part of the IT staff. It shall be policy to adopt technology wherever it can help eliminate routine and/or tedious manual work.
TS006	**Hardware Standards**	The standard PC and server shall be current industry standard.
TS007	**Operating System Standards**	The standard operating systems shall be Windows and SCO-Unix, but Redhat/Linux, MAC OS, and AS400 are authorized within the limits of their current use.
TS008	**Openness**	Technology purchase decisions shall be biased toward those products that comply with industry standards, with a preference for vendor-neutral components.
TS009	**Availability**	GCC technological assets shall be highly available. Availability means having information accessible and

		having a means of accessing it. Availability also means a high percentage of "uptime." An application or network connection that is functional only 80% of the time is not available. The goal shall be 95% availability. Striving for 100% is unrealistic and too costly to attempt.
TS010	**No Early Adopter**	GCC shall not be an early adopter of new, emerging technology. The standard shall be to never purchase anything newer than the 2nd version or release of a product. While the college as a whole is limited by this standard nothing in this standard precludes research and development activities or restricts experimentation in a classroom setting.

Technology IT Architecture (TA)

The following architecture is not in place. In the future, all technology will comply with this architecture.

TA001	**Power**	The architecture will assume that main power will be lost every day. The architecture will provide for the routine continuation of operations regardless of the source of power.
TA002	**Servers**	Servers with current industry standards are the standard platform for all GCC applications and databases. While the college as a whole is limited by this architecture, the architecture still fully supports research and development activities, experimentation in a classroom setting, and the use of other platforms for instructional purposes.
TA003	**Portable PC Workstation**	The preferred workstation of the future will be a WiFi enabled laptop. This laptop workstation will provide all of the speed and disk storage capabilities of today's desktop without the need for cables, special desk space, UPS.
TA004	**PC Configuration**	Each PC shall have a standard configuration. This "image" shall be stored on the network. Automated software tools shall be used to periodically evaluate the status of each PC on the network. If a PC is in need of "re-imaging" it will be scheduled for an appropriate time and handled via the network.
TA005	**Laptop Configuration**	Each Portable PC Workstation shall be procured with an extra hard-drive. Both hard-drives are imaged at the same time. When it is necessary to re-image the laptop, the extra hard-drive will replace the corrupted one. The corrupted one will then be re-imaged and stored for future use.
TA006	**Primary and Secondary Servers**	To protect against the loss of an application server, for each primary application server there will a secondary server. A single secondary server may shadow or mirror one or more applications. All applications will be hosted on one server and seconded on another. In the event of the loss of the primary server the secondary server will be able to resume operations within an acceptable timeframe (hours not days).

TA007	**Networks**	The network is as important to the operations of the college as electric power, running water, and air conditioning. It shall be of the highest quality, impeccably secure, and extremely durable. The network will be transparent to the user. They will be able to do what they need to do, when they need to do, 99% of the time.
TA008	**Dedicated Labs**	The Computer Science Department shall be provided with dedicated instructional labs, no longer using shared labs. Due to the nature of computer science courses these labs will need to be more readily isolated from the rest of the network. Likewise due to the nature of computer science instruction, these labs will be under the day-to-day control of the Computer Science Department. In this capacity, the Computer Science Department is accountable to the CTC. (See MA006)
TA009	**e-GCC**	The architecture will no longer be geared solely for internal users and purposes. It will be equally important to provide government data to outside users – in particular the general public. This will mean secure firewalls, virus protection, and high levels of security (PINS, passwords, help desk). It also will mean that normal operations cannot interfere with or impede access and response times for outside users. The outside user community will be viewed as a critical partner who has the same rights to access as any other member of GCC.
TA010	**Planned Obsolescence**	Each piece of technological will have a replacement plan that reflects that technologies lifecycle (the number of years a technology may be used before it becomes obsolete). Each year, the plan will replace the oldest pieces of technology with the newest. In this way, the entire technology architecture will remain current at all times.

Technology IT Training (TT)

The following training requirements are not in place. In the future, all technology staff will be fully trained and highly skilled in this area.

TT001	**Engineering**	Technology staff shall be highly trained at analyzing and designing technology solutions using the appropriate (system, network, database) engineering disciplines, methodologies, and tools.
TT002	**Research & Development**	Technology staff shall be highly trained at performing emerging technologies research and development.
TT003	**Wireless**	Technology staff shall be highly trained at analyzing, designing, and implementing wireless technologies.
TT004	**Survivability**	Technology staff shall be highly trained at analyzing, designing, and implementing system backups, recovery techniques, hot swapping, mirroring, and other survivability protocols.
TT005	**Portability**	Technology staff shall be highly trained at taking full advantage of portable computing and communication technologies.
TT006	**All Assets**	Technology staff shall be highly trained at using, troubleshooting, and teaching the proper use of all of GCC's technology assets.
TT007	**eCommerce**	Technology staff shall be highly trained at analyzing, designing, and implementing eCommerce solutions appropriate to fulfill the e-GCC requirements.
TT008	**Networks**	Technology staff shall be highly trained at analyzing, designing, and implementing local area networks.
TT009	**PC Troubleshooting**	Technology staff shall be highly trained at analyzing, designing, and implementing solutions to PC and PC peripheral equipment problems.

TT010	**Customer Service & Support**	Technology staff shall be highly trained at providing, recording, analyzing, and measuring Customer Service and Support activities (i.e. Help Desk).
TT011	**Application Support**	Technology staff shall be highly trained in the fundamental usage of GCC applications so as to better assist users with application problems.
TT012	**Classroom Support**	Technology staff shall be highly trained in the various technologies used in the classroom so as to better assist faculty and students with in-classroom problems.

FUTURE IT MANAGEMENT ENVIRONMENT

IT Management IT Standards (MS)

The following standards are not in place. In the future, IT Management will be fully trained and highly skilled in these standards. **The term 'IT Management' means the person or persons responsible for a particularly portion of the architecture. It does not signify MIS only.**

MS001	**Roles & Responsibilities**	IT Management personnel shall abide by the IT-related organizational charters which delineate the roles and responsibilities of all those charged with managing portions of the GCC EA.
MS002	**Supervising & Leading**	IT Management personnel shall be highly skilled in leading and supervising other members of their staff, employees from other offices, and vendors/contractors.
MS003	**Team Building**	IT Management personnel shall be highly skilled in building and motivating teams.
MS004	**Customer Service & Support**	IT Management personnel shall be highly skilled in providing high quality customer service and support to the users of the systems for which they are responsible. They shall be highly skilled in Interest-based Bargaining and other negotiation skills.
MS005	**Help Desk**	IT Management shall provide a robust Help Desk function. It shall have a single contact phone number and email address; it shall be staffed by trained Help Desk technicians and shall operate in accordance with the IT Help Desk Standard Operating Procedure.
MS006	**Systems Management**	IT Management personnel shall be highly skilled in the principles, disciplines, techniques, and tools used to manage complex computer and network systems.

MS007	**Risk Management**	IT Management personnel shall be highly skilled in identifying and assessing risks, devising mitigation strategies and contingency plans, and effectively communicating potential risks to senior management.
MS008	**Project Planning and Scheduling**	IT Management personnel shall be highly skilled in scoping a project, identifying the resources required by the project, developing project plans and building project schedules based upon the availability of resources.
MS009	**Project Management**	IT Management personnel shall be highly skilled in managing projects so that they are delivered in accordance with the agreed to requirements, on schedule, and within the budgeted amount of resources.
MS010	**Configuration Management**	IT Management personnel shall be highly skilled in controlling the configurations of the myriad software, hardware, and documentation under their control to ensure that updates, releases, and patches are properly introduced into the architecture.
MS011	**Strategic Planning**	IT Management personnel shall be highly skilled in planning for system needs and opportunities up to 5 years into the future.
MS012	**Performance Management**	IT Management personnel shall be highly skilled in measuring their workloads, adjusting workloads and staffing to ensure the most cost-efficient operation, and then requesting budgets in accordance with these workloads.

IT Management IT Architecture (MA)

The following architecture is not in place. In the future, IT Management will be compliant with this architecture. **The term 'IT Management' means the person or persons responsible for a particularly portion of the architecture. It does not signify MIS only.**

MA001	**Remote Access**	IT Management shall have full, remote, access to every database, application, directory, and operating systems, that make up the GCC Enterprise Architecture. With this access they shall be able to perform their duties without having to physically relocate to the site of the problem.
MA002	**Full Authority**	IT Management shall have authority to debug, fix, monitor, and perform other necessary duties throughout the GCC architecture.
MA003	**Tools**	IT Management shall have all the tools (software applications, test equipment) necessary to perform all routine maintenance, troubleshooting, and future planning on every component within the architecture.
MA004	**Enforcement**	IT Management shall constantly monitor the architecture and shall have the right to disallow, deactivate, confiscate, and remove any unauthorized additions to, or modifications of, the approved architecture.
MA005	**Accountability**	IT Management shall be accountable for its decisions and actions to the CTC.
MA006	**Delegation**	IT Management shall distribute and delegate authority as it deems appropriate. There shall be no centralized owner of the GCC except the CTC.
MA007	**Licensing**	IT Management shall be responsible for maintaining all licensed software media (diskettes, CD/DVD's) for tracking the location of each use of licensed software; and for ensuring that licensed software is either renewed or replaced before it expires.

IT Management IT Training (MT)

The following training requirements are not in place. In the future, IT Management will be fully trained and highly skilled in this area. **The term 'IT Management' means the person or persons responsible for a particularly portion of the architecture. It does not signify MIS only.**

MT001	**Supervising & Leading**	IT Management personnel shall be highly trained in leading and supervising other members of their staff, employees from other offices, and vendors/contractors.
MT002	**Team Building**	IT Management personnel shall be highly trained in building and motivating teams.
MT003	**Customer Service and Support**	IT Management personnel shall be highly trained in providing high quality customer service and support to the users of the systems for which they are responsible.
MT004	**Systems Management**	IT Management personnel shall be highly trained in the principles, disciplines, techniques, and tools used to manage complex computer and network systems.
MT005	**Risk Management**	IT Management personnel shall be highly trained in identifying and assessing risks, devising mitigation strategies and contingency plans, and effectively communicating potential risks to senior management.
MT006	**Project Planning and Scheduling**	IT Management personnel shall be highly trained in scoping a project, identifying the resources required by the project, developing project plans and building project schedules based upon the availability of resources.
MT007	**Project Management**	IT Management personnel shall be highly trained in managing projects so that they are delivered in accordance with the agreed to requirements, on schedule, and within the budgeted amount of resources.
MT008	**Configuration Management**	IT Management personnel shall be highly trained in controlling the configurations of the myriad software, hardware, and documentation under their control to ensure that updates, releases, and

		patches are properly introduced into the architecture and applications.
MT009	**Strategic Planning**	IT Management personnel shall be highly skilled in planning for system needs and opportunities up to 5 years into the future.
MT010	**Performance Management**	IT Management personnel shall be highly skilled in measuring their workloads, adjusting workloads and staffing to ensure the most cost-efficient operation, and then requesting budgets in accordance with these workloads.

ONE-TO-FIVE YEAR INITIATIVES

Redundant Network and Systems

Introduction

As it stands today, the college is in a very vulnerable and precarious position due to the lack of a compatible facility to conduct systems, applications, and data recovery, as well as business continuity procedures. There is currently no Information Technology or Information Systems strategy in place within or outside of GCC to allow us to continue with operations in case of disasters to mission critical systems. With GCC's high dependency on the new SunGard BANNER Integrated Database Management System (IDBMS) for operational, administrative, and instructional tasks, every effort must be made to safeguard or mirror this valuable resource. Any major disaster occurring in the existing computer server room facility or on the campus' network infrastructure will seriously paralyze the college and interrupt services until the site or the network is repaired, rebuilt, or another suitable location is identified to host recovery efforts. This addresses our inability to immediately recover and restore all systems to full normal operational status from most major disasters. In order to make sure we are prepared for the worst contingencies, we need to build redundancy into our network and in our systems. GCC should build the network infrastructure, identify a suitable facility, procure and install the redundant and failover systems that can be readily accessible when it is needed. This long-term forecast will put in place the network, server systems, and use a data hosting facility that will allow the college to continue business operations despite natural or manmade disasters of its primary communications and file servers' location. This also addresses data, network, and communications security compliance while creating a mirror of the primary and secondary locations' critical information and instructional technology. This outlook will safeguard the college's vital digital data assets and allow GCC to continue to operate and meet internal or external federal and local reporting requirements, while complying with mandatory data protection regulations. More specifically, this will provide the technology and the means to recover from disaster and equip all employees with necessary resources to continue servicing our students. In short, the college's system's hardware, software, network, and Internet connection needs will be there when it is most needed after any major catastrophe or as an emergency backup.

Minimum Technical Requirements

The following specifications define the minimum requirements for GCC's Redundant Network and Systems Project to support the main campus in Mangilao and its mirrored remote site.

- GCC's Mangilao Campus Redundant Network link to Existing Network
- Remote Site with Mirrored Servers' Located at the Data Hosting Facility, Linked with High Speed Network Lines to GCC's Mangilao Campus' Redundant Network

Five-fold Project Description
This future environment envisions a five-fold approach

1. Design a redundant network
2. Putting in place a redundant network
3. Connected to an off-campus mirrored site of primary data and applications systems
4. Linked via high-speed fiber-optic network
5. Located and utilizing an on-island data hosting facility

This infrastructure will be capable of linking and synchronizing the main Mangilao campus systems to a remote, secure and safe data hosting facility housing a mirrored systems environment. In case of disasters or emergencies, the redundant network along with the data hosting facility will be capable of quickly deploying existing systems applications and networked data services back and forth to GCC's main campus. The configuration of the redundant network and systems at the data hosting facility, will act as a backup infrastructure that is fully self-sufficient with redundant power, communication links, and air conditioning and air-quality control systems, as some of the basic requirements. The facility must be hardened and able to withstand major disasters, such as typhoons and earthquakes. The facility must

have fire detection and suppression systems, security camera surveillance, and 24 hours, 7 days a week, 365 days a year manned security.

The servers and network hardware to be procured and housed in the primary Mangilao campus location and in the data hosting facility must be fully fault-tolerant and be able to provide 99.999% uptime with zero to very minimum loss of business operations. The systems in place at both the primary and at the data hosting facility must have an automated monitoring and alert system that will be triggered depending on the seriousness of the problem or the overall health status of the network, database, or file server resources. The remote data hosting facility will also have onsite technical personnel to assist GCC's internal technical support staff with problem resolutions between the primary and remote hosting facility.

This future environment should cover a redundant network and systems (server hardware & software) configuration and construction for the main Mangilao campus with failover capability to the mirrored site at the data hosting facility. This environment must be able to work in and not be in conflict with GCC's existing network infrastructure, and in a multi-network protocol, multi-network operating systems, and in multi-operating systems environment that include the following:

- Windows NT/2000/2003/2008 Network Operating System
- UNIX, REDHAT, LINUX, FEDORA, OS/400, Novell NetWare
- Windows 98/VISTA, and Macintosh Operating Systems
- 3Com Hubs and Switches
- 3Com 100mbps and Giga Switches
- CISCO Routers
- CISCO ASA Firewalls
- TRENDNet, NetGear, Nortel Routers
- Symantec Firewalls
- Ethernet Hub Topology
- Private/public TCP/IP Protocol
- Others

New environment should not conflict with GCC's broad range of desktop and specialized academic and operations applications, network monitoring solutions, and its enterprise systems that include the following:

- Microsoft Office
- WordPerfect Office
- InterMapper
- SolarWinds
- Symantec AntiVirus
- TracDat
- Banner Integrated Database Management System
- Luminis (MyGCC Portal mygcc.guamcc.edu)
- Moodle/Joomla (www.guamcc.edu)
- WorkFlow
- Banner Document Management System
- Operational Data Store
- iPlanet Messaging Server
- Oracle Database Management System
- Xerox Printing/Copying/Scanning System
- Others

Redundant, Reliability, Failover, and Mirrored Capabilities: Redundant network and systems must not have a single point of failure and must have multiple automatic failover systems for optimum continuous use and operation; allow outbound and inbound network traffic to the mirrored site at the data hosting facility when primary network and/or servers are down and offer 24-hour by 7-day reliability/availability. The main Mangilao campus location must maintain connectivity and processing to the mirrored remote site in the event an outage occurs to the primary network and/or primary servers. In the event of a total systems failure or power failure of the main servers or the primary site, the proposed mirrored systems' site must be at least accessible from the designated redundant or secondary network of the main campus. All start and end points of key network segments of this setup must include continuous power and power

protection. This operation must be automatically provided by the system and not require GCC or vendor staff to make any configuration changes to the system or to start and end point equipment, in order to allow for this capability to occur upon outage or failure. Redundancy and mirroring capability must be set to have continuous synchronization between the primary network systems and servers. All updates to the primary network's servers must occur immediately with the mirrored site servers at the data hosting facility and vice versa. For technical specifications of servers to be proposed please see appended "Technical Bid Specifications for Blade Servers, Storage Area Network (SAN), and Software". Proposed servers and other items on this hardware section of the bid must meet all minimum specifications and must include the service component, inclusive of copying, imaging, or virtualizing existing servers at the main Mangilao campus to these new servers. This is a critical and mandatory requirement in the event the on-campus systems become unavailable for whatever reason. If the on campus systems become unavailable, it is also mandatory for the mirrored remote site's database, files, and information systems applications to be as up-to-date, synchronized, running, and accessible to our users. Once the on-campus systems come online and before it is accessed by the users, it must synchronize first with all the updates that occurred at the mirrored remote site.

Quality and Industry Standards: Systems must be to industry standard for terminating connectors, terminating equipment, copper and fiber optic cable, for system redundancy, reliability, failover, mirroring, and data hosting facility. Network efficiency must be at optimum level to meet current demand and be capable of upgrades without significant costs in equipment or cabling replacement. All fiber cabling implementations must meet or exceed industry standard. All network backbone segments must at least support 10gbps bandwidth capacity.

Remote GCC Locations: The design of this system must utilize the existing connectivity implementations for the remote GCC high school satellite sites to access network resources located at GCC's Mangilao campus. In the implementation, users from any remote GCC high school location or GCC Internet users outside the main Mangilao campus must have access to the servers residing in the primary network. However, in case of a connection or access failure to these systems, outside users must be rerouted to the mirrored site at the data hosting facility until the connection and/or access failure is resolved and the servers at both Mangilao and mirrored remote sites are synchronized.

- Data Hosting Facility: Data Hosting Facility must be equipped and constructed with:
- Standby generators and backup AC power systems
- 24x7x365 Uninterruptible power sufficient for proposed servers and communications equipment at full load
- Fire suppression and detection
- Air conditioning and air quality control system
- Typhoon-proof and earthquake protection structure
- 24x7 Network Operations Center and Security
- Customizable cabinets

Existing Network, Redundant: Network, Cabling and Inside Wiring: GCC's requirement is to utilize the existing LAN (Local Area Network)/CAN (Campus Area Network) in place at the main Mangilao campus AND for the vendor to design, build, implement and link to a new redundant network infrastructure. The redundant network must link to one or both of GCC's existing Internet Connections/Lines AND must also have a separate Internet connection(s) and/or connectivity to the data hosting facility, independent of the two existing Internet lines. This independent connection(s) will be necessary to satisfy all other remaining and related technical requirements of redundancy for this bid. The main Mangilao campus is currently connected to two Internet Service Providers via dedicated 10mbps fiber/Ethernet line from MCV, and another dedicated 10mbps Metro Ethernet line from GTA. The campus LAN/CAN is made up both 100mbps (copper/fiber) and 1gpbs multimode fiber backbone lines. CISCO routers and 3COM switches and hubs make up most of the networking equipment all linked by fiber optic cable and/or CAT5 (or greater) cabling. Pure wireless (DSL) connections are limited with only a few hotspots and some wired-to-wireless implementations are in place. The redundant network along with its new line to the data hosting facility can also optionally use and/or expand either one or both existing Internet connections, as long as all related technical requirements are satisfied. Vendor is responsible for doing a feasibility assessment of the current network and Internet lines for the main Mangilao campus and the mirrored remote sites for the purpose of linking into the redundant network and systems environment. The redundant network should be designed, built, implemented, and linked in such a way that any physical break or equipment failure anywhere on the network will not result in an extended interruption or discontinued operation for the whole of GCC (please see Redundant, Reliability, Failover, and Mirrored Capabilities). All hardware, software, tools, equipment, materials, supply, construction, permits, connection lines, and/or services (inclusive of one-time charge, and annual and monthly maintenance) must be clearly detailed and included in the proposal.

Systems Administration: A secured and authenticated device and administrator login management console from any point or from any GCC-designated point on the network for all and any component of the redundant network and systems must be provided and supported. GCC's network coordinators, systems programmers, and administrator must be able to conduct work through a secured access either via a standard browser-based interface or vendor-provided control console. Any required server(s) for systems administration, must be based on industry standard server-grade hardware/appliance and use Microsoft Windows Network Operating System or any of the latest and common UNIX operating system (RedHat, LINUX, FEDORA, IBM AIX), and must be able to work in and not be in conflict with GCC's existing network infrastructure, multi-network protocol, multi-network operating systems, and multi-operating systems environment, and various desktop applications, enterprise, and specialized systems (see list provided above). On-site or on-island off-site systems administration technical training must be provided for all pertinent technical GCC IT/MIS personnel.

Scalability: Capable of modular, cost-effective growth in service, hardware and software inclusive of equipment and systems applications over the next five years. Vendors must provide evidence that the system they are recommending can be expanded or configured with increased efficiency and robustness (as examples, more bandwidth throughput, more routing options, increase security, adaptation to new technologies, IPv4/IPv6 changes) without substantial investment in or replacement of systems components such as cabling, switches, servers, and routers/gateways.

Enterprise Security: Include an enterprise security component that will work with a multiplatform / multivendor environment such as Windows, Mac, Novell NetWare, and LINUX/UNIX. Users accessing the network must be allowed to at least authenticate and register the (1) device(s) they are using, (2) their personal credentials such as username, login account, and password, or (3) a combination of both "1" and "2". For more details of the Enterprise Security technical specifications please see the appended "Technical Specifications for Enterprise Security".

Voice-over-Internet-Protocol (VoIP) Telephone System

Introduction

GCC spends over $100,000 per year on telephone utility costs, not including all expenses for telephone instruments, long distance charges, telephone system reprogramming, cabling/wiring, and other related services costs. The college is currently installed with over 200 telephone lines with most of the numbers going through a PBX/Centrex phone system and all services provided by Guam Telephone Authority (GTA). The last FY09 telephone utility budget was at $132,000 and is expected to increase in the following years if the college does not act now to adopt new technology that can significantly reduce this cost. There are now different types of technology in the market that can meet the college's telephone communication needs without the high cost associated with GCC's current telephone system. Voice-over-Internet-Protocol, or VoIP, is technology that has proven itself over the recent years and different types of this technology are implemented throughout the world by various system manufacturers and phone service providers. This is a proven phone system that can provide the college with lower cost of ownership, is easy to manage and can grow with the college, as needed. Many installations of similar VoIP systems, within the first two years of use, are known to have paid for its self with all the cost-savings from paying standard telephone services.

The following specifications define the minimum requirements for the new IP based (VoIP) Phone system that GCC is interested in procuring to support the main campus in Mangilao and its remote office/classroom operations at the Guam public high schools:

- GCC's Mangilao Campus Buildings, Offices, Classrooms, and Conference Rooms
- High school sites below are optional and are not part of the requirements:
- GCC Only Offices/Classrooms at Simon Sanchez High School
- GCC Only Offices/Classrooms at Southern High School
- GCC Only Offices/Classrooms at Okoodo High School
- GCC Only Offices/Classrooms at George Washington High School
- GCC Only Offices/Classrooms at John F. Kennedy High School
- All types of existing telephone lines inclusive of
  - Voice
  - Fax
  - DSL/Modem

Project Description
The college will be looking at procuring necessary services, hardware, software, network, and Internet lines that can provide VoIP telephone services to the college. The system installation will be for the main Mangilao campus. The college may choose to these services, over the Internet, to GCC's remote satellite classrooms and employee offices.

The system can be either entirely housed in the primary Mangilao campus server room, located throughout strategic points on the network, and/or be at a vendor's facility. Any combination of this system's configuration, as far as its location(s), is acceptable. This system must be redundant and fully fault-tolerant and be able to provide 99.999% uptime with zero to very minimum loss of business operations. The system in place must have an automated monitoring and alert system that will be triggered depending on the seriousness of the problem or its overall health status. Technical vendor personnel, whether on- or offsite, must be available to assist GCC's internal technical support staff with problem resolutions.

VOIP system must be scalable and able to incorporate up to 300+ lines/end users. Configuration of phone systems must be for all main campus employees at their designated office space, classrooms, and conference rooms. Proposal must include in the bid all necessary items. Any and all additional items that are not required or are deemed as extras must be clearly labeled as "optional". This system must be able to work in and not be in conflict with GCC's existing network infrastructure, and with a multi-backboned, multi-network protocol, multi-network operating systems, and in multi-operating systems environment that include the following:

- Windows NT/2000/2003/2008 Network Operating System
- UNIX, REDHAT, LINUX, FEDORA, OS/400, Novell NetWare
- Windows 98/Windows VISTA, and Macintosh Operating Systems
- 3Com Hubs and Switches
- 3Com 100Mbps and Giga Switches
- CISCO Routers
- CISCO ASA Firewalls
- TRENDNet, NetGear, Nortel Routers
- Symantec Firewalls
- Ethernet Hub Topology
- Others

Vulnerability Testing (Placeholder)

Distance Education (Placeholder)

THE GAP

GAP AND IMPACT ANALYSIS

The purpose of capturing GCC's current IT environment and projecting a desired and optimum IT environment is to identify the gaps which need to be addressed. Identifying the gaps sets the stage for finding potential solutions and alternatives, reprioritization of college objectives, and inserting these action plans into GCC's budgeting life-cycle. Ultimately, it will take individual projects to implement the specific pieces of the future environment. As predicted, there are gaps between the current environment and the future architecture. What follows is a manageable list of the most pressing ones.

DATA

There is a sizable gap between the current data architecture and the proposed future architecture.

1. The first initiative is already underway. The acquisition and implementation of the new SUNGARD integrated database addresses many of the current Data shortcomings. Once SUNGARD is fully stable smaller tasks should be undertaken to eliminate as many of the MS Office pseudo-applications as possible. And the other smaller applications which share data with SUNGARD need to provide the means of sharing data directly with little or no manual processing or data entry.

2. A second initiative yet to be scoped is the institution of Student Login Ids. This initiative will give birth to others as well. Once we can identify an individual user, what else can we provide that user in terms of services and features? No doubt users could be granted differing levels of authority with their login. What should those levels be and who should have them? From a capacity planning perspective, we will have volumes of information to study. How can this information be used to get ahead of approaching risks and looming problems? Both of these opportunities will become available once we have Student Login Ids implemented.

3. A third important initiative is to conduct an analysis of the Records Management situation. The goal is to drastically reduce the amount of paper being generated and stored. Two solutions to this problem are 1) replace paper forms with online forms, and 2) store the electronic image of a document but not the physical document. The first solution should be the primary focus for addressing this problem, not the continued storing of paper forms and documents that duplicate

online data. Only those original documents which must be stored shall be stored. All others will be scanned and stored electronically.

4. And a fourth initiative is to more fully automate the administration of GCC's email accounts. An automated system should provide this capability and free up human resources for more important tasks.

APPLICATION

1. The plan to fill the gap with Applications is already underway. The acquisition and implementation of the new SUNGARD integrated database addresses many of the current Application shortcomings. Once SUNGARD is fully stable smaller tasks should be undertaken to eliminate as many of the MS Office pseudo-applications as possible. And the other smaller applications which share data with SUNGARD need to provide the means of sharing data directly with little or no manual processing or data entry.

2. A second initiative is to procure a robust Help Desk system to satisfy the needs of the IT Help Desk Standard Operating Procedure. This could be an open source system, like Moodle is, that would be supported by a world-wide community of IT professionals. It should be web-based with significant reporting capabilities.

3. A third initiative is to procure a robust Issues Tracking system to satisfy the needs of the College Technology Committee - Tracking System (CTC-TS) Standard Operating Procedure. This could be an open source system, again like Moodle. It should be web-based with significant reporting capabilities.

4. A fourth initiative worthy of consider is the replacement of the Cougar Mountain application. The new application should be compatible with SUNGARD. It should be bookstore software that tracks sales and inventory.

TECHNOLOGY

The gap between the current technology architecture and the proposed future technology architecture is nearly as great as the gap in IT Management. This is where some significant funds will be needed. To move into the future state of the technology these gaps must be filled.

1. The most pressing issue is the overhaul of the network. It needs to be modified from its current topology into a robust double ring topology. Additionally, a third high-speed internet connection should be brought onto campus. Then, this new network needs to be fitted with powerful load balancing software to deliver on the promise that all of this new technology holds. Not only will all users benefit from this modernization but existing MIS resources will be able to begin tackling other important issues.

2. Email administration is the second issue to undertake. Users should be able to create and administer their own email accounts. A technician need not be involved in this process except to handle problems. This means the acquisition of some new technology to replace the manual process currently in place.

3. Imaging takes up an inordinate amount of staff time. First, the policies surrounding imaging need to be reconsidered. Primarily, does GCC wish to continue to insist that all PC's be under one site license for the operating system? What are the costs associated with this decision? What are the risks of other options? In any case, imaging is a reality. Therefore, technology will be procured to more fully automate the image/re-imaging process. Rather than use CDs images will be housed on the network and re-imaging accomplished via the network. Software exists that constantly monitors the images of PC's on the network and re-images them automatically when necessarily.

4. Administering Student User Ids manually is an onerous task that MIS is not staffed to provide. Current resources are fully utilized on networking, PC troubleshooting, PC imaging, and supporting the SUNGARD implementation. However, there is much good that can come from requiring students to login before using GCC equipment. The lack of user ids causes its own set of problems but more importantly precludes GCC from implementing an even more capable IT environment. (See discussions in earlier sections of this document.) It is in GCC's best interests to require

Student User Ids but only if their administration can be supported with substantial technology and tools.

IT MANAGEMENT

The gap between the current state of IT Management and the future environment is the largest, and by far the most serious gap of all. The IT Management function suffers from understaffing, miss-placed staffing, under-trained staff members, and too much responsibility. Centralized IT management is appropriate for infrastructure (procurement, networking, licensing) but is not appropriate for every aspect of the IT environment.

1. New Governance policies and structures are already being implemented. In the very near future, the College Technology Committee (CTC) will replace MIS as the entity in overall control of the IT environment. While committees do not manage day-to-day operations well, they are effective at guiding the activities of other organizations who can manage operations. The CTC will be able to reach consensus decisions. CTC will be able to present recommendations to senior management. CTC will be able to handle grievances against IT-related policies and procedures. In the future, representatives from all areas of GCC will make all major IT decisions.

2. Likewise, organizations such as MIS and the ITC will have new responsibilities. No longer will MIS have the final decision in IT matters. The CTC will be ultimately held responsible for the IT environment, thus lightening MIS' load. Certain organizations, such as the ITC and the Electronics Department, will be responsible for portions of the IT architecture – the parts they are the most involved in. This new responsibility matrix, as outline in the various IT-related organizational charters, will take some time to learn and fine tune. In the short-term, however, users will be better served by IT management. In the long-term, GCC will have a single IT vision and voice.

4. As MIS in particular is relieved of some of its responsibilities, it will want and need to learn new skills so as to better serve users' needs. The most pressing new skill to be learned is Project Management. Not far behind, however, are other complex skills such as system and database design, capacity planning, customer service and support, performance measuring, and others. MIS is not the only organization in need of acquiring new skills. As organizations embrace new responsibilities over portions of the IT architecture they will need the skills to do it.

NETWORK SECURITY

GCC is taking steps to institute safeguards against security breaches in its network. To identify areas of weaknesses and vulnerabilities in a network, a penetration test is a method used to evaluate the security of a computer system or network by simulating an attack from malicious outsiders and insiders. The process involves an active analysis of the system for any potential vulnerabilities that could result from poor or improper system configuration, both known and unknown hardware or software flaws, and operational weaknesses in process or technical countermeasures. This analysis is carried out from the position of a potential attacker and can involve active exploitation of security vulnerabilities.

Security issues uncovered from a penetration test are presented to the system owner. Effective penetration tests will couple this information with an accurate assessment of the potential impacts to the organization and outline a range of technical and procedural countermeasures to reduce risks.

Penetration tests are valuable for several reasons:

- Determining the feasibility of a particular set of attack vectors
- Identifying higher-risk vulnerabilities that result from a combination of lower-risk vulnerabilities exploited in a particular sequence
- Identifying vulnerabilities that may be difficult or impossible to detect with automated network or application vulnerability scanning software
- Assessing the magnitude of potential business and operational impacts of successful attacks
- Testing the ability of network defenders to successfully detect and respond to the attacks
- Providing evidence to support increased investments in security personnel and technology

Recommended penetration testing of GCC's network should include each of the following:

- Internet/DMZ Servers
- CGI abuse scans
- SQL Injection testing
- IDS Evasion and testing
- Firewall Penetration
- Email account harvesting
- Internet Information Gathering
- HTTP and HTTPS Scanning
- Custom scripting attacks
- Man-in-the-Middle attacks
- Denial-of-service emulation
- Open Source Search
- Application and Banner Grabbing

TRANSITION PLANS

The Guam Community College Enterprise Architecture (GCC EA) is the highest level planning and objectives document. It communicates the current situation and also the desired vision of the future. A subsequent and supporting document is the Information Technology Strategic Plan (ITSP). It will address specific challenges and objectives spelled out in, or derived from, the GCC EA. It then assigns each approved initiative to a project manager who creates a project plan, acquires the necessary backing and resources, and establishes a time frame for completion.

What is needed at this point is to identify those parts of the current architecture which are the most deserving of remedy. These should be addressed first by the ITSP. In this way – from GCC EA to ITSP to individual project plans – GCC will transition into the future.

The Transition Plans are presented in a rough order to priority. Those listed first have the highest probability of saving staff hours and/or improving GCC efficiency. The CTC will decide on the final disposition of each and make recommendations through the Faculty Senate to senior management.

Transition Plan 0 – CTC:

1. CTC meets with the Faculty Senate to present its charter. Gains approval.
2. CTC presents MIS, ITC, ED, CSD, and ADMIN charters to Faculty Senate for approval.
3. CTC presents an overview of the IT Strategic Plan and Enterprise Architecture to the Faculty Senate.
4. CTC gains approval from the Faculty Senate for the Transition Plans, as appropriate.

Transition Plan 1 – GENERAL:

1. Identify all current projects.
2. Suspend work on those projects.
3. Ascertain the goal of the projects and the architecture and standards being used.
4. Re-instate those projects in alignment with the GCC EA.
5. Determine the best course of action for those projects in conflict with the GCC EA.

Transition Plan 2 – SUNGARD:

1. Train the staff to be able to do this type of work.
2. Establish SUNGARD project team, project plan, quality plan and other documents.
3. Implement the SUNGARD system.
4. Determine the business functions each tool performed.
5. Determine whether SUNGARD provides this function automatically or the capability to add it to SUNGARD functionality.
6. Incorporate the business function into SUNGARD.

Transition Plan 3 – NETWORK:

1. Train the staff to be able to do this type of work and/or contract for services.
2. CTC will review the policies, procedures, and practices surrounding the current network, its topology, traffic volumes, and monitoring capabilities.
3. MIS creates a new Network Requirements Definition document defining a double-ring topology with 3 high-speed internet connections and load balancing software, plus other pertinent design features.
4. Conduct a Technical Options Study on the feasibility and opportunities of implementing the new Network.
5. Report findings to the CTC for further action.
6. CTC recommends to senior management the creation of a project to procure and implement the Network Requirements Definition.
7. CTC selects a project manager who creates a project team, project plan and schedule, quality plan, product selection criteria.

Transition Plan 4 – IMAGING:

1. Train the data staff to be able to do this type of work and/or contract for services.
2. CTC will review the policies, procedures, and practices surrounding PC imaging.
3. CTC creates a new PC Imaging Requirements Definition document.
4. Conduct a Technical Options Study on the feasibility and opportunities of automating any and all Imaging requirements and activities.
5. Report findings to the CTC for further action.

6. CTC recommends to senior management the creation of a project to implement the PC Imaging Requirements Definition.
7. CTC selects a project manager who creates a project team, project plan and schedule, quality plan, product selection criteria.

Transition Plan 5 – EMAIL ADMIN:

1. Train the data staff to be able to do this type of work and/or contract for services.
2. CTC will review the policies, procedures, and practices surrounding Email Administration.
3. CTC creates a new Email Admin Requirements Definition document.
4. Conduct a Technical Options Study on the feasibility and opportunities of automating any and all Email Admin requirements and activities.
5. Report findings to the CTC for further action.
6. CTC recommends to senior management the creation of a project to implement the Email Admin Requirements Definition.
7. CTC selects a project manager who creates a project team, project plan and schedule, quality plan, and product selection criteria.

Transition Plan 6 – STUDENT LOGINS:

1. Train the data staff to be able to do this type of work and/or contract for services.
2. CTC will review the policies, procedures, and practices surrounding Student Logins.
3. CTC creates a new Student Logins Requirements Definition document.
4. Conduct a Technical Options Study on the feasibility and opportunities of automating any and all Student Login requirements and activities.
5. Report findings to the CTC for further action.
6. CTC recommends to senior management the creation of a project to implement the Student Logins Requirements Definition.
7. CTC selects a project manager who creates a project team, project plan and schedule, quality plan, and product selection criteria.

Transition Plan 7 – IT SKILLS TRAINING:

1. CTC identifies the new or enhanced skills needed to implement the EA.
2. CTC reviews the current skills matrix against the new skills.

3. CTC tasks each organization to create individual training plans for the acquisition of these new skills.
4. CTC creates a master IT Skills Training Plan.
5. CTC recommends to senior management that training funds be provided in accordance with the master IT Skills Training Plan.
6. CTC administers and monitors each organization's compliance with the master IT Skills Training Plan.

Transition Plan 8 – RECORDS MANAGEMENT:

1. Train the data staff to be able to do this type of work and/or contract for services.
2. Identify all paper forms currently in use.
3. Identify all other documents received and stored.
4. Determine which paper forms could be replaced with an online data entry form within SUNGARD.
5. Report findings to the CTC for further action.
6. Establish a project to permanently replace these paper forms with online data entry forms.
7. Determine which documents must be stored in their original paper form for legal reasons.
8. Establish a project to design and build an electronic documents storing solution that will allow paper documents to be scanned into electronic format and stored on a computer.
9. Establish cataloging and storage requirements and procedures for those documents which are not allowed to be stored electronically.
10. Scan and store all documents.
11. Destroy all paper documents that are not legally required to be kept.

APPENDIX I: MIS IT INVENTORY

Below is the current hardware inventory baseline since the spring of 2011.

MIS Technology Inventory Summary						
ROOM	COMPUTER COUNT	TYPE	ESTIMATED COST TO REPLACE OVERDUE/DUE WITH LAPTOPS	ESTIMATED COST TO REPLACE OVERDUE/DUE WITH DESKTOPS	ESTIMATED COST TO REPLACE OVERDUE/DUE WITH SAME	ESTIMATED VALUE OF TECHNOLOGY
101	3	Desktop				3,750.00
104	15	Laptop	27,750.00	18,750.00	27,750.00	27,750.00
104	4	Desktop	7,400.00	5,000.00	5,000.00	5,000.00
108	15	Desktop				18,750.00
202	4	Laptop				7,400.00
202	1	Desktop				1,250.00
203	1	Desktop				1,250.00
204	20	Desktop				25,000.00
205	5	Desktop				6,250.00
205	2	Desktop				2,500.00
206	7	Desktop				8,750.00
206	4	Laptop				7,400.00
206	1	Laptop				1,850.00
206	1	Desktop				1,250.00
206	1	Desktop				1,250.00
206	1	Desktop				1,250.00
206	1	Laptop				1,850.00
206	1	Desktop				1,250.00
206	1	Laptop				1,850.00
206	1	Desktop				1,250.00
207	3	Desktop				3,750.00
301	1	Laptop				1,850.00
303	6	Desktop				7,500.00
303	1	Laptop				1,850.00
303	2	Desktop				2,500.00
304	6	Desktop				7,500.00
501	12	Desktop	22,200.00	15,000.00	15,000.00	15,000.00
503	1	Laptop				1,850.00
601	1	Desktop				1,250.00
605	20	Laptop	37,000.00	25,000.00	37,000.00	37,000.00
605	4	Mac				7,400.00
601	1	Laptop				1,850.00
901	4	Desktop				5,000.00
TC1113	1	Desktop				1,250.00
TC1114	1	Desktop				1,250.00
TC1206	1	Desktop				1,250.00
TC1206	1	Laptop				1,850.00
TC1207	1	Desktop				1,250.00
TC1212	1	Desktop				1,250.00

TC1213	1	Desktop				1,250.00
TC1214	1	Desktop				1,250.00
TC1215	1	Desktop				1,250.00
Adm2102	2	Desktop				2,500.00
Adm2104	1	Desktop				1,250.00
Adm2105	2	Desktop				2,500.00
Adm2107	2	Desktop				2,500.00
Adm2109	1	All in one				1,850.00
Adm2112	2	Desktop				2,500.00
Adm2113	2	Desktop				2,500.00
Adm2114	1	All in one				1,850.00
Adm2114	1	Desktop				1,250.00
Adm2117	1	All in one				1,850.00
Adm2119	1	All in one				1,850.00
Adm2122	2	Desktop				2,500.00
Adm2123	1	Desktop				1,250.00
Adm2123	1	Laptop				1,850.00
Adm2124	2	Desktop				2,500.00
Adm2125	1	Desktop				1,250.00
Adm2126	1	Desktop				1,250.00
Adm2127	1	Desktop				1,250.00
Adm2128	2	Desktop				2,500.00
Adm2129	2	Desktop				2,500.00
Adm2132	1	Desktop				1,250.00
Adm2132	2	Desktop				2,500.00
Adm2133	1	Desktop				1,250.00
Adm2134	1	Desktop				1,250.00
Adm2135	1	All in one				1,850.00
Adm2135	1	Laptop				1,850.00
Adm2136	2	Desktop				2,500.00
Adm2137	1	Desktop				1,250.00
Adm2138	1	Desktop				1,250.00
Adm2139	1	Desktop				1,250.00
Adm2204	1	Desktop				1,250.00
Adm2204	1	Laptop				1,850.00
Adm2205	1	Desktop				1,250.00
Adm2207	2	Desktop				2,500.00
Adm2209	2	Desktop				2,500.00
Adm2212	1	All in one				1,850.00
Adm2213	1	Desktop				1,250.00
Adm2215	1	Desktop				1,250.00
Adm2217	1	All in one				1,850.00
Adm2218	1	All in one				1,850.00
Adm2219	1	Desktop				1,250.00
Adm2219	1	Desktop				1,250.00
Adm2222	2	Desktop				2,500.00
Adm2223	1	Desktop				1,250.00
Adm2225	1	Desktop				1,250.00
Adm2226	1	Desktop				1,250.00
Adm2227	1	Laptop				1,850.00
Adm2227	2	Desktop				2,500.00
Adm2228	2	Desktop				2,500.00

Adm2228	1	Laptop				1,850.00
Adm2228	1	Laptop				1,850.00
Adm2232	1	Desktop				1,250.00
Adm2233	1	Desktop				1,250.00
Adm2234	2	Desktop				2,500.00
Adm2234	1	Laptop				1,850.00
Adm2235	1	Laptop				1,850.00
Adm2235	1	Laptop				1,850.00
Adm2236	1	Desktop				1,250.00
Adm2236	1	Laptop				1,850.00
Adm2236	1	Desktop				1,250.00
Adm2237	1	Desktop				1,250.00
Adm2238	1	Desktop				1,250.00
Allied3114	40	Desktop				50,000.00
Allied3116	6	Desktop	11,100.00	7,500.00	7,500.00	7,500.00
Allied3117	5	Desktop	9,250.00	6,250.00	6,250.00	6,250.00
Allied3123	1	Desktop				1,250.00
Allied3124	1	Desktop				1,250.00
Allied3125	2	Laptop				3,700.00
Allied3125	1	Desktop				1,250.00
Allied3130	1	Desktop				1,250.00
Allied3205	2	Desktop	3,700.00	2,500.00	2,500.00	2,500.00
Allied3205	6	Desktop	11,100.00	7,500.00	7,500.00	7,500.00
Allied3210	1	Desktop				1,250.00
Allied3220	4	Desktop				5,000.00
Allied3220	2	Desktop				2,500.00
Allied3223	2	Desktop				2,500.00
Allied3229	2	Desktop				2,500.00
Allied3229	1	Desktop				1,250.00
A-10	1	Mac				1,850.00
A-10	7	Desktop				8,750.00
A-10	2	Laptop				3,700.00
A-26	31	Desktop	57,350.00	38,750.00	38,750.00	38,750.00
A-27	31	Desktop	57,350.00	38,750.00	38,750.00	38,750.00
A-7	32	Desktop	59,200.00	40,000.00	40,000.00	40,000.00
A-8	8	Desktop	14,800.00	10,000.00	10,000.00	10,000.00
A-8	15	Laptop				27,750.00
A-9	5	Desktop				6,250.00
A-9	10	Laptop	18,500.00	12,500.00	18,500.00	18,500.00
A-9	5	Desktop				6,250.00
Allied Health	14	Desktop				17,500.00
Allied Health	41	Desktop				51,250.00
B- Building	1	Laptop				1,850.00
B- Building	4	Desktop				5,000.00
B- Building	2	Desktop				2,500.00
C1	21	Laptop	38,850.00	26,250.00	38,850.00	38,850.00
C23	25	Laptop				46,250.00
C25	21	Desktop				26,250.00
C3	4	Laptop				7,400.00
C3	6	Desktop				7,500.00
Compass	15	Laptop				27,750.00
D-10	21	Desktop	38,850.00	26,250.00	26,250.00	26,250.00

D-2	21	Desktop	38,850.00	26,250.00	26,250.00	26,250.00
D-3	21	Desktop	38,850.00	26,250.00	26,250.00	26,250.00
D-4	20	Desktop	37,000.00	25,000.00	25,000.00	25,000.00
D-5	24	Desktop	44,400.00	30,000.00	30,000.00	30,000.00
D-7	20	Desktop	37,000.00	25,000.00	25,000.00	25,000.00
D-8	21	Desktop	38,850.00	26,250.00	26,250.00	26,250.00
D-8B	4	Desktop				5,000.00
D-9	21	Desktop	38,850.00	26,250.00	26,250.00	26,250.00
Electronic	7	Laptop				12,950.00
F-2	6	Imac				11,100.00
F-2	4	G4 mac				7,400.00
301	11	Desktop	20,350.00	13,750.00	13,750.00	13,750.00
Library	7	Desktop				8,750.00
Library	1	Imac				1,850.00
New LRC	20	Desktop				25,000.00
New LRC	12	Laptop				22,200.00
New LRC	9	Desktop				11,250.00
New LRC	10	Mac				18,500.00
MIS	25	From Library				46,250.00
TC1102	1	G4 mac				1,850.00
TC1103	1	Desktop				1,250.00
TC1106	21	Desktop				26,250.00
TC1106A	18	Desktop	33,300.00	22,500.00	22,500.00	22,500.00
TC1108	21	Intel Imac	38,850.00	26,250.00	38,850.00	38,850.00
TC1109	13	G5 MAC	24,050.00	16,250.00	24,050.00	24,050.00
TC1110	8	Desktop	14,800.00	10,000.00	10,000.00	10,000.00
TC1110	1	Desktop				1,250.00
TC1110	1	Laptop				1,850.00
TC1111	1	Desktop				1,250.00
TC1115	2	G4 mac				3,700.00
TC1215	1	All in one				1,850.00
TC1218	13	Desktop				16,250.00
TC1220	21	Desktop	38,850.00	26,250.00	26,250.00	26,250.00
TC1221	21	Desktop				26,250.00
TC1222	19	Intel Imac	35,150.00	23,750.00	35,150.00	35,150.00
	7	Desktop				8,750.00
TOURISM	1	Laptop				1,850.00
PROSTART	1	Laptop				1,850.00
MARKETING	1	Laptop				1,850.00
Electronic	1	Laptop				1,850.00
J102	7	Desktop				8,750.00
J103	5	Laptop				9,250.00
J104	23	Laptop				42,550.00
J112	20	Desktop	37,000.00	25,000.00	25,000.00	25,000.00
TOURISM	3	Laptop				5,550.00
PROSTART	1	Laptop				1,850.00
MARKETING	1	Desktop				1,250.00
Electronic	1	Desktop				1,250.00
301	10	Desktop				12,500.00
302	11	Laptop				20,350.00
311	15	Desktop				18,750.00
311	4	iMac Desktop				7,400.00

412	19	Desktop	35,150.00	23,750.00	23,750.00	23,750.00
MARKETING	1	Desktop				1,250.00
Allied Health	1	Laptop				1,850.00
Electronic	1	Laptop				1,850.00
TOURISM	4	Laptop				7,400.00
Student Center	36	Laptop				66,600.00
1206	13	Desktop				16,250.00
6117	23	Desktop	42,550.00	28,750.00	28,750.00	28,750.00
3111	16	Desktop				20,000.00
Tourism	1	Laptop				1,850.00
Electronics	1	Desktop				1,250.00
Marketing	1	Laptop				1,850.00
D109	14	Desktop				17,500.00
D107	19	Desktop	35,150.00	23,750.00	23,750.00	23,750.00
D115	11	Laptop				20,350.00
D115	4	iMac Desktop				7,400.00
C105E	6	Desktop				7,500.00
C106E	1	Desktop				1,250.00
				Total Value		**1,927,450.00**