

**Centre of Specialisation in Information and
Communication Technology in the OECS
Needs Assessment Report**

**Prepared for the Education and
Telecommunications Reform Units of the OECS**

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Table of Contents

	Page
Introduction	4
Executive summary	5
Needs assessment – scope and underlying assumptions	7
Methodology and approach to the assignment	8
Relevance of ICT to the OECS – an overview of the global and regional dynamic	9
• ICT – trends, evolution and impact	
• Emergence of ICT as a key economic sector in the OECS sub-region	
<i>ICT - the universal information enabler</i>	
<i>The information revolution and regional expectations of ICT</i>	
<i>Statistics supporting the economic emergence of ICT</i>	
<i>Examples of the contribution of ICT to sub-regional economies</i>	
ICT Skills Application	13
• Target employers and institutions	
• Major ICT skills categories	
Findings: ICT application areas	15
Findings: The ICT Labor Market	17
• A model of supply and demand in the OECS	
• ICT skills	
The ICT Centre of Specialisation	21
• Objectives and goals	
• Major functions of a Centre	
• Alternative models for a Centre of Specialisation for ICT	
• Features of a “technology-enabled” Centre of Specialisation for ICT	
• Framework and context of the Centre – relationships with stakeholders	
Implementation	28
• Consistency with <i>The Model ICT policy for the Education System</i>	
• Critical success factors	
<i>Legitimacy – meeting employer and private sector requirements</i>	
<i>Role of regional tertiary colleges</i>	
<i>Validation of the concept by the use of technology for operation of the Centre</i>	
<i>Maximising the use of scarce administrative, faculty and infrastructure resources</i>	

Addressing regional economic competitiveness and the needs of the labor market
Maintaining goals and objectives - flexibility and adaptability

Operational and functional requirements as guidelines to the design of a Center	32
• Governance and accountability • Administration and the management of student and financial affairs • Instruction delivery and assessment • Faculty responsibilities for program design and development • Program review, accreditation and articulation • Infrastructure – supporting physical and virtual facilities	
Conclusion	36

Introduction

The OECS Education Reform Unit is undertaking a comprehensive sub-regional project for development of tertiary education in its member countries: Antigua-Barbuda, Dominica, Grenada, Montserrat, St. Kitts-Nevis, Anguilla, St. Lucia, St. Vincent and the British Virgin Islands.

One component of the OERU project is the setting up of Centres *of Specialisation* for study, research and development relating to key industries or sectors in which the countries and colleges have a demonstrated comparative advantage. The primary sectors identified are marine studies, tourism/hospitality, information and communications technology` and agriculture.

The purpose of the project is “to increase levels of trained human resources in the OECS labour market in priority sectors of the economy.”

The BVI is being considered for the centre in Marine studies, St. Lucia for Information and Communications Technology (ICT), Dominica, St. Lucia, and Grenada for agriculture, and with a regional coordinating entity for Tourism.

The selection of one college as a Centre of Specialisation, or a combination of colleges for specialisation in specific dimensions of the industry for training, requires a thorough comparative assessment of the existing national and industry context within which the Centre will operate. The most important considerations pertain to:

1. The existing levels of investment in the industry;
2. National endowments;
3. Government policies and perspectives;
4. The operations of existing regional and national institutions;
5. Existing training and development programs;
6. Alternative approaches to development of the industry;
7. Human resource development requirements and priorities.

Executive Summary

A wide range of regional and national studies and reports have addressed the subject of ICT and its sectoral and educational relevance to the economies of the OECS. The intention of this project, therefore, is to review and summarize the major findings of these studies, and to examine important emerging national and institutional issues from the perspective of a sub-regional Centre of Specialisation for ICT. Accordingly a series of field visits were planned and undertaken. Again, the intention was to examine the perspectives of those entities that are stakeholders in the Center. These stakeholders are the institutions responsible for the development of ICT skills and for employing skilled ICT resources.

The approach was to develop a model of the 'Supply and Demand' for ICT skills, which was relevant to the sub-region. The model served to represent the key factors shaping the growth and direction of ICT within a competitive economic context, as well as the framework for policies, which could guide the development of a viable ICT Centre of Specialisation.

The Education Reform Unit (OERU) of the OECS has proposed the implementation of the Centre within the context of several broader and foundational reform initiatives. Reform of the primary and secondary levels is expected to provide the basis for an academic and vocational body of educated resources who meet the needs of a competitive and productive regional economy. Within the wider region, a rationalisation of institutional resources involving accreditation of educational programs of all types is in process. Greater flexibility and choices for students has led to the articulation of programs between institutions. In response to competition from extra-regional institutions, a wider variety of programs, instructional delivery modes and content are being offered. Regional institutions have established effective partnerships with foreign institutions. Finally new models are being employed for the financing and resourcing of education in the region.

The Centre of Specialisation for ICT was therefore positioned as a tertiary level institution closely partnered with national community colleges. It would broker the ICT skills requirements of the key productive employers in the region against the program offerings of regional tertiary public and private sector training institutions. At the same time, with the recognition of severe regional infrastructure and human resource deficiencies, the imperative was for a Centre that was highly efficient and cost effective. One that was flexible and responsive to the requirements of wider reform initiatives, and skills development trends. One that could be easily and quickly established and could immediately make significant and recognized contributions to the development of ICT skill in the OECS region.

Faced with this challenge, and with very limited research resources, it was decided by the Task Force that selective interviews with key contacts at some of the national stakeholder institutions would yield the most effective results. The approach adopted was to be highly selective in the choice of employers, institutions, government ministries and private sector stakeholders to interview. Emphasis would be placed on the design of interview guides with sufficient breadth and depth for various target groups. To a large extent, the emphasis of research would vary depending on the judgement of the interviewer (based on the interviewer's experience). The prior experience of the interviewer within and outside the region, as well as a broad understanding of ICT and organizational issues in a wide range of public and private

sector institutions was deemed to be an asset. The interviewer had experience with the design of educational programs and the delivery of instructional content using state-of-art technologies. The interviewer also had recourse to specific resources for the design of the interview guides, as well as guidance in the strategy for conducting information-gathering interviews.

The result of the field visits, interviews and documented research confirmed many of the prior expected findings by the Task Force: The findings of the needs assessment which are detailed more fully in a later section applied to two broad groups:

1. Specific issues relating to ICT skills and resource deficits
2. Generally adopted organizational prescriptions for remedy of ICT-related concerns.

In the former, some of the more significant findings could be summarized as follows:

- The lack of high-end ICT skills presents a significant barrier to the adoption of new applications of ICT
- The implementation of anticipated new ICT applications by both public and private sector institutions, will require significantly increased application of ICT skills
- There is a high degree of mobility within the economy, as well as leakage of trained ICT resources to foreign labor markets, driven primarily by economic opportunity
- Private training providers as well as Internet and distance-based learning have emerged as complementary to, and in some cases competitors of, traditional educational institutions.
- Future trends toward cheaper, more functional and easier-to-use technology could contribute to overcoming some areas of ICT skills shortage.

In the latter category, key findings were:

- ICT skills shortages are a major constraint, and hence employers adapt by limiting ICT initiatives to match available skills.
- Within most institutions, ICT personnel tend to be fully utilized.
- Several opportunities exist for the allocation and acquisition of new ICT skills, including:
 - Hiring of additional staff
 - Staff training and retraining to increase skill levels
 - Procurement of the services of temporary staff and contracting with service providers
- Emerging competitive business processes will require employer institutions to adopt by using a combination of these approaches and to undergo significant organizational restructuring to bring about the full potential advantage of associated ICT technologies.

The study concludes with a description of the critical success factors and guidelines that inform the design and implementation of the Centre. The Centre is unique in its ability to fully utilize ICT for its own operation, thus an implementation framework is offered as a guide to the possible design and operation of the Centre. In this way strategic and operational goals may be met.

Needs assessment – scope and underlying assumptions

The OECS / World Bank Telecommunications Reform Project includes a component for “Informatics Training”. The Telecommunications Reform Unit has suspended activity on this component, and is considering recommending to the Bank that these funds be used elsewhere. The Telecommunications Reform Unit together with the Education Reform Unit are jointly supporting and funding this study - Needs Assessment Consultation for the Centre of Specialisation in ICT (COS-ICT).

The Task Force committee is responsible for decisions affecting the scope and direction of the COS-ICT.

There is agreement that findings of the needs assessment should include:

- Findings and situational analyses of the Informatics component of the Telecommunications Reform Unit.
- Reviews of relevant and recent studies and reports by the OECS
- Ongoing reports and recommendations produced for and by national entities (e.g. Dominica’s NDC – Situation Analysis, and St. Vincent Ministry of Planning study on ICT by UNECLAC)
- National Situation Analyses. A recent decision was made by representatives of NDC’s, and national Ministries of Education, Planning, Works & Communications and Finance to undertake such analyses for submission to the OECS.

The findings of this needs assessment therefore provides only one source of several that the Task Force on COS-ICT will use to inform its proposal for an ICT Centre of Specialisation.

Methodology and approach to the assignment

In light of the foregoing situation, and the limited resources for researching the required fundamental aspects of the ICT sector in the region; the following strategy for information collection has been adopted:

- The more rigorous techniques (i.e. Direct Observation, questionnaires, focus groups, tests and work samples) have been foregone
- Instead, anecdotal approaches such as consultations with key personnel, interviews and reviews of relevant literature have been used.
- At the outset, a broad range of institutions representing several dimensions of the regional economy was contemplated as interview targets. These included:
 - Regional and national public and private sector institutions
 - Developmental, strategic, and tactical agencies
 - Private sector organizations, both umbrella and national
 - Employers from a wide range of the productive sectors in the region

However time constraints have made it necessary to abbreviate the breadth of these interviews.

In addition provision had been made to cross-reference and validate information from certain sources with other complimentary and objective sources.

To a great extent, this approach has had to be altered in the interest of expediency.

Labor market data and other objective statistics have not been accessible. It has also been difficult to obtain market data from private entities relating to volumes and trends of hardware, software and service usage.

Relevance of ICT to the OECS – an overview of the global and regional dynamic

The *Centre of Specialisation* in ICT will be developed and implemented in relation to existing realities of the ICT sectors of the individual countries. As with most developing regions of the world, the OECS has embraced the promise of information and communication technology as a way forward for advancing their societies by ‘leap-frogging’ the evolutionary burden and costs of developing these technologies. The recent advances of ICT promise the ability to compete in markets now dominated by advanced countries without the need for large capital or infrastructure investment. The one requirement however is the investment in human resource development to make this possible. How can the emerging economies create and maintain this pool of skills in the face of constantly changing technology, and the ravages of the brain-drain? How do their societies begin to incorporate the entire range of infrastructure upon which economically productive sectoral improvements can be made. Above all, how can the wide range of technology know-how; the strategic, the tactical and the operational, become part of the fabric of the major productive sectors? The following provides the brief treatment of various aspects of this challenge.

ICT – trends, evolution and impact

ICT was originally adopted in the Caribbean as a tool for data processing and for streamlining cumbersome manual processes in larger government and private sector institutions. With rapid ICT developments in the 70’s came better price / performance, and wider adoption of new systems for office applications. The PC revolution in the 80’s heralded the almost ubiquitous use of computers by small enterprises, departments and individuals. More recently, with the advent of the Internet and an even cheaper and wider range of applications, ICT now makes universal access to information and better decision-making possible for the entire society. As services become ever increasingly important to the earnings of OECS economies, and as the ‘information component’ of manufactured goods begins to represent a significant part of their ‘added value’, so has come the realisation of the foundational importance of ICT. The importance of ICT will continue to grow as these shifts in economic production takes place, and as traditional ways of information sharing are replaced by more technology-intensive ways. The price to be paid for this technology advance is a society that fully embraces a technology ethic and which has the capability of maintaining the required level of high-tech skills

Emergence of ICT as a key economic sector in the OECS sub-region

In all OECS nations, the traditional mainstay industries of the mid-century have declined. The Sugar cane, banana, citrus fruit, and cotton industries have all but disappeared. The fishery, forestry and mining industries based on traditional modes of production have similarly suffered. In their place the hospitality industry and financial service sectors have emerged. The manufacturing and processing industries have fallen victim to foreign economies with more competitive production sectors. At the same time the pressure of competition on surviving industries requires them to improve their productive efficiency and to exploit new markets by the use of new methods of advertising and new models for their supply chains. Underlying all of these changes is the need for the greater application of ICT. The example

set by advanced economies and some of the emerging economies is that ICT is not only an enabling capability, but can also be revenue-producing. The result of these trends is the recognition of ICT in the OECS region as an economic productive sector in its own right. As such there is increasing attention to its economic contribution and its costs as well as to its positive and negative impact on society.

ICT – the universal information enabler

The basic building blocks of the information revolution are the hardware and the software of the general purpose microcomputer: the processors, integrated circuits, memory chips and the programs which produce the intelligence and functionality for an ever increasing range of consumer products. Year after year, the speed, power and capability of these devices increases exponentially. And increasingly, more and more of the knowledge bases of societies and the functional processes of their public and private sector institutions become dependant on these computing technologies. There are no alternatives to the use of these technologies. Without their use societies would cease to function. Likewise, with better application of these technologies, societies have the potential to become more productive. The so-called ‘digital-divide’ separates societies and groups within societies that effectively adopt these technologies from those that do not.

The information revolution and regional expectations of ICT

As ICT has become all pervasive, as processors become integral parts of all the new “intelligent” applications in the modern world, and as institutions and societies transform themselves into information-based entities; the opportunities for revenue-generation, cost-reduction and the production of services based specifically on ICT have become apparent. ICT is making government institutions better able to serve society at lower cost. The private sector is becoming more efficient and more competitive. Small and medium enterprises are able to exploit ICT to penetrate export markets and generate sustainable foreign earnings. The public is able to engage ICT to become part of the “Global Knowledge Community”. ICT is no longer just an enabling mechanism, but an engine of growth and development in the Caribbean.

The ICT Sector is poised for even more rapid expansion in the Caribbean than it has enjoyed in the last decade. In some Caribbean countries (such as Barbados, Jamaica and less so Trinidad), governments recognize ICT development as the dominant strategy of transforming their societies into information and knowledge based economies. Increased employment and external revenues are anticipated from these changes. All Caribbean Governments are placing increasing emphasis on the development of soft and hard infrastructure for ICT growth, and strengthening their development to increase the market share of other productive sectors such as tourism, financial services, trade and commerce, manufacturing and agriculture. Today even the smaller countries recognize the strategic benefit of a supportive ICT infrastructure.

Statistics supporting the economic emergence of ICT

Regrettably, no national or regional statistics exist to support these commonly recognized trends. In the absence of such data, inferences must be made regarding the extent and rate of adoption of ICT in the region. The following are strong indicators of the ICT sector:

- Telephone lines per thousand population
- Access to PC's per thousand population
- e-mail accounts per thousand
- Internet connect hours
- Electronic files in circulation.

The following Table shows, based on available data, the percentage sectoral contribution to GDP in OECS countries: (\$M per annum).

Country	Agri	Tour	Mfg	Const	Mining	Pet	Com	Govt
Antigua	5.5	17.0	4.0	10.0	0.0	0.0	11.0	16.0
Barbados	9.0	12.5	10.5		0.0	2.0	19.0	14.0
Dominica	30.0	--	10.0	5.0	3.0	0.0	11.0	23.0
Grenada	17.0	6.5	6.2	7.5	0.0	0.0	16.5	28.0
St.Lucia	15.0	12.0	8.5	7.0	0.0	0.0	16.0	22.0
St. Kitts	5.0	6.0	5.0	7.0	0.0	0.0	15.0	10.0
St. Vincent	20.0	--	8.0	11.0	0.0	0.0	12.5	19.0

In all of the foregoing productive sectors, it would be safe to assume that without ICT as a key enabler, such economic activity would be impossible. Furthermore, as global changes challenge many key sectors such as agriculture and manufacturing, it is apparent that without the continued and increased establishment of ICT infrastructures, such levels will quickly diminish.

In order to fulfil its promise, ICT must contribute to sustaining and enhancing all traditional productive sectors of the economy, and emerge as a new productive sector in its own right

Furthermore, it must generate efficiencies in all areas of society, including:

- Streamlined and effective public sector institutions that service civil societies better
- Sustainable and productive private sector institutions
- Civilians who can make better informed decisions for their individual and collective benefit

Examples of the contribution of ICT to sub-regional economies

A few examples of new applications of ICT will serve to highlight significant and structural applications of this technology in several public and private sector institutions. While some applications are only in the 'pilot' stage, their adoption serves to indicate the extent of the commitment within the region to making new and effective use of ICT.

Customs document clearing system: Funded by the UN through the WTO, this system being implemented across the Caribbean will facilitate access to and processing of customs transactions for brokers, shippers and handlers by the establishment of a central document repository. Ultimately the savings resulting from faster, cheaper and more efficient handling will result in lower product costs.

Hospitality Industry Tour Booking Systems: A significant global trend to centralised tour booking is through on-line systems, one example of which is AMADEUS. This will have profound effects on the profitability of larger hotels in the region that cater to foreign clients. These systems support the emerging 'customer-driven' model of hospitality marketing.

TRADECOMPASS An internationally accepted import / export transaction clearing system.

PINNACLE A system used to facilitate off-shore company registration (St. Lucia).

EDUTECH / 2000 & EDTECH / 2000 are both examples of heavy ICT investment by the governments of Barbados and Jamaica to transform their education systems and to provide universal access to computer facilities to all students

ICT skills application

Target employers and institutions

For the purpose of this study, the ICT application areas considered include:

- Personal Computer systems both standalone and networked
- Server-based systems for support of networked clients as well as enterprise applications
- Host systems for large-volume data-processing
- Systems supporting inter-networking and Internet applications

Specifically excluded were computer-based and application-specific systems for:

- Specialized scientific, monitoring and industrial and plant application
- Specialized communication and network control / management systems
- Special communications, telephony and broadcast systems
- Local and wide area networking devices (router, hubs, bridges, etc)

The criterion used for determining the applicability of systems was that such systems should be used for the creation, access, storage or distribution of information in support of organizational business decision-making and in the conduct of operational and administrative functions.

While this would normally have excluded entities such as manufacturing, repair, assembly, public utility plants, laboratories, scientific and research operations, etc. Nevertheless it is apparent that even in such operations, systems that would normally be excluded; are becoming integrated into their business and operational decision-making, and as such involve and require broader ICT skills for their use. This trend is expected to accelerate as both technology and business re-structuring lead to the integration of ICT into more and more business processes.

In this study, institutions and business operations were also only considered if they employed staff with ICT skills, or required ICT skills for the implementation and support of their systems.

Furthermore, since the focus of the *Centre of Specialisation* was the productive sectors of the economy where competitive advantages apply. The primary targets of the needs assessment included the following types of institutions that are major employers of ICT skills:

- Public sector and administrative institutions
- Public service institutions (schools, hospitals, judiciary, licensing, transportation, etc.)
- The hospitality industry (including accommodation, restaurant, travel, tour and event operators)
- The agricultural, maritime and resource sectors
- The financial services sector (banking, insurance, investment, etc.)
- Construction and real estate
- Manufacturing, processing, retail and distribution
- Providers - manufacturers, producers, distributors and vendors of ICT products and services
- ICT service providers (Internet, application development, consulting and valued-added resellers)

- Associations and organizations involved in regional, national and sectoral planning with regard to ICT (e.g. National Development and Industrial Development entities, manufacturers and professional associations, chambers of commerce, etc.).
- National and regional aid and lending agencies

Major ICT skills categories

Within the foregoing target areas, the following organizational levels were investigated along with their associated ICT skills:

1. Strategic management, supervisory and project management
 - System design
 - Project management
 - Hardware and software evaluation and acquisition
 - IT training
2. Telephony and data systems and network operations
 - Operating system programming
 - Electronic Mail and Internet support
 - Network administration, cabling plant management and communications
 - Database management
 - Telephone switch management and administration
3. Application developmental
 - Systems analysis
 - Application programming
 - Web site programming
 - System documentation
 - Application testing
4. Technical Support and maintenance
 - end user support
 - call centre and helpdesk
5. Data entry/ data processing
 - Keyboarding skills
 - Records and file management
6. Administrative support
 - Office management
 - Clerical support

Findings: ICT application areas

ICT is evolving at a rapid pace. It is therefore not easy to forecast future developments. Below are some of the trends that are becoming apparent both worldwide and in the OECS:

- ◆ **Internet –based Technologies** (Internet, Intranets and Extranets). These technologies (based on the flexible and adaptable TCP/IP protocol) have become the main network for both messaging, and application interfaces. All major vendors now offer Internet variants of their products. This trend applies to a wide range of data, voice and multimedia products. Within the next few years, the following changes will have taken place worldwide:
 - The convergence of data, voice and video over TCP/IP
 - All major classifications of application software accessible via browsers
 - Data linkages within these applications that can interact with a variety of common data and database structures without the need for custom-programmed interfaces. At the forefront of this trend are CORBA and XML; with XML most likely emerging as the primary web-based programming format.
 - Internet appliances in the form of firmware-based Television, wireless / handheld and network-ready “thin client” PC’s. The common feature of these devices will be their user interface which can be used without the need for any prior ICT skills training
- ◆ **Network-centered computing:** In this model, operating systems, applications and data will be hosted exclusively on network servers. Client PC’s will evolve to cheaper and low-maintenance “thin client”. Changes in wireline and wireless bandwidth economics will determine the rate of evolution of this trend.
- ◆ **Electronic Commerce** is being used increasingly by organizations and consumers for commercial activities. Business to Business (B2B), and Business to Customer (B2C) are technologies, which will enable the restructuring of business to exploit the Internet. Enabling infrastructures include communications bandwidth, secure transaction environments (such as Internet “Virtual Private Networks”), and commercial merchant banking facilities for credit verification.
- ◆ **Application Service Provisioning** Large-scale integrated applications which handle multiple business functions and integrate these functions to facilitate decision-making, are too expensive for adoption by individual enterprises. However there is the potential for such systems to be hosted by commercial providers, or centralized agencies for use in the public sector.
- ◆ **Digital Libraries** Rapidly falling costs for storage will usher in the capability to retain all institutional records, correspondence, video and audio transcripts, telephony messages and paper-

based documents as well as all electronically generated documents in accessible electronic form. New intelligent application interfaces will then enable these digital archives to be accessed from all common applications such as word processors and browsers.

- ◆ **Knowledge Management:** these technologies will facilitate the access and reuse of valuable institutional knowledge resources and corporate “memories”.
- ◆ **Component-based Software Development (CBD):** these technologies use and re-use tested software components to eliminate the redesign and redevelopment of the same software features repeatedly; thus enabling efficiencies in application program development.
- ◆ **Multimedia** will be used increasingly in the broadcast industry, event marketing, music and cultural product advertising, education, and tourism attraction promotion. These capabilities will be used to enhance existing applications and to deliver a more compelling “presence” via the Internet.
- ◆ **Network Security and Quality of Service** This strengthening of security and the delivery of selective quality on existing networks will become necessary for new converged applications and for a viable “E-Commerce” environment
- ◆ **ICT Hosting and “Out-sourcing”.** Within the ICT sector in the Europe and North America, this trend is already well underway. Individual enterprises are now routinely provisioning network services, software development and maintenance and distributed services from external providers. This allows them to concentrate on their areas of core competence such as business/IT alignment, IT strategic planning, IT architecture, standards, projects and customer relationship management.

These are just some of the major predictions for the coming years. It is apparent that some of these trends such as network computing and component-based software will directly contribute to the reduction of support and development responsibilities within IT departments, and therefore result in a reduced demand for the associated skills. However, this will be offset to a small extent, by the need for these skills at by hosting services and providers.

Many of these trends will occur in the OECS region. No doubt trends that contribute to reduced cost, complexity and a smaller demand for high-end skills will be embraced readily, especially where enabling environments are provided by way of government incentives or legislation and regulatory reform.

Findings: The ICT Labor Market

A Model of Supply and Demand in the OECS

It is necessary to explore some of the major dynamics in the ICT skills labor market in the OECS before any rational predictions can be made with regard to future skills needs.

The basis of this discussion is a conceptual “supply-demand” model as applied to labor market economics.

Presently, the major providers of ICT skills are represented by tertiary educational institutions, while the major consumers are private and public sector employers. This model holds true as long as there is no major restructuring of the market by government intervention (e.g. Incentives, labor mobility legislation, etc.) Within the OECS region, however several such interventions are contemplated. These, together with significant shifts in skills costs caused by technology changes (e.g. Service provisioning, hosting, network computing, etc.) will significantly change the future skills market for ICT.

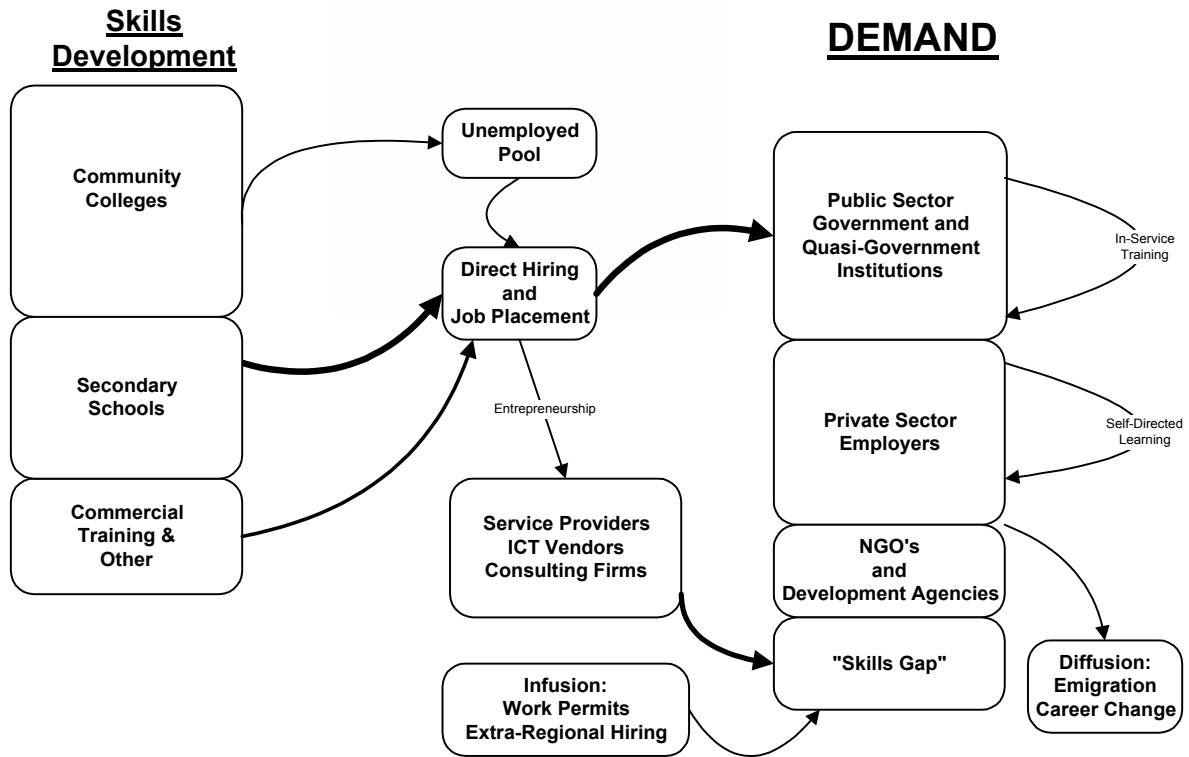
These elements are depicted in the ICT Labor Market model diagram (see following page).

Governed by these overall trends, specific and significant changes will occur in the OECS with regard to ICT skills. These include:

- Increased skills supply from private training institutions and self-directed modes of training
- Significant losses of high-end ICT skills to foreign markets
- Rapid emergence of private service providers and hosting services. These providers will be forced to acquire their scarce high-end skills from external markets.
- The need for more managerial, problem solving, analytical and critical business skills to support the trend to streamlined IT departments.
- Reduced demand for low-end ICT skills such as keyboarding, application and support skills as technologies become more user-friendly.
- Evolution of programming away from low level to high level languages (XML, Java and HTML) together with a need for database and multimedia technology skills.
- Strategic design and planning skills as institutions restructure around the knowledge-based enterprise model.

Labor Market Model

Human Resource Development of Information and Communication Technology skills in the
OECS Region



Prepared : Sept 10, 2000

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ICT Skills Needs

Some of the key IT skills that will be required for these new trends are indicated below

IT Trends	Skills Required
Internet-based Technologies	Website Development
	Programming in XML, JAVA and HTML
	Managing Internets, Intranets, Extranets
	TCP/IP
	Networking
	Data Communications
	Integration skills (interfacing client/server and Web platforms)
Electronic Commerce	Electronic Data Interchange Skills
	Systems Administration
	Database Administration
	Software Engineers
	Network design and implementation (VPN's, Proxy servers, firewalls and routers)
	Networking and TCP/IP Skills
	Network Security in the area of encryption, authentication and authorization
	Systems Integration
	Website Development
Network-centered computing	Server design and configuration
	Mass Storage and Storage Area Networks
	High speed LAN's and Fibre connect
	Network Management
	Client directory and application administration
Application service provisioning	Business Applications
	Software Evaluation
	Programming for customize applications
	Data Warehousing
	Systems Implementation
	IT Training
	End-User Support
	Application Testing
	Database Design and Management
Network Security	Programming skills in encryption, firewalls, verification and authorization
	Networking

Multimedia	Software Design experienced in multimedia applications: digital video, 2D and 3D graphics, 2D and 3D animation and digitized audio
	Internet streaming Multimedia technology
Digital Libraries	Systems design
	Programming in HTML and JAVA
	Project Management
	Experience with Scanning Technology
ICT Hosting and Out-sourcing	Project Management
	Database Management
	Data Warehousing
	Programming for customize applications
Knowledge Management	Database Management
	Data Warehousing
	Intranet
	Programming in XML, HTML and JAVA
	People skills

The ICT Centre of Specialisation

Objectives and Goals

The objective of The Centre of Specialisation is to:

- Conserve and maximize the use of limited regional resources and minimize duplication of effort;
- Use the comparative advantage of member countries o facilitate the development of particular economic sectors;
- Develop the internal capacity of that country to serve the training and development needs of the region;
- Establish a model of regional cooperative education at the tertiary level.

The goal of the Centre is to increase levels of trained human resources in the OECS in the field of Information and Communications Technology (ICT).

With the wide range of training and educational facilities and programs already available to the region, it is neither feasible nor necessary for the Centre to attempt to provide all the training required for ICT skill development.

The national colleges and other individual countries have already made significant strides in establishing extensive ICT training programs and in setting up the requisite infrastructure, This lends weight to the option of different colleges within the region “specializing in a particular aspect of the discipline and excelling in that aspect for regional training.”. Meeting this challenge will be critical to the success of this project, particularly as applying that option might seem to diminish the rationale for the overall concept of a *Centre of Specialisation*.

Major Functions of a Centre

In association with regional training institutions, the main function of a *Centre of Specialisation* will be ICT skills development within the wider context of human resource development. This will include coordination, of the ICT-related programs of the community colleges. Such a *Centre* should, however, also serve the purpose of:

- Evaluating and monitoring ICT growth and strategies
- Promoting and facilitating ICT related research
- Assisting in coordinating the services of public and private sector institutions associated with the adoption and adaptation of ICT within the region
- Promoting ICT as a productive economic sector in its own right
- Fostering a broad societal awareness of the importance and impact of ICT
- Demonstrating appropriate applications of information and communication technologies
- Providing consulting services to industry and governments
- Hosting international ICT workshops and conferences

Alternative models for a Centre of Specialisation for ICT

The regional environment allows for three alternative models for a Centre of Specialisation for ICT. The models are characterized by their differences in structure and operation.

Model A: Centrally located conventional centre

In this model, the Centre would resemble a traditional college. It would consist of a physical campus. Its location would be determined by the criteria as specified in the *Guidelines for Centres of Specialisation*. Such a model would require all the conventional resourcing for its infrastructure, faculty and administration. As a conventional institution, it would offer a conventional mode of instruction to its students. Students would therefore (for the most part) be required to come to the institution to receive traditional classroom instruction. Similarly the faculty would be resident at the Centre's location to offer instruction, and to collaborate on the development of instructional programs. In addition, all the supporting facilities, (resource centres, equipment, support staff, etc.) would reside at one central location. The establishment of such a Centre would require immense capital, human and time resources. An equally significant outlay of capital and human resources would be needed to sustain such an institution. The most significant limitations of this model is its inability to meet fundamental needs for appropriate delivery of ICT skills training in the region. These limitations include:

- cost and logistic constraints preventing full regional access by students
- inability to respond quickly to emerging ICT skills
- structural constraints to rapid modification of programs and delivery modes

The more significant benefits of such a centralised model are its:

- significant institutional identity as a Centre for ICT
- ability to offer a strong institutional learning experience to graduates of the Centre
- significant addition to the region's inventory of training institutions

Model B: Decentralised conventional centre

In this model, many of the limitations of the central model can be avoided by decentralising the infrastructure and administrative and instructional functions of the Centre. The end result and purpose of a Centre is met except for the formidable co-ordination and harmonization issues which decentralisation raises, not to mention the intrinsic conflict of interest that would result from each national college having to balance its national goals against the regional goals of that part of the Centre which it hosts. The sum total of all the capital and human resource needs of the disparate campuses of the Centre would equal and more than likely exceed that of the centralised model. While a decentralised model serves to emphasize the fundamental importance of collaboration, co-operation and harmonization between all participating colleges; an effective centralised coordinating function would require significant resources, furthermore, it will be continually challenged by opposing national goals.

Some of the major limitations of such a model include:

- A long implementation process involving the harmonization of individual national college goals with those of the Centre at the strategic, tactical and operational level.
- Significant coordination challenges to the sustainable operation of the Centre

- Potential weakening of regional strategic goals in the face of more pragmatic national college objectives
- More complex governance and administrative structure to provide strategic, tactical and operational management of the Centre

Benefits of this model include:

- A structure that strongly re-enforces the requirement for meaningful cooperation of the national colleges by providing a sense of ownership and identity of the Centre by the national colleges
- Increased sensitivity to national ICT skills needs.
- Potential for the Centre to access more of the conventional resources of the national colleges.

Model C: The Virtual Centre

This model combines the strengths of both the centralised model with the benefits of de-centralisation. This would be achieved by full use of a wide range of networked computing, communications technologies and educational application software tools. The objective of this infrastructure would be both to facilitate a centrally administered Centre with a de-centralised group of campuses that take advantage of the strengths and resources of the national colleges. The underlying design would be to deliver quality programs that consistently meet identified regional ICT skills development needs and are delivered in a manner consistent with the constraints and requirements of both students and faculty. Such a model should not only enable a Centre to be established with lower capital and human resources than the foregoing two models, but it would be designed to make optimal use of administrative, faculty and instructional resources and equipment. Moreover, the design of such a Centre could demonstrate the reality of the ICT technologies that it is designed to teach. In so doing it will meet the objective of a live research and development model for regional ICT.

Several Caribbean and extra-regional examples of such Centres exist today. Each is instructive of the factors that underly the successful implementation of such virtual centres. Furthermore a wide and growing body of knowledge exists that can and should inform the design of such a Centre given the specific environmental factors in the region.

Some of the key design factors are:

- The telecommunications infrastructure to support data, voice and video exchange between the national colleges and the other stakeholders.
- The existing levels of computing and communications infrastructure at the national colleges
- The levels of ICT skills at the national colleges to develop and support the respective capabilities which will be hosted at these sites

Features of a “technology-enabled” Centre of Specialisation for ICT

- The design of the computing and communications infrastructure of such a virtual center will be consistent with and based upon the policies outlined in *the OECS policy for educational technology, which* has been adopted by all participating colleges.
- The centre for accountability and administrative control should reside at and with the Sir Arthur Lewis Community College in Castries St. Lucia.
- The OERU will retain the role of ensuring that the Centre’s policies remain consistent with regional tertiary education reform strategies
- The primary repository of instructional content will be electronically based, and be contributed to, and accessed by the participating national colleges. Individual colleges may choose to design programs that comprise any combination of their own or this regional instructional content-base.
- The central repository will be developed by a collaborative process involving instructors and curriculum design resources from all participating colleges. In addition it will be consistent with the strategic goals for regional ICT skills development as identified in this report, and ongoing under the direction of the existing committees that review curriculum design in the OECS region
- Instructional delivery will be mediated by a combination of live instructors, on-demand delivery of audio/video-based lectures and live interactive tutorial sessions using video-conferencing technology. Each national college choosing the appropriate combination according to their needs.
- While functionally, accountability and control reside centrally at SALCC, the computational infrastructure to enable and support such functions need not reside at SALCC, but may in fact be delivered by another college or a group of colleges. Thus (although optimally it should be located at SALCC), the servers, database and software for administering any aspect of the Centre’s operation could be provided by any other ICT facility. This capability could serve both to expedite the establishment of the Centre as well as to provide the necessary backup and redundancy to ensure the resilience of the system against unforeseen failures

Despite the significant benefits of the virtual Centre, the requirements for the establishment should not be minimized. There are significant technology and process design issues to be overcome, including:

- Upgrade / Install a common (standard) architecture in at least one computing laboratory in each participating institution
- Implement a “client / server” architecture linking all institutions, made possibly using high-bandwidth “private” Internet-based networks
- Establish hosting of administrative application software, instructional content, and messaging capabilities that all participating institutions can access via a simple Internet browser
- Implement common accessibility to instructional content including:
 - digitized lecture videos, lecture notes, assignments, and
 - the full text of licensed electronic texts, journals and articles
- Establish systems for electronically maintaining:
 - student files
 - collaborative student forums
 - administrative systems
 - scheduling of classes, resources and events and activities
 - student registration, examination results, financial transactions, etc.
 - faculty instructor meetings and forums

- policies, procedures and administrative processes
- messaging and interactive facilities
- administration, faculty and student E-Mail
- Internet access (on and off campus)
- appropriate access to all information and facilities (on and off campus)
- full interactive videoconferencing and scheduling capabilities (for administration, faculty and student use)

Framework and context of the Centre – relationships with stakeholders

In summary, these are the respective roles and responsibilities of the Centre, the participating national colleges and private sector partners.

CENTRALIZED FUNCTIONS (The St. Lucia-based administrative Centre)

- Policy-making & strategy
- Accreditation of proposed core associate degree program and electives for UWI accredited degrees
- Articulation with appropriate institutions
- Functional and administrative control

DECENTRALIZED FUNCTIONS (All participating colleges):

- Contribution to instructional content for a core program for an associate degree
- Development of areas of national ICT specialisation and focus, and with other ICT-related programs and other Centres of Specialisation
- Manage and contribute the curriculum and instructional content for these areas
- Collaborate in the strategic and tactical decision-making together with the administrative Centre

PRIVATE SECTOR PARTNERS

Beyond the involvement of the national colleges, it is recognized that the private sector must play a key role in the sustainability of the Centre. The private sector alone defines the dynamics of the ICT sector in terms of application, growth and direction. Only the private sector, can accurately interpret the ICT skills requirements of most of the employers in the productive sectors. The private sector comprises the following key players:

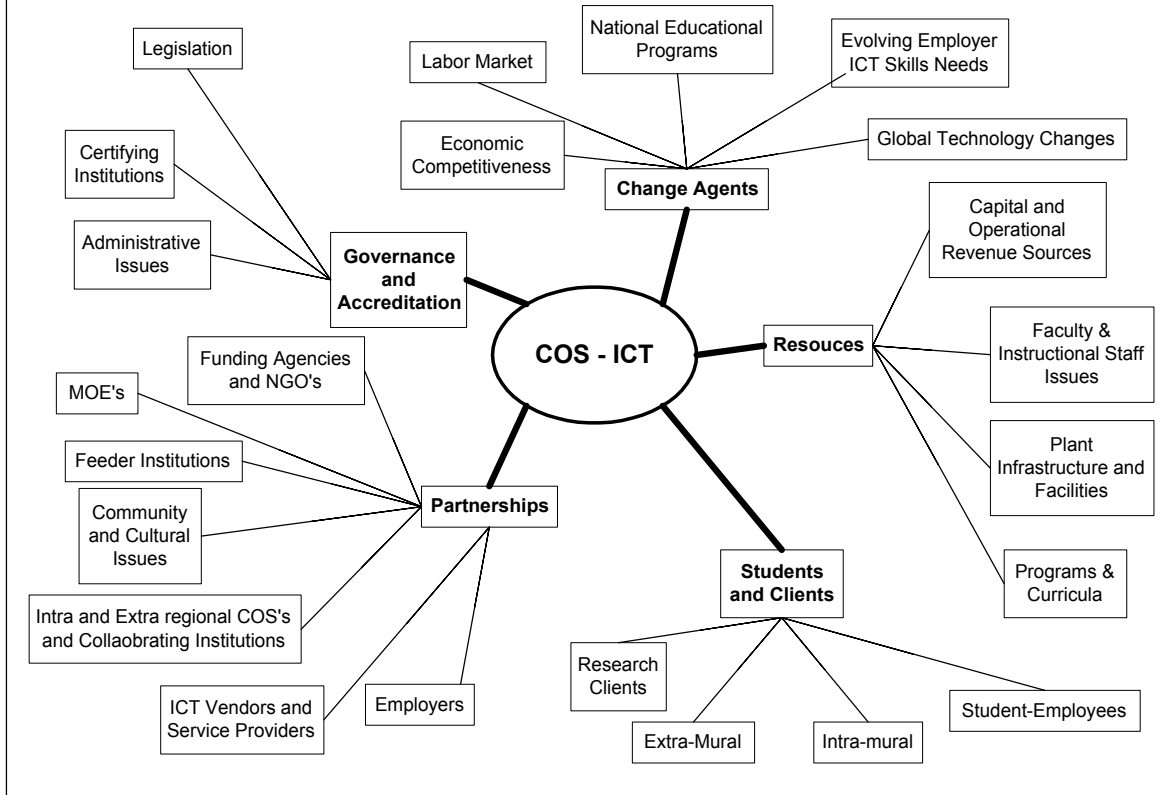
- The main employers of skilled ICT resources in the productive sectors of the economy
- The alternative commercial ICT skills training academies
- The commercial providers of ICT products and services to the consumers in the economy

To bring about this partnership between institutional delivery of skills and the private sector it will be necessary to:

- Establish appropriate private sector (and other) linkages to facilitate responsive and “market-driven” program designs and employment attachments for students.
- Provide, where possible, the computing, communications infrastructure and the systems administration support for this Centre’s network

The diagram following depicts the main elements of a Centre of ICT Specialisation.

Center or Specialisation - ICT **Conceptual Framework**



Implementation

Implementation recommendations are not part of the projects term of reference.

However in recognition of the valuable feedback received during desk research and field visits, and the many suggestions for informing successful implementation of a Centre for ICT, a brief summary of this commentary is included here.

NOTE: These observations are not intended in any way to prejudice the outcome of the implementation stage, which follows the approval for proceeding with the establishment for a Centre of Specialisation for ICT.

Consistency with *The Model ICT policy for the Education System* document

This document establishes the standards and policies on which institutional ICT development in the region is to be based. The ongoing activities of the *OETEC* and the *OECS ICT planning Committee* will also inform the process of approval and authorization of subsequent development phases.

The policies articulated in the **Model** report focus on the overall improvement of education at all levels in the region by better application of ICT which affects administration, delivery and teacher skills in ICT. As such, it establishes the basis for the selection, use and application of ICT in regional education institutions and ministries. Its policies with respect to standardisation, consistency, usage training and application also serve to guide the implementation process for ICT in education. In this report, therefore, these principles will not be re-iterated. Instead this document seeks to identify those other key issues, which, while consistent with the framework of the Model, impact the implementation of a Centre for ICT directly.

Critical success factors

1. Legitimacy – meeting employer and private sector requirements

This first issue serves as a reminder that while the Centre for Specialisation for ICT is an entity within the regional and national public institutional education framework, its primary ‘reason for being’ is to serve the ICT skills development needs of the productive sectors (i.e. the private sector) of the region. This means that in deriving the working goals of the Centre, and designing the governance mechanism for the Centre the need for private sector input and participation must be recognized. As such, the on-going review of programs and curricula should be more than a reactive ‘after-the-fact’ process. Instead it should actively incorporate private sector representation within the review process itself. One clear example of this is in the case of skills training for the communications sub-sector of the ICT industry. Here, in a sub-sector presently dominated by a single communications service provider, the reality is that Cable & Wireless alone defines the size and nature of this sub-sector, and hence it alone can adequately determine skills needs. With emerging de-regulation, of course, new players will enter this sub-sector, and new products and technologies will emerge in time to challenge the dominance of this sole provider. As this happens, the programs delivered by the Centre in support of this sub-sector must also change. This may require that, in the program review process, broader representation than from Cable and Wireless alone, be recognized. Other examples of vendor and provider dominance exist in areas of enterprise database (Oracle), PC desktop Operating Systems (Microsoft), Data Communications Equipment (Cisco), and possibly Telephony Systems (Nortel). This situation is indicative of the need for the Centre’s review

mechanism to understand the nature of the evolution of technology, the emergence of dominant forces and in so doing, adequately forecast the impact on regional ICT skills needs.

2. Role of regional tertiary colleges

In the discussion of alternative models for the Centre, the potentially inherent divergence between national college goals and regional goals remains as a major challenge to be overcome. Therefore, a Centre whose processes are designed to be both fully inclusive of national goals, sensitive and reactive to these issues, and one that can adapt its offerings and mode of operation to match these needs will be better equipped to survive in this environment. The Centre should therefore be governed in a way so that National Colleges see themselves as defining the Centre's offerings to complement their own goals. By contributing to the program content of the Centre, colleges gain 'ownership' and become active stakeholders. To facilitate this process, a sophisticated mechanism for collaboration between and among colleges and the Centre must be established. Given the constraints of budget and geographical separation between these partners, there needs to be emphasis on appropriate advanced collaborative technologies (e-mail, video-conferencing, and telepresence) to enable this process.

3. Validation of the concept of a Centre by the use of technology

The foregoing observations lead into a discussion of the application of ICT technologies within the Centre's operation and in support of its processes and procedures. The Centre should seek to apply appropriate ICT in its operations for three significant reasons:

- As a means of minimizing operational costs. There will be a need for meaningful ongoing collaboration between stakeholders. This implies that there will be significant communications usage. Emerging regional deregulation will support this requirement; however in addition full use should be made of new Internet based telephony (Voice over IP) and internet videoconferencing (H323 protocols) to maximize use and minimize costs using available bandwidth between the Centre and national colleges. Other administrative functions such as student registration, course scheduling, examination and assignment tracking, etc. are obvious areas where a modest investment in application software will yield considerable savings in administrative staff resources while enabling distributed access to participating colleges for these and several other functions. Another significant area where cost-savings can be realized is in material distribution costs (by providing on-line course material and assignments), lecture content (use of streamed audio and video for delivering on-line pre-recorded lectures), and course texts and journals (on-line licensed access to e-books and e-journals).
- As a demonstration of the real-life use of the technologies for which it provides skills training
- As a testing ground and research area where the appropriateness of new technologies may be validated for use in the region

3. Maximizing the use of scarce administrative, faculty and infrastructure resources

It is safe to say that one of the major constraints to regional development is the scarcity of skilled human resources. This applies to nearly every major field of technology including ICT. The impact on the viability and sustainability of a Centre for ICT is therefore obvious. Without financial and human resources to support the operations of the Centre, its goals cannot be met. The emphasis that this report

places on the application of ICT within the operations of the Centre are meant to identify areas of cost saving and more importantly, to suggest ways in which scarce skills can be utilized to the fullest:

- In the administration of the Centre, not only can fewer staff at the Centre maintain essential systems and processes, but by the use of distributed application technologies, skilled administrative staff at the national colleges can now manage and maintain the processes in support of students at their college who enroll in the Centres programs. Existing administrative computing facilities (PC's and networks) at the colleges can be adapted to access the Centre's administrative systems without additional hardware and software infrastructure investment. The Centres systems can be integrated into each college's administrative and (possibly) financial procedures and systems.
- Likewise, scarce instructional and program design faculty members at each participating college can become part of the Centres program delivery and review process. The many technology applications described in the foregoing sections offer significant leverage for delivery of additional ICT lecture content, tutorials and seminars, as well as ongoing review of programs with minimal effort by faculty and with minimal financial burden on the colleges.
- As mentioned earlier, with the establishment of a minimum of communications and computing infrastructure at each college, the full instructional, administrative and collaborative offerings of the Centre will be available to each national college. By the full use of communications technology and the distribution of computational power and applications, the Centre can provide a full and complete presence in each college.

4. Addressing regional economic competitiveness and the needs of the labor market

Maintaining regional economic competitiveness is the responsibility of regional governments and agencies. One aspect of this is the full involvement of the private sector. This aspect has been previously addressed in the context of a governance model for the Centre, which embraces input from the private sector. Regional competitiveness and regional labor market issues must however look toward the wider issues of globalization, unemployment and the brain-drain, emerging trends in the use (and abuse) of ICT and the wider social context. While solutions to these topics are outside of the scope of this report, the success of the Centre in the long-term will depend on how it responds and addresses these issues.

- Globalization: In the narrow context of ICT skills development, it may be that the Centre should be as flexible and adaptive as possible. If there is a need for the rapid development of certain key skills, and if insufficient program development resources exist within the region, then the key may be adopt and adapt content from extra-regional sources. Several examples within the region exist of effective collaboration between external institutions (institutional and commercial) and regional institutions. The Centre must seek to foster and facilitate such partnerships. As mentioned earlier, a large body of knowledge exists extra-regionally about the application and 'best practices' for virtual Centres. In the design of its structure, and its operational processes, the Centre can benefit immensely from these resources. Also in other areas of instructional human resources, instructional material (i.e. books, journals, seminars, workshops, etc.) the Centre can benefit from an immense number of extra-regional resources. Outside of the formal institutional context, it should be remembered that the extra-regional commercial sector (vendors, providers and consulting firms) are willing and eager to establish partnerships with the region. Some examples of this are (IBM, Oracle, Cable & Wireless and ISIS/APTECH).

- Regional labor markets and unemployment: In this context, the role of the Centre is seen as effectively and efficiently delivering ICT skills to an ever wider and larger 'market'. Its programs must therefore be appropriately designed to deliver content in a wide variety of modalities.
 - to full-time registered intra-mural students at national colleges
 - to part-time, occasional and continuing and adult education student at colleges
 - extramural recipients with a variety of distance education methods (including video-tape, CD, and the Internet)
 - commercial clients (private training academies, etc)
 - employees within the business environment

This content delivery infrastructure can easily be adapted to offer an ever wider variety of material such as; recorded proceedings of guest lectures, seminars, presentations of technical material from commercial sources, workshops and discussion forums. These are all opportunities for incorporating a wider variety of ICT material and serving a wide variety of recipients.

- Social issues: This issue while less tangible and subject to wider influences than just the visible use and abuse of ICT in society, is one that has a major impact on the rate and manner of adoption of technology. The Centre should see itself as a model for the adoption of appropriate technologies and for its effective and relevant application to regional problems.

5. Maintaining goals and objectives - flexibility and adaptability

The essence of this issue is the sustainability of the Centre as an effective agent for skills development. The findings underlying this study indicate that a number of radical changes appear about to take place in the ICT sector. These changes, which could all, take place too rapidly for a conventional institution to respond adequately, can nevertheless be appropriately managed given the presence of an appropriate review structure. Mention has been made of the need for responsive program review, short-term adaptation of extra-regional content, use of commercial and collaborating foreign college instructional resources to name but a few. Underlying this however should be a mechanism that:

- Understands ICT trends elsewhere and regionally
- Has access to alternative ways of incorporating new material, processes and resources.
- Selects and uses new technologies as they become stable and viable
- Identifies other marginal areas for skills training which while not mainstream might emerge as necessary adjuncts to core ICT skills. An example of this is the rapidly developing conjunction of creative design and layout as part of web development
- Seeks to identify other socially significant areas of the use of ICT, and champions its use. Examples are; tele-medicine, satellite image analysis, and the use of ICT for the disabled.

Operational and functional requirements as guidelines to the design of a Center

What then are the key recommendations for the design of an effective and sustainable Centre for ICT? What are its major functions and how can they be described as derivatives of a Needs Assessment in a way that informs future stages of development and implementation?

Governance and accountability

Governance relates to strategies and policies which guide the design and operation of the Centre: Specifically the *Education Reform Unit (OERU)*, and its collaborative committees *The ICT Technology Planning Committee*, and OETEC. Nevertheless governance must extend to national colleges and to private sector partners and stakeholders. In order to embrace such a wide number of disparate and dispersed entities, a hierarchy of approval levels must be established. Then, the policies that make for smooth and rapid collaboration between these entities can be enacted by the use of appropriate technologies. The system must enable new policies to be identified, refined and approved within a short period without losing the benefit that full and in-depth review of these ideas.

Furthermore, the process should allow for the development of such policies within the wider framework of regional education and economic reform. It should incorporate feedback from several other economic sectors, student bodies, educators, and other professional and societal sources. It should also enable its proposed policies to be reviewed in the light of ‘best practices’ from other countries. In summary, the entire process should be visible and be able to withstand public scrutiny from any quarter – especially from stakeholders. Once policies are adopted, they should then be applied faithfully and effectively by all participants. Ideally, policies will be developed which can be adopted optionally by participants without compromising either regional or national goals.

Accountability, on the other hand, should and must reside with the Centre. The Centre is charged with a clear responsibility for decision-making and for the prescription of resource usages. For this, all actions, which are taken by other participants, must take place under the control and authorisation of the Centre. The systems, which support this process, should delegate the appropriate authorization to these participants, and the procedures, which support this mechanism, should create the necessary information reporting flows back to the Centre.

Administration, and student and financial affairs

As with most conventional educational institutions a number of administrative and financial offices need to be established for the proper management and control of the Centre.

Director of the Centre: Responsible for the adoption of policies and procedures, Overall budget responsibility and strategic direction of the administrative, faculty and infrastructure resources.

Registrar: Responsible for student intake and graduation, course scheduling, test and examination administration and student records.

Financial Controller (Bursar): Responsible for the control of the annual operating budget and the accounting for revenues (fees, payments, etc) and operating expenses.

Dean or Faculty Administrator: responsible for the process of program and curriculum review, instructor and course assignment, setting and the administration and marking of examinations and tests.

The administrative and financial locus of the Centre will be at the Sir Arthur Lewis Community College. Resource appointments for these positions will be decided upon at subsequent stages in the project, however by the use of appropriate technologies (as mentioned previously), existing college staff could retain control of these functions while allowing staff at the national colleges to perform the detailed operational tasks associated with each of these functions.

Again, facilitating technology can optimize staff resources at both the Centre and at participating colleges.

Instruction delivery and assessment

As described earlier, the Centre will maintain an electronic repository of instructional content. This content-base will comprise digital video/audio/data files, which can be delivered to target audiences in a variety of formats (presentation replay, internet distribution, video tape, CD, audio cassette and printed transcripts). Where possible the Centre will acquire proprietary intellectual rights over this material, so that it may freely distribute, copy, reproduce or sell this material. Similarly, the Centre will permit participating colleges to access and use this material freely for specified purposes. In other cases, the Centre may acquire other content, which it may be licensed to use in specified ways. The networking of the Centre with national colleges will permit them to easily access and use such material. Other forms of Instruction, which require live lecturers, or which are of a seminar, tutorial or workshop style may be performed through interactive videoconferencing. Appropriate communications networks and technologies will be required to support these formats

For testing and examinations, a conventional supervised model may be required. Here again appropriate technologies can facilitate on-line examinations, and the marking, exchange and recording of results.

Program review, accreditation and articulation

The Centre may utilize many alternative content providers, and many types of instructional content. But the requirement will be in all cases for such material to complement existing national college programs, furthermore, the Centre should offer the desired level of accreditation from regional bodies for these programs. The process of program review may therefore be very complex.

It has been proposed that the Centre develop programs at the Associate Degree level consistent with the guidelines developed in collaboration with UWI for regional national colleges (for example SALCC). The process of developing appropriate programs will require the collaboration and input from all participating colleges. Depending on the various areas of expertise within these colleges, individual courses may comprise material developed by these colleges. In other cases, several complimentary and alternative courses may co-exist, and in yet other, new material may need to be developed.

Maintaining key private sector partnerships

Prior to, and during the duration of this project, the OERU had received several overtures from private sector vendors and providers who expressed a wish to collaborate with the Centre.

At this stage, specific scenarios need not be discussed, however it might be instructive to provide a general discussion of the various areas in which private sector collaboration might be appropriate:

- Direct grants of capital and operating funds in exchange for naming rights
- Donations of hardware, software or equipment.
- Collaboration with commercial training academies with a view to acquiring instructional resources
- Management and operating contracts that might provide for acquiring needed technical services

Infrastructure – supporting physical and virtual facilities

The technologies, which will be required to support the Centre, will reside in several forms and locations.

Communications: The Centre together with all participating colleges and many stakeholders could be networked via high bandwidth (minimally T1) data connections. Using appropriate data, voice and video communications devices, regulatory guidelines permitting, these networks will ideally be able to establish appropriate telephony, data and video / videoconferencing connectivity over Internet-based (IP) facilities. This capability could yield considerable savings and operational benefits from the integration of all such facilities over a single consistent mode of communication. The design should also allow for alternative providers and services in the event of loss of service from the primary providers

College classroom laboratories: Each participating college will be equipped with at least one such facility; this lab will be networked with both the college local area network (LAN), as well as

being linked to the Centre. The labs will offer audio/video presentation of pre-recorded instructional content. Students may use these facilities in either an individual or group setting. PC's in the lab will permit students to access course materials (e-books and e-journals) and to collaborate with course instructors and other students. The lab will also be used for conducting live and interactive tutorials and seminars, and for administering on-line examinations and tests.

Instructor laboratories Either part of or separate from the student labs, this facility will permit the faculty at each college to privately collaborate with their colleagues at other colleges, and with the Centre. The exchange will be supported by interactive videoconferencing systems and be used primarily for program design and review purposes. Optionally, and where colleges are involved in the preparation of instructional content for the Centre, these labs will also be equipped with video / audio design, editing and recording facilities. The Centre will provide the required training and procedures to assist the colleges in the development of quality instructional material.

Administration terminals: National college administration staff will have access to the Centre's administrative, financial / accounting and student management systems. The Centre will achieve this by properly configuring the desktop PC's, which the college staff uses for their day-to-day activities.

Servers and Application systems To support its computing and communication requirements, the Centre will establish data communications systems, application servers and system management facilities that can support the above-mentioned facilities. Distributed systems technology will permit the Centre to administer and support this facility, and allow for it to be established at any, or at any combination of, the participating colleges.

Conclusion

The development and implementation of a Centre of Specialisation for ICT is a critical and necessary requirement for regional economic competitiveness.

The findings of the needs analysis study indicate that significant deficits in ICT skills exist in the region and that immediate and continuing delivery of such skills is necessary to ensure that economic development objectives of the ICT sector are met.

While alternative models for its design exist; the preferred model consists of a virtual Centre based on de-centralised program development at the national colleges, and a central locus for accountability and control at the Sir Arthur Lewis campus. The Centre will be charged with delivering a wide variety of ICT skills through a wide variety of instruction delivery modes.

A virtual Centre can best provide for the delivery of these skills, and yet be implemented sooner and be operated at lower cost and with lower human resources levels than could conventional institutions.