

Table A-8.4.4 (2) Indicative training packages for Manufacturing Technology (Optional Modules)

CERTIFICATE I OPTIONAL MODULES:	CERTIFICATE II OPTIONAL MODULES:	CERTIFICATE III OPTIONAL MODULES	CERTIFICATE IV OPTIONAL MODULES:	CERTIFICATE V OPTIONAL MODULES
<p><i>Complete any Optional Modules from:</i></p> <p>Draw and interpret a sketch</p> <p>Use comparison and basic measuring devices</p> <p>Mark-off/out (General engineering)</p>	<p><i>Complete any Optional Modules from:</i></p> <p>Interpret technical drawings</p> <p>Prepare basic engineering drawing</p> <p>Use comparison and basic measuring devices</p> <p>Mark-off/out (General engineering)</p> <p>Mark-off/out structural fabrications and shapes</p>	<p><i>Complete any Optional Modules from:</i></p> <p>Interpret technical drawings</p> <p>Prepare basic engineering drawings</p> <p>Apply basic engineering design concepts</p> <p>Mark-off/out (General engineering)</p> <p>Mark-off/out structural fabrications and shapes</p> <p>Use comparison and basic measuring devices</p> <p>Electrical/electronic measurement</p> <p>Perform inspection (Basic)</p> <p>Use improvement processes in team activities</p>	<p><i>Complete any Optional Modules from:</i></p> <p>Interpret technical drawings</p> <p>Prepare basic engineering drawings</p> <p>Apply basic engineering design concepts</p> <p>Precision mechanical measurement</p> <p>Precision electrical/electronic measurement</p> <p>Calibrating measurement equipment</p> <p>Perform basic statistical quality control</p> <p>Use improvement processes in team activities</p> <p>Perform inspections (advanced)</p> <p>Perform laboratory procedures</p>	<p><i>Complete any Optional Modules from:</i></p> <p>Perform advanced statistical quality control</p> <p>Use improvement processes in team activities</p> <p>Perform inspection (Advanced)</p> <p>Conduct product and/or process capability studies</p> <p>Maintain/manage application of quality procedures</p>

Table A-8.4.4 (3) Indicative training packages for Manufacturing Technology (Specialist Stream Modules)

CERTIFICATE I SPECIALIST STREAM MODULES	CERTIFICATE II SPECIALIST STREAM MODULES	CERTIFICATE III SPECIALIST STREAM MODULES	CERTIFICATE IV SPECIALIST STREAM MODULES	CERTIFICATE V SPECIALIST STREAM MODULES
Materials Handling Drawing, Drafting and Design Fabrication Surface Finishing Assembly Installation & Commissioning Machine and Process Operations Casting and moulding Forging Mechanical Engines, Mobile Plant & Equipment. Refrigeration & Air Conditioning Control Instrumentation & Electronics Electrical Fluid Power	Materials Handling Drawing, Drafting and Design Fabrication Surface Finishing Assembly Installation & Commissioning Machine and Process Operations Casting and moulding Forging Mechanical Engines, Mobile Plant & Equipment. Refrigeration & Air Conditioning Control Instrumentation & Electronics Electrical Fluid Power	Materials Handling Drawing, Drafting and Design Fabrication Surface Finishing Assembly Installation & Commissioning Machine and Process Operations Casting and moulding Forging Mechanical Engines, Mobile Plant & Equipment. Refrigeration & Air Conditioning Control Instrumentation & Electronics Electrical Fluid Power	Materials Handling Drawing, Drafting and Design Fabrication Surface Finishing Assembly Installation & Commissioning Machine and Process Operations Casting and moulding Forging Mechanical Engines, Mobile Plant & Equipment. Refrigeration & Air Conditioning Control Instrumentation & Electronics Electrical Fluid Power	Manage systems
EXAMPLE OF SPECIALIST MODULE – FORGING Complete 1 Specialist Module Hand forging Hammer forging Drop and upset forging Perform basic incidental heat/quenching, tempering and annealing	EXAMPLE OF SPECIALIST MODULE – FORGING Complete 2 Specialist Module Hand Forging Hammer forging Drop and upset forging Carry out heat treatment	EXAMPLE OF SPECIALIST MODULE – FORGING Complete 3 Specialist Module Hand Forging Hammer forging Drop and upset forging Select heat treatment processes and test finished product Spring repair		

Table A-8.4.5 (1) Indicative training packages for Hospitality / Tourism (Core Modules)

It is possible to offer a range of qualifications in the following areas of HOSPITALITY

<p>HOSPITALITY OPERATIONS Operations Food and Beverage Accommodation Services Food and Beverage (Supervision) Accommodation Services (Supervision)</p>		<p>KITCHEN/COOKERY/CATERING Kitchen Operations Commercial Cookery Catering Operations Patisserie Special Cuisine Cooking (Chinese, Indian, Thai, Vietnamese, Ghanaian, etc.)</p>		
<p>CERTIFICATE I CORE MODULES in Kitchen Operations <i>Complete all Core Modules in Kitchen Operations</i> <i>Cert. I</i> PLUS Select 6 Core modules from Specialist Strands: <i>Commercial Cookery</i> Catering Operations Patisserie Special Cuisine (eg. Ghanaian) Example of Commercial Cookery-Modules Use basic methods of cookery Prepare hot and cold deserts Implement food safety procedures Prepare and produce pastries Prepare and produce cakes Prepare and produce yeast goods</p>	<p>CERTIFICATE II CORE MODULES In Kitchen Operations <i>Complete all Core Modules in Cert. I</i> PLUS Select 6 Core modules from Specialist Strands: <i>Commercial Cookery</i> Catering Operations Patisserie Special Cuisine (eg. Ghanaian) Example of Commercial Cookery-Modules Use basic methods of cookery Prepare hot and cold deserts Implement food safety procedures Prepare and produce pastries Prepare and produce cakes Prepare and produce yeast goods</p>	<p>CERTIFICATE III CORE MODULES In Kitchen Operations <i>Complete all Core Modules in Cert. II</i> PLUS Use basic methods of cookery Implement food safety procedures Example of Catering Operations-Modules Package prepared foodstuffs Transport and store foods in a safe and hygienic manner Apply catering control procedures Plan and control menu based catering Prepare daily food plans</p>	<p>CERTIFICATE IV CORE MODULES in Commercial Cookery. <i>Complete all Core Modules in Certificate III</i> PLUS Perform clerical procedures Control and order stock Monitor work operations Implement workplace health, safety and security procedures Lead and manage people Manage workplace diversity Manage finances within a budget</p>	<p>CERTIFICATE V CORE MODULES in Hospitality Management <i>Complete all Core Modules in Certificate IV</i> PLUS Maintain financial records Develop and implement operational plans Establish and maintain a safe and secure workplace Roster staff Manage workplace relations Prepare and monitor budgets Develop and maintain the legal knowledge required for business compliance Access and retrieve computer data Produce documents on computer Plan and manage meetings Plan and establish systems and procedures</p>

Table A-8.4.5 (2) Indicative training packages for Hospitality / Tourism (Elective/Specialist Stream Modules)

CERTIFICATE I ELECTIVE MODULES	CERTIFICATE II SPECIALIST STREAM MODULES	CERTIFICATE III SPECIALIST STREAM MODULES	CERTIFICATE IV SPECIALIST STREAM MODULES	CERTIFICATE V SPECIALIST STREAM MODULES
<p>FOR KITCHEN (OPERATIONS) A minimum of ONE additional units, selected from the following functional areas eg.:</p> <p>COMERCIAL COOKING COMMERCIAL CATERING</p> <p>FOR HOSPITALITY (OPERATIONS) A minimum of TWO additional units, selected from the following:</p> <p>FOOD & BEVERAGE HOUSEKEEPING</p>	<p>FOR OPERATONS A minimum of TWO additional units, selected from the following:</p> <p>FOOD & BEVERAGE GAMING FRONT OFFICE HOUSEKEEPING COMMERCIAL CATERING COMMERCIAL COOKERY PATISSERIE SPECIAL CUISINE</p> <p>And general areas CUSTOMER SERVICE, SALES & MARKETING HYGIENE, HEALTH, SAFETY & SECURITY GENERAL ADMINISTRATION FINANCIAL ADMINISTRATION COMPUTER TECHNOLOGY</p> <p>Some Tourism units may be selected</p>	<p>A minimum of TEN additional units, selected from the following with at LEAST FIVE from functional area of specialisation:</p> <p>FOOD & BEVERAGE FRONT OFFICE HOUSEKEEPING GAMING COMMERCIAL COOKERY COMMERCIAL CATERING PATISSERIE</p> <p>And general areas CUSTOMER SERVICE, SALES & MARKETING HEALTH, HYGIENE, SAFETY & SECURITY GENERAL ADMINISTRATION FINANCIAL ADMINISTRATION COMPUTER TECHNOLOGY LEADERSHIP SPECIAL CUSIENE</p> <p>Some Tourism units may be selected</p>	<p>A minimum of TWELVE additional units, selected from the following including the requirements for a Certificate III in Hospitality, with at LEAST FIVE from functional area of specialisation:</p> <p>FOOD & BEVERAGE FRONT OFFICE HOUSEKEEPING GAMING COMMERCIAL COOKERY COMMERCIAL CATERING PATISSERIE CUSTOMER SERVICE, SALES & MARKETING HEALTH, HYGIENE, SAFETY & SECURITY GENERAL ADMINISTRATION FINANCIAL ADMINISTRATION COMPUTER TECHNOLOGY LEADERSHIP SPECIAL CUSIENE</p> <p>Some Tourism units may be selected</p>	<p>A minimum of TWO additional units, selected from the following:</p> <p>TRAINING CUSTOMER SERVICE, SALES & MARKETING HEALTH, HYGIENE, SAFETY & SECURITY GENERAL ADMINISTRATION FINANCIAL ADMINISTRATION COMPUTER TECHNOLOGY LEADERSHIP</p> <p>Also the following units from the TOURISM Training package may be included</p> <p>TOURISM CORE SALES & MARKETING PLANNING & PRODUCT DEVELOPMENT MEETINGS</p>

Table A-8.4.5 (3) Indicative training packages for Hospitality (Catering) / Tourism (Core Modules)

It is possible to offer a range of qualifications in the following areas of TOURISM

SALES/OFFICE OPERATIONS MEETINGS AND EVENTS MANAGEMENT	ATTRACTIONS & THEME PARKS SALES AND MARKETING OPERATIONS MANAGEMENT	GUIDING (EG. Ghanaian Cultural Guiding) MARKETING AND PRODUCT DEVELOPMENT
<p>CERTIFICATE I</p> <p>Not generally offered in this area</p>	<p>CERTIFICATE II CORE MODULES</p> <p><i>Complete all Common Core Modules</i></p> <ul style="list-style-type: none"> Work with colleagues and customers Work in a socially diverse environment Follow health, safety and security procedures Develop and update tourism industry knowledge Communicate on the telephone Perform Clerical Procedures Access and retrieve Computer Data Produce documents on Computer Process Financial Transactions 	<p>CERTIFICATE III CORE MODULES</p> <p><i>Complete all common Core Modules in Cert. II</i></p> <p>PLUS</p> <ul style="list-style-type: none"> Deal with Conflict Situations <p>PLUS</p> <p><i>Select all Core modules from Specialist Strands: EG.</i></p> <ul style="list-style-type: none"> Source and provide Destination Information Prepare Quotations Sell tourism Products & Services Receive & Process Reservations
<p>CERTIFICATE IV CORE MODULES</p> <p><i>Complete all Core Modules in Certificate III</i></p> <p>PLUS</p> <p><i>Select Core modules from Specialist Strands: EG.</i></p> <ul style="list-style-type: none"> Make presentations Plan & Implement Sales Activities Co-ordinate Marketing Activities Create a Promotional Display Stand Prepare Business Documents Plan & Manage Meetings 	<p>CERTIFICATE V CORE MODULES</p> <p><i>Complete all Core Modules in Certificate IV</i></p> <p>PLUS</p> <ul style="list-style-type: none"> Coach Others in Job Skills Monitor Work Operations Implement Workplace OH&S and Security Procedures Lead & Manage People Manage Workplace Diversity Manage Finances Within A Budget Prepare Business Documents <p>PLUS</p> <p><i>Select Core Units from Specialist Strands. EG></i></p> <ul style="list-style-type: none"> Develop and Implement Operational Plans Establish and Maintain a Safe & Secure Workplace Prepare and Monitor Budgets Develop & maintain the Legal Knowledge Required for Business Compliance Plan & Manage Meetings Establish & Conduct Business Relationships 	

Table A-8.4.5 (4) Indicative training packages for Hospitality (Catering) / Tourism (Elective/Specialist Stream Modules)

<p>CERTIFICATE I ELECTIVE MODULES</p>	<p>CERTIFICATE II SPECIALIST STREAM MODULES</p>	<p>CERTIFICATE III SPECIALIST STREAM MODULES</p>	<p>CERTIFICATE IV SPECIALIST STREAM MODULES</p>	<p>CERTIFICATE V SPECIALIST STREAM MODULES</p>
<p>Select ONE Module from one of the Specialist Streams:</p>	<p>A minimum of FIVE additional units selected from the following:</p> <ul style="list-style-type: none"> Guiding Attractions & Theme Parks Hygiene, Health & Security Technical & Maintenance Services General Administration Financial Administration Merchandise Sales An Example of Attractions & Theme Parks may include: Monitor entry to Venue Conduct Pre-event Briefing Operate a Ride Location Load & Unload a Ride Maintain Safety in Water Based Rides Operate a Games Location Carry Out Spruiking Operate Animal Inclosure/Exhibit Provide General Animal Care Rescue Animals Provide Customers with Information on Animals Coordinate Animal Care Manage Animal Enclosures/Exhibits 	<p>A minimum of THREE additional units selected from the following with at least one from the specialist strand area:</p> <ul style="list-style-type: none"> Specialist Strand Area eg. Guiding Attractions & Theme Parks Tour Operations Hygiene, Health & Security General Administration Financial Administration Sales/Office Administration Merchandise Sales An Example of Guiding may include: Offer Arrival & Departure Assistance Coordinate & Operate a Tour Lead Tour Groups Present Interpretive Activities Develop Interpretive Content for Eco-tourism Activities Manage Extended Touring Programs 	<p>A minimum of TWO additional units, selected from the following:</p> <ul style="list-style-type: none"> Planning and Product Development Leadership General Administration Sales & Marketing Financial Administration Training An example of Sales & Marketing may include: Make Presentations Plan & Implement Sales Activities Coordinate Marketing Sales Activities Establish & Conduct Business Relationships Coordinate Production of Brochures & Marketing Materials Create a Promotional Display Stand 	<p>A minimum of TWO additional units, not previously counted towards a qualification at a lower level within this framework selected from the following:</p> <ul style="list-style-type: none"> Planning and Product Development Leadership General Administration Sales & Marketing Financial Administration Computer Technology Training An example of Leadership may include: Roster Staff Monitor Staff Performance Recruit & Select Staff Manage Workplace Relations Manage Quality Customer Service Manage & Purchase Stock Monitor & Maintain Computer System

Table A-8.4.6 (1) Indicative training packages for Post Harvest and Food Processing (Core Modules)

CERTIFICATE I CORE MODULES	CERTIFICATE II CORE MODULES	CERTIFICATE III CORE MODULES	CERTIFICATE IV CORE MODULES	CERTIFICATE V CORE MODULES
<p>Complete all 4 Core Modules Communicate in the workplace Apply basic mathematical concepts Apply safe work practices Apply basic quality assurance practices Apply basic food safety practices</p>	<p>Complete all 4 Core Modules Collect, present and apply workplace information Implement Occupational Health & Safety principles & procedures Implement the quality system Implement the food safety plan</p>	<p>Complete all 4 Core Modules Analyse and convey workplace information Monitor the implementation of occupational health and safety Monitor the implementation of the quality system Monitor the implementation of the food safety plan</p>	<p>Complete all 7 Core Modules Manage personal work profiles and professional development* Establish and manage effective workplace relationships* Manage operations to achieve planned outcomes Manage workplace information* Manage quality customer service* Maintain workplace systems Contribute to the development of a workplace learning environment*</p>	<p>Complete all 9 Core Modules Manage personal work priorities and professional development* Provide leadership in the workplace* Establish and manage effective workplace relationships* Participate in, lead and facilitate teams* Manage operations to achieve planned outcomes* Manage workplace information* Manage quality customer service* Design workplace systems Contribute to the development of a workplace learning environment*</p>

Table A-8.4.6 (2) Indicative training packages for Post Harvest and Food Processing (Optional Modules)

CERTIFICATE I OPTIONAL MODULES	CERTIFICATE II OPTIONAL MODULES	CERTIFICATE III OPTIONAL MODULES	CERTIFICATE IV OPTIONAL MODULES	CERTIFICATE V OPTIONAL MODULES
<p>Complete any 3 Optional Modules from:</p> <ul style="list-style-type: none"> Work in a team to achieve designated tasks Manually clean and sanitise equipment Operate a container washing process Conduct minor routine preventative maintenance Use basic product and stores knowledge to complete work operations Shift materials safely Use manual handling equipment 	<p>Complete any 5 Optional Modules from:</p> <ul style="list-style-type: none"> Use information technology devices in the workplace Participate in teams Apply sampling techniques Conduct routine tests Clean and sanitise equipment Implement environmental procedures Operate a waste treatment process Conduct routine preventative maintenance Plan to meet work requirements Handle dangerous goods Load and unload goods Operate a forklift Operate pumping equipment Operate palletising equipment <i>One enterprise-specific unit of competency approved by NFITC may be included as an optional unit</i> 	<p>Complete any 3 Optional Modules from:</p> <ul style="list-style-type: none"> Facilitate teams Prepare for training Deliver training Review training Conduct assessment in accordance with established assessment procedure Calculate and present statistical data Participate in a HACCP team (AQF III or above) Pest prevention and control Monitor the implementation of the environmental management program Diagnose and rectify equipment faults Manage personal work priorities and professional development Work with temperature controlled stock <i>One enterprise-specific unit of competency approved by NFITC may be included as an optional unit</i> 	<p>Complete any 4 Optional Modules from:</p> <ul style="list-style-type: none"> Implement and monitor continuous improvement systems and processes* Facilitate and capitalise on change and innovation* Provide leadership in the workplace* Participate in, lead and facilitate teams* Plan and co-ordinate a routine preventative maintenance program Participate in a HACCP team Plan Assessment ** Conduct Assessment ** Review Assessment ** Plan and promote training program ** Deliver training sessions ** <i>One enterprise-specific unit of competency approved by NFITC may be included as an optional unit</i> 	<p>Complete any 2 Optional Modules from:</p> <ul style="list-style-type: none"> Implement and monitor continuous improvement systems and processes* Facilitate and capitalise on change and innovation* Manage service agreements and contracts Contribute to the development of the food enterprise Manage financial planning and performance to achieve business plans Design and establish the Assessment system ** Manage the training and assessment system ** Evaluate the training and assessment systems ** Develop assessment tools ** <i>One enterprise-specific unit of competency approved by NFITC may be included as an optional unit</i>

Table A-8.4.6 (3) Indicative training packages for Post Harvest and Food Processing (Specialist Stream Modules)

CERTIFICATE I SPECIALIST STREAM MODULES	CERTIFICATE II SPECIALIST STREAM MODULES	CERTIFICATE III SPECIALIST STREAM MODULES	CERTIFICATE IV SPECIALIST STREAM MODULES	CERTIFICATE V SPECIALIST STREAM MODULES
Aerated waters	Aerated waters	Aerated waters	Aerated waters	Aerated waters
Dairy Processing	Dairy Processing	Dairy Processing	Dairy Processing	Dairy Processing
Edible Oils and Fats	Edible Oils and Fats	Edible Oils and Fats	Edible Oils and Fats	Edible Oils and Fats
General Foods	General Foods	General Foods	General Foods	General Foods
Biscuits	Biscuits	Biscuits	Biscuits	Biscuits
Flour Milling	Flour Milling	Flour Milling	Flour Milling	Flour Milling
Confectionery	Confectionery	Confectionery	Confectionery	Confectionery
Pastry	Pastry	Pastry	Pastry	Pastry
Stockfeed Milling	Stockfeed Milling	Stockfeed Milling	Stockfeed Milling	Stockfeed Milling
EXAMPLE OF SPECIALIST MODULE -- FRUIT AND VEGETABLES Complete 1 Specialist Modules from: Locate industry and company products and processes (Fruit and Vegetables) Pack product manually	EXAMPLE OF SPECIALIST MODULE -- FRUIT AND VEGETABLES Complete 1 Specialist Modules from: Operate a drying process Operate evaporation process Fill close and inspect can seams Operate a freezing process Operate a heat treatment process Operate homogenising equipment Pre-process raw materials Operate a retort process Operate a packaging process Operate a flour pre-mix process Operate a packaging process	EXAMPLE OF SPECIALIST MODULE -- FRUIT AND VEGETABLES Complete 1 Specialist Modules from: Operate a system (Fruit and Vegetables)	EXAMPLE OF SPECIALIST MODULE -- FRUIT AND VEGETABLES Complete 1 Specialist Modules from: Co-ordinate a fruit and vegetable production system Co-ordinate a mix plant system (Fruit and Vegetable)	EXAMPLE OF SPECIALIST MODULE -- FRUIT AND VEGETABLES Complete 1 Specialist Modules from: Manage fruit and vegetable-based production system

8.5 Simulation of Enrolment Growth Plan for Polytechnics

(1) Basic assumptions in relation to enrolment

The growth rates of student enrolment in each technical education course in polytechnics were simulated in order to reach the target capacity in 2020, discussed in Section 7.2.3.

- In relation to packaged courses, 8 pilot programs in 6 pilot areas are proposed to start at 8 polytechnics as a high priority for development. The details of selecting these pilot programs are discussed in Section 8.1 of Main Report.
- Enrolment of existing departments offering HND increased by 32% up to the year 2000. It is proposed that this enrolment growth will be then frozen until the year 2007, during which period polytechnics will focus on development of the newly proposed pilot programs. Then, along the expansion of enrolment in pilot programs, enrolment of existing departments will decrease after 2008.
- Non-tertiary courses will stop their intake after the year 2002, recognizing that polytechnics should focus on tertiary education only, leaving non-tertiary education to TIs.
- The development of pilot programs can be divided into three phases. In the first phase, each polytechnic will select one pilot program for the development. In the second phase, following trials in the first phase, some polytechnics will be selected to commence other pilot programs. In the third phase, any polytechnic can start pilot programs, as long as there are demonstrated needs in the region. The development plan of these pilot programs is shown in Table A-8.5.1, although the implementation of this plan will be dependent on industrial needs in the future.
- In relation to short courses and distance-learning, enrolment is planned based on their ratios to packaged courses, as shown in Table A-8.5.2. Pilot programs in short courses will commence their intake of students from the beginning of the project, because there are already strong industrial demands for specifically trained personnel in related industries. It is assumed that intakes by existing department in the provision of short course will start later when appropriate research and investigation of needs have been completed. Distance-learning will commence in keeping with implementation of the proposed project in 2008.
- Both growth rates of existing departments after the year 2009, and pilot programs in the third phase, are determined in order to meet the target training capacities in 2020.

Table A-8.5.1 Growth rates of enrolment for packaged course

Existing departments		Up to 2000	2001-2008	2008-2020
1	HND: Engineering	32.0%	0.0%	-2.0%
2	HND: Applied science	32.0%	0.0%	-2.0%
3	HND: Management/business	32.0%	0.0%	-2.0%
4	Non-tertiary	0.0%	Stop intake	Stop intake

New department

		No of PI (2005-08)	No of PI (2008-11)	No of PI (2011-20)	Class size	Growth after
1	Hospitality and tourism	2	5	9	80	15.0%
2	IT and communications	1	5	7	80	12.0%
3	Business IT	1	5	10	80	15.0%
4	Post harvest and food processing	2	6	7	60	15.0%
5	Wood processing technology	1	2	3	60	10.0%
6	Manufacturing technology	1	6	8	60	13.0%

Table A-8.5.2 Enrolment ratios of short course and distance-learning to packaged course (this will be changed later)

	Up to 2008	2008-2011	2011-2020
Short course			
Existing courses	0.0%	30.0%	60.0%
Pilot program courses	20.0%	40.0%	80.0%
Distance-learning			
Existing courses	0.0%	0.0%	4.0%-23.0%
Pilot program courses	0.0%	20.0%-40.0%	50.0%-100.0%

Note: Ratios of distance-learning is assumed to increase year by year.

(2) Proposed plan of enrolment growth

Based on the assumptions described above, the enrolment plan was made, as shown in Table A-8.5.3 for existing packaged course and Table A-8.5.4 for the overall polytechnic enrolment. The following is a summary of the results:

- With regard to existing packaged course, the total enrolment will decrease from 22,000 in 2000 to 17,000 in 2020, in which the shares of Engineering, Applied math/science and Management/business study will be 30%, 21% and 49% in 2020, respectively.
- With regard to the overall polytechnic enrolment, the total enrolment will increase from 22,000 in 2000 to 97,000 in 2020 or 4.4 times, in which the shares of Packaged course, Short course and Distance-learning will be 42%, 30% and 28% in 2020, respectively.

Table A-8.5.4 Estimation of the overall polytechnic enrolment

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	(Many-year) 2020	Share in 2020		
Packaged courses																										
Existing packaged courses																										
Engineering	3,745	4,943	6,525	6,706	6,889	7,075	7,216	7,361	7,508	7,658	7,825	7,974	7,227	7,082	6,941	6,802	6,666	6,532	6,402	6,274	6,148	6,025	5,905	5,905	6.1%	
Applied science	2,696	3,559	4,699	4,791	4,887	4,985	5,085	5,186	5,290	5,396	5,296	5,190	5,086	4,984	4,885	4,787	4,691	4,597	4,505	4,415	4,327	4,240	4,156	4,156	4.3%	
Management/Business	5,842	7,711	10,179	10,483	10,890	11,302	11,624	11,857	12,094	12,336	12,159	11,916	11,678	11,444	11,215	10,991	10,771	10,556	10,344	10,133	9,935	9,736	9,541	9,541	9.8%	
Non-tertiary engineering	549	549	549	366	366	183	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0%	
Sub-total	12,832	16,763	21,951	22,529	23,033	23,545	23,925	24,404	24,892	25,390	24,979	24,480	23,990	23,510	23,040	22,579	22,128	21,685	21,252	20,827	20,410	20,002	19,602	19,602	20.7%	
Pilot program courses																										
Existing pilot program courses																										
Hospitality and tourism										160	320	480	720	960	1,200	1,520	1,840	2,160	2,419	2,710	3,035	3,399	3,807	3,807	3.9%	
IT and communications										80	160	240	560	880	1,200	1,600	1,920	2,240	2,560	2,880	3,200	3,520	3,840	3,840	2.8%	
Business IT										80	160	240	560	880	1,200	1,600	2,000	2,400	2,800	3,200	3,600	4,000	4,400	4,400	4.3%	
Post harvest and food processing										120	240	360	600	840	1,080	1,440	1,800	2,160	2,520	2,880	3,240	3,600	3,960	3,960	2.3%	
Wood processing technology										60	120	180	240	300	360	420	480	540	600	660	720	780	840	870	0.9%	
Manufacturing technology										60	120	180	480	780	1,080	1,320	1,560	1,800	2,040	2,280	2,520	2,760	3,000	2,319	2.4%	
Sub-total										560	1,120	1,680	3,180	4,840	6,120	7,240	8,360	9,480	10,544	11,729	13,049	14,516	16,151	16,151	16.6%	
Total	12,832	16,763	21,951	22,529	23,033	23,545	23,925	24,404	24,892	25,950	26,099	26,160	27,150	28,150	29,160	29,819	30,488	31,165	31,796	32,556	33,459	34,518	35,753	35,753	36.7%	
Short courses																										
Existing short courses																										
Engineering						354	361	368	375	766	1,505	2,212	2,891	3,541	4,164	4,761	5,353	5,979	6,402	6,274	6,148	6,025	5,905	5,905	6.1%	
Applied science						249	254	259	265	540	1,059	1,557	2,034	2,492	2,931	3,351	3,753	4,138	4,505	4,415	4,327	4,240	4,156	4,156	4.3%	
Management/Business						555	581	593	605	1,264	2,432	3,575	4,671	5,722	6,729	7,694	8,617	9,500	10,344	10,133	9,935	9,736	9,541	9,541	9.8%	
Sub-total						1,168	1,196	1,220	1,245	2,559	4,996	7,344	9,596	11,755	13,824	15,806	17,702	19,517	21,252	20,827	20,410	20,002	19,602	19,602	20.1%	
Pilot program courses																										
Existing pilot program courses																										
Hospitality and tourism										16	64	144	288	480	720	1,064	1,472	1,944	2,419	2,710	3,035	3,399	3,807	3,807	3.9%	
IT and communications										8	32	72	224	440	720	982	1,216	1,512	1,848	2,033	2,286	2,560	2,706	2,706	2.8%	
Business IT										8	32	72	224	440	720	1,120	1,400	1,680	1,968	2,256	2,544	2,832	3,120	3,120	4.3%	
Post harvest and food processing										12	48	108	240	420	648	798	960	1,134	1,411	1,581	1,770	1,983	2,221	2,221	2.3%	
Wood processing technology										6	24	54	96	150	216	294	384	486	594	653	719	791	870	870	0.9%	
Manufacturing technology										6	24	54	96	150	216	294	384	486	594	653	719	791	870	870	2.4%	
Sub-total										56	224	504	1,254	2,320	3,672	5,069	6,688	8,532	10,544	11,729	13,049	14,516	16,151	16,151	16.6%	
Total	0	0	0	0	0	1,168	1,196	1,220	1,245	2,585	5,220	7,848	10,860	14,075	17,495	20,874	24,380	28,049	31,796	32,556	33,459	34,518	35,753	35,753	36.7%	
Distance learning																										
Existing courses																										
Pilot program courses																										
Total	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Grand total	12,832	16,763	21,951	22,529	23,033	24,713	25,121	25,624	26,136	28,544	31,319	34,008	38,642	43,618	49,104	57,700	64,320	71,271	78,403	82,957	88,129	92,554	97,458	97,458	100.0%	
																									99.9%	

8.6 Overview of Current Financial Conditions of Polytechnics

Table A-8.6.1 shows a summary of revenues and recurrent expenditures in polytechnics for the years 1996 to 1998, with values in US\$ for 1998, based on the reports of "Statistical Digest of the Polytechnics, NCTE".

In comparing revenues with recurrent expenditures, some cases show a negative value (deficit). At an interview with the staff of NCTE, it was learned that, in such cases, polytechnics request a "Government Grant" for the following year in order to make up for such a deficit. For 1998, the total amount of both revenue and recurrent expenditure in the seven polytechnics reported is about US\$ 4 million, with a slight positive balance.

Table A-8.6.1 Summary of revenue and recurrent expenditure in 7 polytechnics

		Actual	Actual	Actual	
		1996 (Mil. Cedi)	1997 (Mil. Cedi)	1998 (Mil. Cedi)	(US\$ 1,000)
(1) Accra	(1) Revenue Income	837.32	1,072.84	1,383.51	597
	(2) Recurrent Expenditures	899.48	1,709.09	1,564.69	675
	(3) (1) - (2)	-62.16	-636.25	-181.17	-78
(2) Kumasi	(1) Revenue Income	302.76	1,406.33	1,728.00	745
	(2) Recurrent Expenditures	989.59	1,196.00	1,316.40	568
	(3) (1) - (2)	-686.83	210.33	411.60	178
(3) Takoradi	(1) Revenue Income	580.72	(n.a.)	1,418.49	612
	(2) Recurrent Expenditures	808.65	1,316.41	2,097.70	905
	(3) (1) - (2)	-227.93		-679.21	-293
(4) Ho	(1) Revenue Income	149.67	(n.a.)	1,998.44	862
	(2) Recurrent Expenditures	692.96	(n.a.)	1,434.69	619
	(3) (1) - (2)	-543.28		563.75	243
(5) Cape Coast	(1) Revenue Income	260.05	348.92	528.83	228
	(2) Recurrent Expenditures	216.58	413.06	535.55	231
	(3) (1) - (2)	43.47	-64.14	-6.73	-3
(6) Tamale	(1) Revenue Income	983.22	(n.a.)	1,122.31	484
	(2) Recurrent Expenditures	527.43	(n.a.)	1,122.39	484
	(3) (1) - (2)	455.79		-0.08	0
(7) Sunyani	(1) Revenue Income			952.18	411
	(2) Recurrent Expenditures			986.19	425
	(3) (1) - (2)			-34.02	-15
Total	(1) Revenue Income			9,131.77	3,940
	(2) Recurrent Expenditures			9,057.62	3,908
	(3) (1) - (2)			74.15	32

Source: Statistical Digest of the Polytechnics, 1996/97, 1997/98 and 1998/99, NCTE.

Note: (n.a.) : Not available

1998 revenue income, for example, stands for that during Nov. 1997 to Oct. 1998.

1998 recurrent expenditure, for example, stands for that during Jan. 1998 to Dec. 1998.

1998 exchange rate applied is Cedi 2,318 per US\$ as an annual average rate based on the data of Bank of Ghana.

Information from Koforidua Polytechnic was not available.

Table A-8.6.2 shows a summary of revenues by aggregated category in polytechnics for the years 1996 to 1998, with values in US\$ basis for 1998, based on the reports of "Statistical Digest of the Polytechnics, NCTE".

The revenue items are classified into four categories of "government grants", "paid by students", "production unit", and "others". "Government grant" is the money provided by the MOE under the government budget. "Paid by student" includes application fees, admission fees, registration fees, examination fees, academic facility use fees, sports fees, health service fees, tuition fees, etc. At present, tuition fees are charged only for students of non-HND courses.

"Production unit" covers generated income obtained from outside of polytechnics, including revenue obtained from charges of the use of polytechnic facilities, sales of production (carpentry, etc.), service charges (repair of auto-vehicles, etc), catering, etc. In the case that the polytechnics provide their productions and services to outside users, such revenues are counted as "production unit". Although in the revenue information in the NCTE report, the revenue item of "use of polytechnic facility" includes both the cases that users are outside and also inside (students), such items are classified as a "production unit" in Table A-8.6.2. "Others" includes rent receivable from staff accommodation, interest receivable, etc.

According to the figures for all polytechnics in 1997/98, the majority of revenue is "government grant" (share ratio of about 70%), followed by "paid by student (28%). The share ratio of "production unit" is rather small (less than 1%).

Table A-8.6.2 Summary of revenue by category in polytechnics

		Revenue Actual 1995/96 (Mil.Cedi)	Revenue Actual 1996/97 (Mil.Cedi)	Revenue Actual 1997/98 (Mil.Cedi)	(US\$ 1,000)
(1) Accra	(1) Government grant	714.79 (85.4%)	728.49 (67.9%)	833.74 (60.3%)	359.7
	(2) Paid by student	111.21 (13.3%)	297.18 (27.7%)	549.28 (39.7%)	237.0
	(3) Production unit	7.36 (0.9%)	4.39 (0.4%)	0.00 (0.0%)	0.0
	(4) Others	3.96 (0.5%)	42.79 (4.0%)	0.50 (0.0%)	0.2
	(5) Total	837.32 (100.0%)	1,072.84 (100.0%)	1,383.51 (100.0%)	596.9
(2) Kumasi	(1) Government grant	0.00 (0.0%)	949.75 (67.5%)	1,015.00 (58.7%)	437.9
	(2) Paid by student	302.76 (100.0%)	401.24 (28.5%)	666.00 (38.5%)	287.3
	(3) Production unit	0.00 (0.0%)	13.76 (1.0%)	28.00 (1.6%)	12.1

		Revenue Actual 1995/96 (Mil.Cedi)	Revenue Actual 1996/97 (Mil.Cedi)	Revenue Actual 1997/98 (Mil.Cedi)	(US\$ 1,000)
	(4) Others	0.00 (0.0%)	41.58 (3.0%)	19.00 (1.1%)	8.2
	(5) Total	302.76 (100.0%)	1,406.33 (100.0%)	1,728.00 (100.0%)	745.5
(3) Takoradi	(1) Government grant	515.59 (88.8%)		1,023.42 (72.1%)	441.5
	(2) Paid by student	63.36 (10.9%)		376.01 (26.5%)	162.2
	(3) Production unit	0.32 (0.1%)		9.04 (0.6%)	3.9
	(4) Others	1.45 (0.2%)		10.02 (0.7%)	4.3
	(5) Total	580.72 (100.0%)	(n.a.)	1,418.49 (100.0%)	611.9
(4) Ho	(1) Government grant	80.00 (53.4%)		1,692.04 (84.7%)	730.0
	(2) Paid by student	67.51 (45.1%)		300.12 (15.0%)	129.5
	(3) Production unit	2.16 (1.4%)		6.04 (0.3%)	2.6
	(4) Others	0.00 (0.0%)		0.25 (0.0%)	0.1
	(5) Total	149.67 (100.0%)	(n.a.)	1,998.44 (100.0%)	862.1
(5) Cape Coast	(1) Government grant	216.48 (83.2%)	280.49 (80.4%)	380.33 (71.9%)	164.1
	(2) Paid by student	42.48 (16.3%)	65.76 (18.8%)	145.39 (27.5%)	62.7
	(3) Production unit	1.09 (0.4%)	1.92 (0.6%)	0.00 (0.0%)	0.0
	(4) Others	0.00 (0.0%)	0.75 (0.2%)	3.10 (0.6%)	1.3
	(5) Total	260.05 (100.0%)	348.92 (100.0%)	528.83 (100.0%)	228.1
(6) Tamale	(1) Government grant	433.03 (44.0%)		834.58 (74.4%)	360.0
	(2) Paid by student	546.96 (55.6%)		259.72 (23.1%)	112.0
	(3) Production unit	1.70 (0.2%)		12.84 (1.1%)	5.5
	(4) Others	1.53 (0.2%)		15.18 (1.4%)	6.5
	(5) Total	983.22 (100.0%)	(n.a.)	1,122.31 (100.0%)	484.2

		Revenue Actual 1995/96 (Mil.Cedi)	Revenue Actual 1996/97 (Mil.Cedi)	Revenue Actual 1997/98 (Mil.Cedi)	(US\$ 1,000)
(7) Sunyani	(1) Government grant			645.33 (67.8%)	278.4
	(2) Paid by student			297.85 (31.3%)	128.5
	(3) Production unit			9.00 (0.9%)	3.9
	(4) Others			0.00 (0.0%)	0.0
	(5) Total			952.18 (100.0%)	410.8
Total	(1) Government grant			6,424 (70.4%)	2,771.5
	(2) Paid by student			2,594 (28.4%)	1,119.2
	(3) Production unit			65 (0.7%)	28.0
	(4) Others			48 (0.5%)	20.7
	(5) Total			9,132 (100.0%)	3,939.5

Source: Statistical Digest of the Polytechnics, 1996/97, 1997/98 and 1998/99, NCTE.

Note: (n.a.): Not available

1998 revenue income, for example, stands for that during Nov. 1997 to Oct. 1998.

1998 exchange rate applied is Cedi 2,318 per US\$ as an annual average rate based on the data of Bank of Ghana.

Information from Koforidua Polytechnics was not available.

Regarding the student fees, the system, naming and amount of fees were previously different in each polytechnic. However, for the year 1999/2000, the following unified tariff system, common for every polytechnic, has been applied. Refer to Table A-8.6.3.

Table A-8.6.3 Unified tariff of student fees in polytechnics

	(Cedi)		
	Business course	Applied science course	Engineering course
Academic facility use fee	135,000	169,000	183,000
Admission (fresh student only)	30,000	30,000	30,000
Registration	15,000	15,000	15,000
Examination	35,000	35,000	35,000
Sports & recreation	7,000	7,000	7,000
Official publications (fresh student only)	15,000	15,000	15,000
(Summary)			
(Fresh students)	274,000	308,000	322,000
(Continuing students)	229,000	263,000	277,000

Source: Ho Polytechnics

Table A-8.6.4 shows a summary of recurrent expenditures by aggregated category in polytechnics for the years 1996 to 1998, with values in US\$ for 1998, based on the reports of "Statistical Digest of the Polytechnics, NCTE".

The items of expenditure are classified into three categories, which are "personnel costs of teachers", "personnel costs related to administrative sections" and "other administrative costs".

Regarding Table A-8.6.4, it should be noted, for example, that the teacher personnel cost in Accra Polytechnic for 1997 was found to include also amounts for several previous years' personnel costs, resulting in large amount, and the personnel costs related to administrative sections in Cape Coast Polytechnic for 1996 and 1997 show zero. These points suggest that there are improvements to be made in regard to the entering-up system in the account books.

According to the figures of all polytechnics in 1998, the share ratio of teacher personnel costs, personnel costs related to administrative sections and other administrative costs were about 35%, 23% and 42%, respectively. According to a statistics, titled by "Statistics in Education, Japan in 2020" issued by Ministry of Education, Japan, the share ratio of teacher personnel costs of all national colleges of technology, personnel costs related to administrative sections and other administrative costs were about 50%, 18% and 32%, respectively. This indicates that (1) the share of teacher salary is very low, (2) the share of administrative staff salary is higher, and (3) other administrative cost is very high. In other words, managerial efficiency needs to be improves by reduction of overhead cost.

Table A-8.6.4 Summary of recurrent expenditure by category in polytechnics

		Recurrent Cost Actual 1996 (Mil.Cedi)	Recurrent Cost Actual 1997 (Mil.Cedi)	Recurrent Cost Actual 1998 (Mil.Cedi)	(US\$ 1,000)
(1) Accra	(1) Teachers personnel costs		1,050.94 (61.5%)	149.74 (9.6%)	64.60
	(2) Admin personnel costs		240.72 (14.1%)	371.85 (23.8%)	160.42
	(3) Other admin costs		417.43 (24.4%)	1,043.11 (66.7%)	450.00
	(Total)	(n.a.)	1,709.09 (100.0%)	1,564.69 (100.0%)	675.02
(2) Kumasi	(1) Teachers personnel costs	518.06 (52.4%)	613.00 (51.3%)	722.00 (54.8%)	311.48
	(2) Admin personnel costs	205.69 (20.8%)	270.00 (22.6%)	304.40 (23.1%)	131.32
	(3) Other admin costs	265.85 (26.9%)	313.00 (26.2%)	290.00 (22.0%)	125.11
	(Total)	989.59 (100.0%)	1,196.00 (100.0%)	1,316.40 (100.0%)	567.90
(3) Takoradi	(1) Teachers personnel costs	390.60 (48.3%)	542.78 (41.2%)	770.88 (36.7%)	332.56
	(2) Admin personnel costs	188.85 (23.4%)	264.90 (20.1%)	344.21 (16.4%)	148.49
	(3) Other admin costs	229.20 (28.3%)	508.73 (38.6%)	982.61 (46.8%)	423.90
	(Total)	808.65 (100.0%)	1,316.41 (100.0%)	2,097.70 (100.0%)	904.96
(4) Ho	(1) Teachers personnel costs	342.86 (49.5%)		604.65 (42.1%)	260.85
	(2) Admin personnel costs	148.21 (21.4%)		403.10 (28.1%)	173.90
	(3) Other admin costs	201.89 (29.1%)		426.95 (29.8%)	184.19
	(Total)	692.96 (100.0%)	(n.a.)	1,434.69 (100.0%)	618.93
(5) Cape Coast	(1) Teachers personnel costs	147.70 (68.2%)	269.47 (65.2%)	199.63 (37.3%)	86.12
	(2) Admin personnel costs	0.00 (0.0%)	0.00 (0.0%)	163.33 (30.5%)	70.46
	(3) Other admin costs	68.88 (31.8%)	143.59 (34.8%)	172.60 (32.2%)	74.46
	(Total)	216.58 (100.0%)	413.06 (100.0%)	535.55 (100.0%)	231.04

		Recurrent Cost Actual 1996 (Mil.Cedi)	Recurrent Cost Actual 1997 (Mil.Cedi)	Recurrent Cost Actual 1998 (Mil.Cedi)	(US\$ 1,000)
(6) Tamale	(1) Teachers personnel costs	170.93 (32.4%)		399.67 (35.6%)	172.42
	(2) Admin personnel costs	132.00 (25.0%)		215.21 (19.2%)	92.84
	(3) Other admin costs	224.50 (42.6%)		507.51 (45.2%)	218.94
	(Total)	527.43 (100.0%)	(n.a.)	1,122.39 (100.0%)	484.21
(7) Sunyani	(1) Teachers personnel costs			351.35 (35.6%)	151.57
	(2) Admin personnel costs			242.24 (24.6%)	104.50
	(3) Other admin costs			392.61 (39.8%)	169.37
	(Total)			986.19 (100.0%)	425.45
(Total)	(1) Teachers personnel costs			3,197.91 (35.3%)	1,379.60
	(2) Admin personnel costs			2,044.33 (22.6%)	881.94
	(3) Other admin costs			3,815.38 (42.1%)	1,645.98
	(Total)			9,057.62 (100.0%)	3,907.51

Source: Statistical Digest of the Polytechnics, 1996/97, 1997/98 and 1998/99, NCTE.

Note: (n.a.) : Not available

1998 recurrent expenditure, for example, stands for that during Jan. 1998 to Dec. 1998.

1998 exchange rate applied is Cedi 2,318 per US\$ as an annual average rate based on the data of Bank of Ghana.

Information from Koforidua Polytechnics was not available.

8.7 Estimation of Unit Costs for Budgetary Simulation

Several unit costs have been estimated and used in the following stages of budgetary simulation:

(1) Unit personnel costs of teachers

Based on the data of salary structure table, "Conditions of Service for Senior Members and Senior Staff of the Polytechnics in Ghana", the average values of salary of teachers by grade, as of April 1999, were obtained. Based on information taken from the "Statistical Digest of Polytechnics, 1998/99, NCTE", the total number of teachers by grade in seven polytechnics was obtained. By utilizing both data, the weighted average salary of teachers for polytechnic was estimated to be Cedi. 5,729,000 per year. Assuming allowances account for 10% of basic salary, the 1999 annual total average personnel cost of each teacher is estimated to be US\$ 2,583, which is equivalent to US\$ 215 per month. Table A-8.7.1 shows a summary of estimation of unit personnel costs of teachers in polytechnics.

Table A-8.7.1 Summary of estimation of unit personnel costs (monthly) of teachers in polytechnics

Grade	Estimated average salary (Cedi 1,000) (*1)	Total numbers of teachers by grade (*2)	Numbers of teachers by grade, percent (*3)	(*1) x (*3)
Principal Lecturer	8,838	0	0.0%	0
Senior Lecturer	7,888	3	0.5%	42
Lecturer	6,226	138	24.4%	1,518
Assistant Lecturer	4,868	9	1.6%	77
Principal Instructor	6,630	111	19.6%	1,300
Senior Instructor	5,899	130	23.0%	1,355
Instructor	4,744	116	20.5%	972
Assistant Instructor	4,456	59	10.4%	464
(Average)		566	100.0%	5,729
	Exchange rate	(as of April 1999)	Cedi 2,440/US\$	(US\$) 2,348
	Assumption on	Allowance: 10%		235
	Annual total			2,583
	Monthly (US\$)			215

Source: (*1) : Conditions of Service for Senior Members and Senior Staff of the Polytechnics in Ghana.
 (*2) : Statistical Digest of Polytechnics, 1998/99, NCTE.

Note: Estimated by JICA Study Team.

(2) Unit personnel costs related to administrative sections

Based on the data of salary structure table, "Conditions of Service for Senior Members and Senior Staff of the Polytechnics in Ghana", the average values of salary of staff related to administrative sections, by grade as of April 1999, were obtained. Based on "Statistical Digest of Polytechnics, 1998/99, NCTE", the total number of administrative

staff by grade in seven polytechnics was obtained. By utilizing both data, the weighted average salary related to administrative sections for polytechnics was estimated to be Cedi. 3,185,000 per year. Assuming that the allowances account for 10% of basic salary, the 1999 annual total average personnel cost of administrative employees is estimated to be US\$ 1,436, which is equivalent to US\$ 120 per month. Table A-8.7.2 shows a summary of estimation of unit personnel costs related to administrative sections in polytechnics.

Table A-8.7.2 Summary of estimation of unit personnel costs (monthly) related to administrative sections in polytechnics

Grade	Estimated average salary (Cedi 1,000) (*1)	Total numbers of employees by grade (*2)	Numbers of employees by grade, percent (*3)	(*1) x (*3)
Principal	8,443	7	0.9%	79
Senior Admini.	6,265	71	9.5%	592
Senior Technical	5,023	93	12.4%	622
Junior Technical	2,797	271	36.1%	1,009
Junior non-Technical	2,144	309	41.1%	882
(average)		751	100.0%	3,185
	Exchange rate	(as of April 1999)	Cedi 2,440/US\$	(US\$) 1,305
	Assumption on	Allowance: 10%		131
	Annual total			1,436
	Monthly (US\$)			120

Source: (*1): Conditions of Service for Senior Members and Senior Staff of the Polytechnics in Ghana.

(*2): Statistical Digest of Polytechnics, 1998/99, NCTE.

Note: Estimated by JICA Study Team.

(3) Estimation of other non-personnel administrative costs

According to the "Statistical Digest of Polytechnics, 1998/99, NCTE", the total amount of other costs, excluding personnel costs, in seven polytechnics is about Cedi 3,815 million (Refer to Table A-8.6.4), and the total number of students (HND and non-HND) in seven polytechnics is 11,682. The annual average other non-personnel administrative costs per students, therefore, are estimated to be about Cedi 326,000, which is equivalent to about US\$ 140 per year, assuming the 1998 average exchange rate of Cedi 2,381 per US\$.

8.8 General Description of Budget Items for Budgetary Simulation

Several budget items of outflow and inflow in cash flow tabulation have been assumed for budgetary simulation:

The general description of budget items is as follows:

(1) Items in cash flow table

Items of outflow

The items of outflow are as follows:

- a. Investment related costs
 - Buildings
 - Equipment
 - Training
- b. Operation and maintenance costs
 - Maintenance costs of buildings
 - Maintenance costs of equipment
 - Personnel costs of teachers
 - Personnel costs of administrative sections
 - Other non-personnel administrative costs

Items of inflow

The items of inflow are as follows:

- Equity
- Student fees

(2) General description of each item

The general description of the above items is as follows:

It is noted that the annual growth rate utilized here means an increase in cost accompanied by a qualitative improvement of each cost factor.

i) Investment costs of buildings

The investment costs of buildings are based on the cost estimates related to building / facilities development. The detailed cost estimation is described in Appendix 8.8.

ii) Investment costs of equipment

The investment costs of equipment are based on the cost estimates related to equipment development. The detailed cost estimation is described in Appendix 8.9.

iii) Training costs

The training costs are based on the cost estimates related to human resource development. The detailed cost estimation is described in Appendix 8.10.

iv) Maintenance costs of buildings

The maintenance costs of buildings are based on the cost estimates related to buildings / facilities development. The detailed cost estimation is described in Appendix 8.8.

v) Maintenance costs of equipment

The maintenance costs of equipment are based on the cost estimates related to equipment development. The detailed cost estimation is described in Appendix 8.9.

vi) Personnel costs of teachers

The personnel costs of teachers are estimated for the two categories of full-time and part-time staff.

The personnel costs are calculated by multiplying the number of teachers by the unit personnel cost.

The required numbers of teachers are obtained based on the previously estimated number of enrolment and an assumed number of students per teacher ratio. The number of part-time teachers is estimated by using ratio of part-time teachers to full-time teachers.

The unit personnel cost per month of US\$ 215 was applied as a base value of monthly salary of full-time teachers in the existing packaged course in 2002, with an annual growth rate of 8%. This value is based on the estimation previously mentioned in Appendix 8.6. In respect to other course / department categories, twice the base value was applied, with an annual growth rate of 4%.

For the part-time teachers, 1.5 times the base value of the existing packaged course was applied, with an annual growth rate of 7%. Regarding other course / department categories, twice the base value was applied, with an annual growth rate of 3%. Refer to Table A-8.8.1.

Table A-8.8.1 Assumptions on personnel costs of teachers

	Teacher-student ratio	Ratio of part time teacher	Full time teacher			Part time teacher		
			Salary in 2002 (US\$/mo)	Salary in 2020 (US\$/mo)	Growth (%)	Salary in 2002 (US\$/mo)	Salary in 2020 (US\$/mo)	Growth (%)
Packaged courses								
Existing packaged courses	20	20%	215	859	8%	323	1,090	7%
Pilot Program courses	15	50%	430	871	4%	645	1,098	3%
Short courses								
Existing courses	80	50%	430	871	4%	645	1,098	3%
Pilot Program courses	60	50%	430	871	4%	645	1,098	3%
Distance learning								
Existing courses	300	0%	430	871	4%	645	1,098	3%
Pilot Program courses	300	0%	430	871	4%	645	1,098	3%

It is noted that in distance-learning, teachers are categorized as tutors. Personnel costs of tutors are included in the item of personnel costs of administrative sections, together with other administrative staff (producer, technical staff, etc.)

vii) Personnel costs of administrative sections

The personnel costs of administrative sections are calculated by multiplying the estimated number of administrative staff by the unit personnel cost.

The required numbers of administrative staff are estimated based on the ratio of administrative staff to teachers. Based on the data in the “Statistical Digest of Polytechnics, 1998/99, NCTE”, the ratio of administrative staff to teachers is estimated to be about 1.3 (total numbers of teaching staff and administrative staff in polytechnics are 566 and 751, respectively). According to statistical data regarding Colleges of Technology in Japan, the ratio of administrative staff to teachers is estimated to be about 0.7. In this analysis, assuming more efficient management in future, the ratio of administrative staff to teachers of 0.7 is applied.

The unit personnel cost per month of US\$ 120 was applied as a monthly salary of administrative staff for every course / department category in 2002, with an annual growth rate of 8%. This value is based on the estimation previously mentioned in Appendix 8.6. Refer to Table A-8.8.2.

Table A-8.8.2 Assumptions on personnel costs of administrative sections

Ratio of administrative staff to teacher	0.7
Salary of administrative staff in 2002	120
Salary of administrative staff in 2020	480
Growth rate of administrative staff salary	8%

viii) Other non-personnel costs

The other non-personnel administrative costs are calculated by multiplying the estimated number of students enrolled by the unit cost per student.

The unit cost per student of US\$ 140 per annum was applied for the existing packaged course in 2002, with an annual growth rate of 4%. This value is based on the estimation previously mentioned in Appendix 8.6.

Regarding other course / department categories, three times the base value for pilot program in packaged courses, twice and three times the base value for existing departments and pilot program in short courses, respectively. Refer to Table A-8.8.3.

Table A-8.8.3 Assumptions on other non-personnel costs

	Unit cost Other Than Salary		
	Cost in 2002 (US\$/student /y)	Cost in 2020 (US\$/student /y)	Growth (%)
Packaged courses			
Existing packaged courses	140	279	4%
Pilot Program courses	420	836	4%
Short courses			
Existing courses	35	70	4%
Pilot Program courses	105	209	4%
Distance learning			
Existing courses	70	139	4%
Pilot Program courses	105	209	4%

ix) Equity

In this budgetary simulation, it is assumed that equity contributions will cover the investment cost portion of items of “building”, “equipment” and “training”.

Furthermore, it has been assumed that the basic portion of personnel costs of teachers and administrative sections will also be covered by equity. Here, the basic portion of personnel cost means the cost in the first year, without incremental increases (year 2002 for category of existing departments and 2003 for category of new departments). Refer to Table A-8.8.4.

Table A-8.8.4 Assumptions on equity

	Existing	Pilot	Distance
(1) Investment			
Building	100%	100%	100%
Equipment	100%	100%	100%
Training	100%	100%	100%
(2) O/M			
Maint. (Building)	0%	0%	0%
Maint. (Equipment)	0%	0%	0%
Personnel Cost (Teacher)			
Base	100%	100%	100%
Incremental	0%	0%	0%
Personnel Cost (Adm.)			
Base	100%	100%	100%
Incremental	0%	0%	0%
Other Costs	0%	0%	0%

x) Student fees

In order to set practical tuition level under the proposed cost recovery policy, the market conditions for the managerial and technical training courses currently offered by various organizations were surveyed as shown in Table A-8.8.6. When they are converted into annual level, it was discovered that the average annual tuition levels are rather high, i.e., US\$ 7,634 for Short management course for executives, US\$ 3,546 for Long-term degree course and US\$ 3,219 for Computer course.

On the other hand, the current student fees charged to the HND students in polytechnics are estimated approximately to be US\$ 50 per year, as discussed in details in Table A-8.6.3 of Appendix 8.6. Although the student fee in 2002 has been assumed to be US\$ 60 for existing departments in packaged courses, it was proposed that annual tuition for new departments would be US\$ 1,000 and US\$ 500 for packaged and Short courses, respectively, considering that other training organizations charge over US\$ 3,000. Regarding other course / department categories, assumptions were made as shown in Table A-8.8.6. The revision of fee levels has been assumed with some annual growth rate, as shown in Table A-8.8.5.

Table A-8.8.5 Assumptions on student fees

	Fee		
	Fee in 2002	Fee in 2020	Growth
	(US\$/student /y)	(US\$/student /y)	(%)
Packaged courses			
Existing packaged courses	60	1,374	19%
Pilot Program courses	1,000	1,428	2%
Short courses			
Existing courses	30	687	19%
Pilot Program courses	500	714	2%
Distance learning			
Existing courses	100	319	7%
Pilot Program courses	100	319	7%

xi) Income generation (production unit)

In this budgetary simulation, no income generation (production unit) is assumed.

xii) Undepreciated value

The depreciation period for building facilities is assumed to be 40 years, considering the physical nature of assets, and also referring to information about the tax system as of September 1999 (a maximum depreciation period for building of 33 years) based on report of "Ghana: Statistical Appendix, compiled by IMF, Jan. 2000".

The project calculation period is set up from 2002 to 2020.

Therefore, in the last year of calculation period (in 2020), some un-depreciated value will remain. This un-depreciated amount is reckoned as a negative outflow (inflow) in 2020.

Table A-8.8.6 Market survey for training course

Training type	Training provider	Course name	Certificate	Duration		Tuition (Res.) (Cedis)	Tuition (Non Res.) (Cedis)	Remarks	Convert into annual level (US\$/year)
					(days)				
Short management course for executives									
	GIMPA	Human resource management	Certificate	1 month	34	6,740,000	4,390,000	Including text, food, lodging	7,151
	GIMPA	Health Administration & management	Certificate	1 month	27	5,301,000	3,421,000	Including text, food, lodging	7,017
	GIMPA	management	Certificate	1 month	34	7,102,320	4,739,640	Including text, food, lodging	7,721
	GIMPA	Short management courses	Certificate	3 weeks	21	5,000,000	3,278,073	Including text, food, lodging	8,645
							Average		7,634
Long term degree course									
	GIMPA	Executive Masters in Public Administration (EMPA)	Certificate	2 years	732		52,195,000	Including text, food, lodging	3,949
	GIMPA	Executive Masters in Governance and Leadership (EMGL)	Certificate	2 years	732		52,195,000	Including text, food, lodging	3,949
	GIMPA	Master	Master degree	15 months	457.5		18,000,000		2,179
	GIMPA	MBA by distance learning	Master degree	2 years	732		58,500,000		4,426
	Kumasi PI	HND for international students	HND	3 years	1098		63,922,423	Including text, food, lodging	3,224
							Average		3,546
Computer course									
	IPMC	Window NT Server 4.0	Certificate	20 Days	20	2,500,000	2,500,000	Manual and Exam fees	6,923
	IPMC	Front Page 2000	Certificate	1 Month	30	1,200,000	1,200,000	Manual and Exam fees	2,215
	IPMC	Certified Accounts Professional	Certificate	1.5 Month	45	3,000,000	3,000,000	Manual and Exam fees	3,692
	IPMC	Diploma in IT	Diploma	6 months	183	5,000,000	5,000,000	Manual and Exam fees	1,513
	IPMC	Honours diploma in office applications	Honours diploma	1.5 Month	45.75	4,750,000	4,750,000	Manual and Exam fees	5,750
	IPMC	Honours diploma in database programming	Honours diploma	9 months	274.5	11,000,000	11,000,000	Manual and Exam fees	2,219
	IPMC	Honours diploma in website development	Honours diploma	6 months	183	8,000,000	8,000,000	Manual and Exam fees	2,421
	IPMC	Honours diploma in desktop publishing	Honours diploma	4 months	122	4,375,000	4,375,000	Manual and Exam fees	1,966
	IPMC	Honours diploma in system administration	Honours diploma	9 months	274.5	17,000,000	17,000,000	Manual and Exam fees	3,430
	IPMC	Diploma in hardware and networking	Diploma	4 months	122	4,500,000	4,500,000	Manual and Exam fees	2,043
							Average		3,219

Source: The JICA Study Team

8.9 Facility Development and Cost Estimation for Building Facilities

8.9.1 Current state of building construction in Ghana

(1) Suitable facility planning with environment

The climate of Ghana belongs to a tropical zone and has two main seasons: the dry season lasting from about October to March, and the wet season consisting of the heavy rains from about April to the end of July, followed by light rains in August and September. The country of Ghana is divided into two main zones by the savanna to the north and the rain forest lands to the south. The north part is dry during a greater part of year. The southwestern part is the wettest zone of the country with an annual rainfall of about 1,000-mm. The southeastern part including the Greater Accra Region is relatively less and the annual average rainfall seldom exceeds 600 mm.

The facility planning should take into consideration the local climate conditions such as sun, wind, humidity and rain, and also local customs such as life style and security. For example, the typical school buildings in Ghana are facing north and south with gallery type open corridors, deep eaves and/or louvers protecting from strong sunlight, heavy rain, and high humidity. In general toilet locations are carefully located with wind direction in order to keep the smell away. As a custom, toilets are often separated from main buildings. However, it is not the fundamental solution to improve the existing poor sanitary condition.



Figure A-8.9.1 Classrooms of Kumasi Polytechnic Institute

(2) Current state of infrastructure

Electricity

Most of the electricity in Ghana is produced in hydro-electric power plants on the Volta River. Although the power generation of Ghana has improved since the new thermal power plants were recently constructed to supplement the hydro-electric power plants, the capacity of electricity is forecasted as still insufficient. The demand for new power plants has already been raised according to the State of the Ghanaian Economy in 1999 document.

Telecommunication system

Since the new telecommunication system such as Internet and mobile telephone has become extremely popular world wide, the present capacity of the telecommunication system in Ghana is chronically insufficient. In order to minimize the impact on the economy of Ghana, a quick solution for the improvement of the system and/or the increase of the capacity will be expected.

Water Supply

The major water source comes from the Volta River. The rehabilitation of 33 major water distribution systems was recently embarked upon countrywide in an effort to improve water delivery. In the major cities no major problems are reported.

Sewerage

The public sewerage system is not evenly distributed throughout Ghana. The sewage from most of the existing major facilities is treated in septic tanks and discharged to the public drainage systems. However, the rate of non-treated sewage is still high. Taking into consideration environmental effects, new public sewage treatment systems should be expected in new development plans.

Solid Waste

Although the public solid waste collection systems are distributed in the major cities, the numbers of the garbage collecting cars in the cities are not enough. The environmental effects caused by solid wastes that are incinerated locally or left alone are becoming one of the major environmental problems. Increasing the numbers of the garbage collecting cars and new garbage collection systems should be expected in new development plans.

(3) Local construction methods of similar facility

The local construction methods of similar facilities are based on the climatic conditions, the locations of the site, local construction materials, construction period, construction cost and maintenance cost. These considerations shall provide the bases of any proposal.

- The local procurement of construction materials (Ref. Table A-8.9.1) shall be considered to reduce construction cost and shorten construction period.

- Considering the adaptation to the local climate, the resistance against climate and the selection of materials that are easy to maintain shall reduce the maintenance cost.
- It is important to note that the selection of material (Ref. Table A-8.9.1) should be made to satisfy the essential functions of polytechnic school such as training room and laboratory, and must be considered along with the utility and equipment plans.

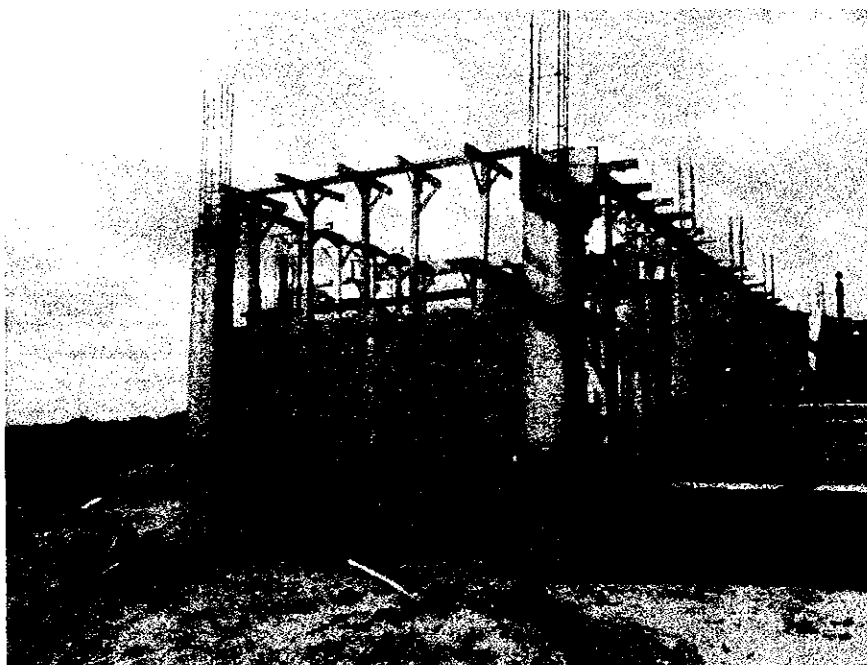


Figure A-8.9.2 Local construction site of similar facility

Table A-8.9.1 Construction materials of similar facility

		Administration	Class Room	Work Shop
Structure		Reinforced Concrete		
Exterior Finish	Roof	Long Span Industrial Aluminum Sheet		
	Eaves	Epoxy Sprayed Painting		
	Exterior Wall	Concrete Block with Epoxy Sprayed Painting		
	Window & Door	Aluminum Sash with Glass Louver		
	Exterior Floor	Granolithic Paving		
	Exterior Ceiling	Ply Wood with V.P.		
Interior Finish	Floor	Carpet	Terrazzo Paving	
	Wall	Mortar Bed with Epoxy Paint		
	Ceiling	Ply Wood with Epoxy Paint		Rock Wool Bd
W.C.	Floor	Non Slip Porcelain Tile		
	Wall	Ceramic Wall Tile		
	Ceiling	Ply Wood with V.P.		

(4) Local construction costs of similar facility

Local construction costs of similar facility are estimated on the basis of the following conditions:

- Two or three story school building with 6 classrooms and administration
- Separate single story workshop building
- Separate single story toilet building
- Infrastructure and landscaping included
- 10% contingency and 0.5% of Insurance
- Equipment not included
- Building materials on basis of Table A-8.9.1
- Consultant fee not included

Table A-8.9.2 Average construction cost per M2

Type of Building	Unit Cost
Administration Building:	US\$ 390 / M2
Classroom	US\$ 300 / M2
Workshop	US\$ 360 / M2
Toilet	US\$ 360 / M2
Assembly Hall	US\$ 330 / M2
Canteen Block (inc. Kitchen)	US\$ 540 / M2
Sports Gym.	US\$ 330 / M2
Generator House	US\$ 210 / M2
Sports Field	US\$ 45 / M2
Landscaping	US\$ 30 / M2
Fence Wall	US\$ 60 / M
Septic Tank (for 500 people)	US\$ 7,200

8.9.2 Construction costs based on Master Plan Scenario

(1) Suitable unit facility size per student

The facility size will be formulated based on the 8 Polytechnic Institutes in Ghana and the similar facilities in Japan. The existing unit facility size per student of 8 Polytechnic Institutes in Ghana ranges 2.0~4.5m² excluding dormitory and any accommodation relate facilities. A similar unit facility size per student in Japan ranges 15.0~25.0m² excluding dormitory and any accommodation related facilities. Taking into consideration the ranges of Ghana and Japan, the suitable unit facility size per students of the new facility development in Ghana was estimated, and the mid-range of 5.0~15.0m² seems

appropriate. The range is changeable depending on the site conditions, types of courses and departments of the Master Plan Scenario. Since the area per student varies depending on the size of workshop, the average sizes for each course and department are selected as follows:

Table A-8.9.3 Average sizes for each course and department

Existing packaged courses

Engineering	10 m ² /student
Applied Science	9 m ² /student
Management/Business	8 m ² /student

Pilot departments

Hospitality and tourism	8 m ² /student
IT and communication	9 m ² /student
Business IT	9 m ² /student
Post harvest and food processing	10 m ² /student
Wood processing technology	10 m ² /student
Manufacturing technology	10 m ² /student

(2) Suitable unit facility cost per student

The unit facility cost per student is determined by the unit construction cost/m² and unit area/student.

Table A-8.9.2 shows that the unit construction cost/m² varies depending on the type of building. Table A-8.9.3 shows that the unit area/student also varies depending on the courses and departments. In order to calculate the construction costs based on Master Plan Scenario, the suitable unit facility cost per student for each course and department are determined as follows:

Table A-8.9.4 Suitable unit facility cost per student

	Unit cost	Unit area	Unit cost
	US\$/m ²	m ² /student	US\$/student
Existing packaged courses			
Engineering	360	10	3600
Applied Science	330	9	2970
Management/Business	300	8	2400
Pilot department			
Hospitality and tourism	300	8	2400
IT and communication	330	9	2970
Business IT	330	9	2970
Post harvest and food processing	360	10	3600
Wood processing technology	360	10	3600
Manufacturing technology	360	10	3600

(3) Total facility development cost based on Master Plan Scenario

The facility development cost in future for existing packaged courses and pilot departments is determined by the increase of the students and the unit cost per student. A necessary investment amount year by year in future has been calculated based on the following growth rate:

Table A-8.9.5 Growth rate and maintenance cost

	Growth Rate	Maintenance cost
Existing packaged courses	%/Year	%/Year
Engineering	7	3
Applied Science	5	3
Management/Business	3	3
Pilot department	%/Year	%/Year
Hospitality and tourism	5	3
IT and communication	5	3
Business IT	5	3
Post harvest and food processing	7	3
Wood processing technology	7	3
Manufacturing technology	7	3
Teaching materials development center	-	3

Teaching Materials Development Center consists of Textbook production room, A/V production studio, Multi-media classroom and Library (local learning center). The facility cost for the center is determined by the unit cost / m² and the size of the building including staff's room. (Ref. Table A-8.9.6)

Table A-8.9.6 Facility cost for teaching materials development center

	Unit Cost: US\$	Floor Area: m2	Facility Cost: US\$
Textbook production room	360	200	72,000
A/V production studio	420	500	210,000
Multi-media classroom	360	100	36,000
Library (local learning center)	360	100	36,000
Total	-	800	354,000

Table A-8.9.7 Total facility investment and maintenance cost

Unit: US\$		
	Facility Investment Cost	Maintenance Cost
Existing packaged courses	66,749,000	2,002,500
Engineering	43,253,200	1,297,600
Applied Science	13,179,800	395,400
Management/Business	10,316,000	309,500
Pilot department	188,950,900	5,668,500
Hospitality and tourism	31,605,900	948,200
IT and communication	25,281,900	758,500
Business IT	43,458,100	1,303,700
Post harvest and food processing	38,113,800	1,143,400
Wood processing technology	11,966,600	359,000
Manufacturing technology	38,524,600	1,155,700
Distance-Learning	354,000	191,200
Total Cost (2003~2020)	256,053,900	7,862,200

8.9.3 Site condition of polytechnic institutes

(1) Accra Polytechnic Institute

Current Site Conditions:

Accra Polytechnic Institute is located in the center of Accra. The campus area of 9.1 hectare is limited by surrounding urban area and fully occupied by buildings, which were built mostly in 1950's and 1960's. Student population in Accra Polytechnic has grown steadily since the inception of the Institution. It grew from 69 students in 1949 to over 4500 students in 2000. Student numbers could be classified as over capacity considering the size of campus, and they are unable to fit into the classrooms and workshops in a manner that provides a good learning environment. The library space is also quite small and able to sit a maximum of 130 students, which is approximately 3% of the total number of students. Only one student dormitory accommodates a maximum of 320 students, representing only 7% of the total number of students. There are 130 teaching staff, with only 17 staff houses provided on campus and 6 staff houses outside campus. Sports facilities are entirely inadequate due to the limited land. A small field for football, hockey, volleyball etc. is the only sports facility on campus and is not well maintained.

Future Expansion:

Since the campus area is not expandable, any rebuilding plan should be proposed as a high-density campus development. New multi-story buildings should replace the single story workshops and lecture rooms. New student dormitories, staff houses and sports facilities, which could be used as a living quarter should be located outside the main campus. In future, all the accommodation and sports facilities should be kept separate from the existing campus, in order to keep the area for any future expansion of classrooms and workshops to accommodate any increase in the student population.

(2) Kumasi Polytechnic Institute

Current Site Conditions:

The site condition of Kumasi Polytechnic Institute, located in the city of Kumasi, is quite similar to that of Accra Polytechnic Institute. The campus area of 4.1 hectare and is limited by the surrounding urban area and is fully occupied by buildings, which were built mostly in 1950's and 1960's. The student population in Kumasi Polytechnic has grown steadily since the inception of the Institution. The present student population in 2000 is over 4000 students.. Student numbers could be classified as over capacity compared to the size of the campus, and students cannot fit into the classrooms and laboratories in a manner that would normally be required for a good learning environment. Although a new library is under construction and will be completed in 2001, the library space of 1600m² will be too small as it will only be able to sit a maximum of 270 students, which is approximately 7% of the total number of students. Sports facilities are entirely inadequate due to the limited land. Three student dormitories accommodate a maximum of 420 students, which is approximately 10% of total number of students. There are a total of 102 teaching staff, and no staff houses are provided on campus. A small piece of land of 6000m² is reserved for playing fields, but it is not large enough for football, hockey etc. This is the only sports facility on this campus, and is currently poorly maintained.

Future Expansion:

Since the campus area is not expandable, any rebuilding plan should be proposed as a high-density campus development. Some of the single story workshops and lecture rooms have started to be replaced by new multi-story buildings, by utilizing unique expansion system which adds columns to the outside of existing single story buildings upon which the upper floors are loaded. Any new student dormitories, staff houses, and sports facilities, which may be used as a living quarter, should be located outside the main campus. In future, all the accommodation and sports facilities should be kept separate from the existing campus, in order to keep the area for the future expansion of classrooms and workshops to accommodate any increase in the student population.

(3) Takoradi Polytechnic Institute

Current Site Conditions:

Takoradi Polytechnic Institute is located in the city of Takoradi. The campus area is divided into two areas by an approach road. The south side is the original campus, and has been developed on an area of 11.2 hectares. Buildings, which were built mostly in 1950's and 1960's, fully occupy the boundary of the approach road. The north side, area of 6.7 hectare, is now used for the sports facilities. The area is large enough for football, hockey, volleyball etc., however, this is the only sports facility on this campus and is not well maintained. The student population in Takoradi Polytechnic has grown steadily since the inception of the Institution. The student population is at present over 3500 students in 2000. Student numbers could be classified as an over capacity in relation to the capacity of the classrooms and workshops. This over capacity inhibits the provision of a good teaching and learning environment. A new classroom and workshop building is under construction and will be completed in 2001. Library space of 300m² is also quite small and able to sit a maximum of 250 students, which is approximately 7% of the total

number of students. Three student dormitories accommodate a maximum of 539 students, which is only 15% of the total number of students. There are 91 teaching staff, and only 52 staff houses are provided on campus.

Future Expansion:

According to the future expansion plan provided by Takoradi Polytechnic in 1999, the southwest side of the campus will be expanded with an additional area of 5.9 hectare, and consist of seven staff accommodation buildings and one classroom building (24 classrooms). The north side of the campus, an area of 6.7 hectare that is currently used for the sports facilities, will be redeveloped into student accommodation, consisting of three student dormitories accommodating 78 students, a sports stadium, a hotel training center and a mini shopping hall.

(4) Ho Polytechnic Institute

Current Site Conditions:

Ho Polytechnic Institute is located at the southwest end of Ho. The campus has an area of 58.9 hectare and has developed with enough space. The northern part of the campus has a compact development of buildings, which stand in a cluster that accommodates an administration building, classrooms, workshops, etc. along a central open corridor. In spite of three decades of development and expansion, the original concept of a development Master Plan has been kept and is still well organized. The student population in Ho Polytechnic has grown steadily since the inception of the Institution. The student population is at present over 2700 students in 2000. Student numbers could be classified as an over capacity when comparing them to the capacity of the classrooms and workshops as would be normally required for a good learning environment. Library space is also becoming inadequate and is able to sit a maximum of 250 students, which is approximately 9% of the total number of students. Toward the south, there are two student dormitories that accommodate a maximum of 300 students, which is only 11% of total number of students. For a total of 97 teaching staff, only 10 staff houses are provided on campus. The rest of the area is used for the sports field and recreational facilities. The area is large enough for football, hockey, volleyball etc., however it is not well maintained.

Future Expansion:

The campus area is large enough for future facility expansion. Following the increase in the student population, new classrooms and new workshops will be extended toward the south and constructed along the main axis of the central open corridor. New student dormitories and new staff houses including sports facilities, which may be used as a living quarter, will be expanded toward the west.

(5) Cape Coast Polytechnic Institute

Current Site Conditions:

Cape coast Polytechnic Institute is located at the northwest side of Cape Coast. The campus has an area of 39.0 hectare and has enough space for its development. The northwest area at the end of the approach road is the original campus, built mostly in

1950's, and houses the administration buildings, workshops and classrooms. The student population in Cape coast Polytechnic has grown steadily since the inception of the Institution. The present student population is over 1800 students in 2000. Student numbers could be classified as an over capacity when comparing them to the capacity of the classrooms and workshops, normally required for a good learning environment. An administration building is under construction along the approach road. There are two libraries for engineering and business. The engineering library has a seating capacity of 150 students. The business library has a seating capacity of 80 students. The total seating capacity of 230 students represents approximately 13% of the total number of students. The east side of the approach road has been recently developed as residential quarters. A student dormitory is under construction and will accommodate a maximum of 320 students. The southeast side is now used for the sports field and recreational facilities. This area includes a football field, two volleyball courts, a basketball court etc. Other games like hockey, table tennis and badminton are also possible. These facilities are not well maintained.

Future Expansion:

The campus area is large enough to accommodate any future facility expansion. New classrooms are under construction and hopefully will be completed soon. The workshops will be expanded toward the northeast. An area of land for new library is reserved near the administration building. A student dormitory is under construction and hopefully will be completed soon. Three more student dormitories are planned for future construction toward the east. New staff houses including sports facilities that may be used as a living quarter will be expanded toward the southeast.

(6) Tamale Polytechnic Institute

Current Site Conditions:

Tamale Polytechnic Institute is located at the northwest side of Tamale. The campus area of 71,1 hectare is divided into two areas by an approach road and has enough space for its development. The area along the approach road has been developed as the original campus, built mostly in 1950's with administration buildings, workshops and classrooms. The student population in Tamale Polytechnic has grown steadily since the inception of the Institution. The present student population is over 1100 students in 2000. Student numbers could be classified as over capacity comparing them to the capacity of the classrooms and workshops as are normally required for a good learning environment. Library space of 290m² is also becoming inadequate and is able to sit a maximum of 173 students, which is approximately 16% of the total number of students. The west part of the campus is the residential quarters. The new student dormitories have recently been developed and form a cluster around the central open court. This building has a similar external appearance as the unique traditional habitats in this area. The student dormitories accommodate a maximum of 330 students, which is approximately 30% of the total number of students. There are 73 teaching staff, and 43 staff houses are provided on campus. The north side is now used for the sports field and recreational facilities. This area includes a football field, two volleyball courts, a basketball court etc. Other games like hockey, table tennis and badminton are also possible. However, these facilities are not well maintained.

Future Expansion:

The campus area is large enough for any future facilities expansion. Following the increase in the student population, new classrooms and new workshops will be expanded toward the north. An area of land has been reserved on the northwest side for proposed new student dormitories. New staff houses including sports facilities that may be used as a living quarter will be expanded toward the west.

(7) Sunyani Polytechnic Institute

Current Site Conditions:

Sunyani Polytechnic Institute is located at the south end of Sunyani. The site condition of Sunyani Polytechnic Institute is quite similar to that of Ho Polytechnic Institute. The campus area of 120.6 hectare has developed with enough space. As seen in the site layout of Ho polytechnic, the northern part of campus has a compact development with buildings standing in a cluster around a central open corridor. In spite of three decades of development and expansion, the original concept of a development Master Plan has been kept and is still well organized. The student population at Sunyani Polytechnic has grown steadily since the inception of the Institution. The present student population is over 2100 students in 2000. Student numbers could be classified as an over capacity when compared to the capacity of the classrooms and workshops. This is creating great difficulty in the provision of a suitable teaching and learning environment.

Library space is, at the moment, very small and able to sit a maximum of 172 students, which is approximately 8% of the total number of students. Two student dormitories accommodate a maximum of 532 students, which is approximately 25% of the total number of students. There are 62 teaching staff, and only 22 staff houses are provided on campus. The rest of area is used for the sports field and recreational facilities. The area is large enough for football, hockey, volleyball etc. however, it is not well maintained.

Future Expansion:

The campus area is large enough for any future expansion of facilities. Following the increase in the student population, new classrooms and new workshops will be expanded toward the south and constructed along the main axis of the central open corridor. New student dormitories and new staff houses including sports facilities, which may be used as a living quarter will be expanded toward the west.

(8) Koforidua Polytechnic Institute

Current Site Conditions:

Koforidua Polytechnic Institute is located at the south side of Koforidua. The campus area of 32.0 hectare has developed with enough space. The northwest corner of the campus has been developed as the original campus with administration buildings, workshops and classrooms, which were built mostly in 1950's. The student population in Koforidua Polytechnic has grown steadily since the inception of the Institution. The present student population is over 1800 students in 2000. Student numbers could be classified as an over capacity when comparing them to the capacity of the classrooms and workshops. This over capacity is creating great difficulty in providing good learning

environments. The construction of an 18 unit-classroom building was started three years ago, but due to a shortage of government funds the construction was stopped over two years ago and only a skeleton remains. Library space is now inadequate and able to sit a maximum of 100 students, which is approximately 6% of the total number of students. There is no student dormitory at present. There are 37 teaching staff, and staff houses are not provided on campus. The construction of two of the proposed 10 staff houses has also stopped at the lintel level two years ago because of a lack of government funds. The south side is now used for the sports field and recreational facilities. This area includes a football field, two volleyball courts, a basketball court etc. Other games like hockey, table tennis and badminton are also possible. However, these facilities are not well maintained.

Future Expansion:

According to the future expansion plan provided by Koforidua Polytechnic in 2000, the campus will be expanded toward the south. The plan has the academic quarter in the north side of the campus, the living quarter in the south side, and sports and recreational facilities in the west side. The academic quarter consists of two administration buildings, seven classroom buildings and a library. The living quarter consists of three dormitories, staff accommodation buildings etc. The sports and recreational facilities consist of football field, tennis courts, a swimming pool, volleyball courts and indoor games.

8.9.4 Present condition of existing facilities

The existing facilities of each Polytechnic Institute have similar conditions and problems. The conditions of facilities in each category are summarized as follows:

(1) Administration building

The administration buildings are basically built as a reinforced concrete (RC) structure and occupy part of a two or three story classroom building constructed in 1950's. The physical structure, of the buildings are quite stable and in relatively good condition. However, there are some damage and problems relating to roofing, glass windows, painting, and air conditioning, etc. As the administration block is generally the first contact point for visitors, it should be made distinguishable from the rest of the classrooms and workshops in such away as to leave a pleasing impression.

(2) Classroom

Classroom buildings are mostly two or three story and built as a reinforced concrete (RC) structure. They were constructed in the 1950's and 1960's. The physical structure of the buildings are quite stable and in relatively good condition. However, there are some damage and problems relating to roofing, glass windows, and painting, etc.

(3) Workshop and laboratory

Most of the workshop and laboratory buildings are single story and built with reinforced concrete (RC) columns and steel or wood roof truss structures. They were constructed in the 1950's and 1960's. The physical structure of the buildings are quite stable and in relatively good condition. However, there are some damage and problems relating to

roofing, glass windows, and painting, and air conditioning etc. In order to provide a good and secure environment for new, expensive and sophisticated equipment these problems are now becoming more crucial.

(4) Library and resource center

Comparing the seating capacity of each library to the number of students could be classified as over capacity. The average seating capacity at present is less than 10% of the total number of students. Since the living conditions for students are not adequate on campus, the study areas like library and resource center should be expanded and become more comfortable.

(5) Student dormitory and staff housing

As the number of students has been planned to increase dramatically, the problem of student accommodation on campus has become more serious. Student dormitories on campus are able to accommodate less than 10% of students at present. It seems very difficult for the students to find a place to sleep. In these circumstances, many of the students have to walk long distance to and from campus. Some student dormitories on campus accommodate so many students, that the space per student becomes less than 2m², and that there is a high-risk possibility for disaster.

Staff housing is also in very short supply. It appears that less than 10% of staff have housing provided by the government. When additional staff are employed for more advanced programs, this demand may become desperate.

8.9.5 Conclusion

In general, two major problems are raised by our survey.

Over Capacity

The student population of Polytechnic Institutes has grown steadily since the inception of the Institutions. The total number of students at present could be classified as an over capacity when compared to the capacity of the classroom, workshop, laboratory and library facilities. This over capacity is creating difficulties in the provision of suitable teaching and learning environments

Demand for Rehabilitation

Most of the buildings and the related infrastructures such as water, electricity, communication system, and air conditioning are in need of rehabilitation. Currently the capacity of government funding is inadequate to provide the necessary funds for maintenance or routine repairs.

In these circumstances, the polytechnic up-grading projects should be implemented at the earliest opportunity.

8.9.6 Distance-learning resource center

(1) Basic concept of required facilities

Distance-Learning Resource Center includes conceptually three important functions as follows:

- Human resource development
- Institutional development
- Teaching material development.

The human resource development provides the training programs for managerial staff and teachers. The required facilities for the human resource development consist of Studio- 1 & 2, Meeting Room and Library.

The institutional development provides the development and operation of the Competency Based Training related organizations such as GHANTA, ITABs, etc. The required facilities for the institutional development consist of Technical Staff Room 1 & 2 and Library.

The teaching material development is carried out the development and production of the audio-visual Videos and Textbook / workbook. The required facilities for the development and production of textbook- / workbook consist of Editing Room 1, 2, 3 & 4 and Printing Room. The required facilities for the development and production of audio-visual videos consist of Studio- 1 & 2 and Rehearsal Room.

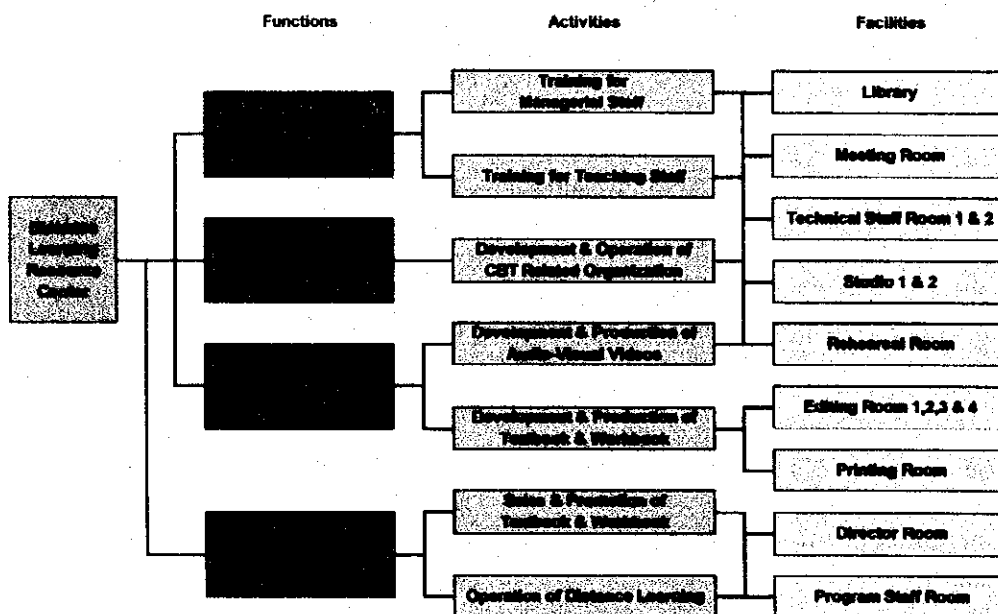


Figure A-8.9.3 Conceptual diagram for distance-learning resource center

8.9.6 Distance-learning resource center

(1) Basic concept of required facilities

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- Human resource development
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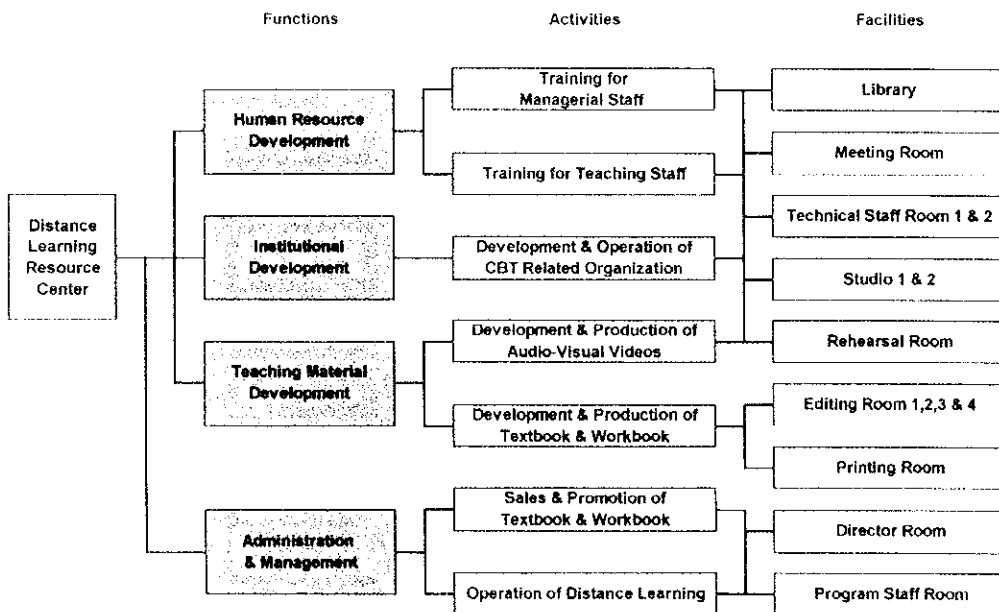
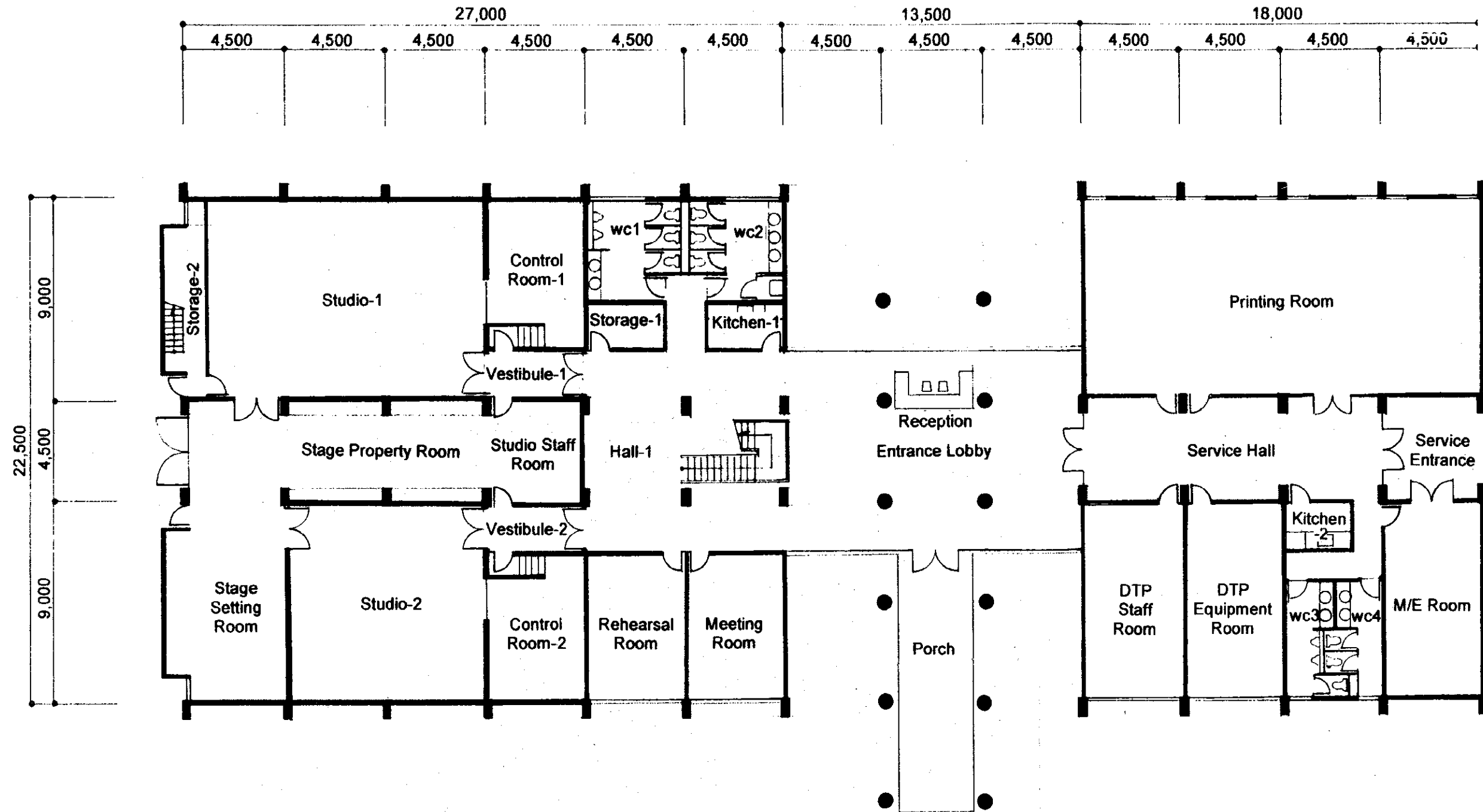


Figure A-8.9.3 Conceptual diagram for distance-learning resource center

Table A-8.9.8 Floor area calculation

Ground Floor		Unit: M2	
Entrance Lobby		121.5	
Studio Wing	Hall-1	81.0	621.5
	Studio-1	112.5	
	Control Room-1	30.5	
	Vestibule-1	10.0	
	Studio-2	81.0	
	Control Room-2	30.5	
	Vestibule-2	10.0	
	Rehearsal Room	30.5	
	Meeting Room	30.5	
	Stage Setting Room	67.5	
	Stage Property Room	40.5	
	Studio Staff Room	20.0	
	WC-1, WC-2, Kitchen-1, Storage-1	61.0	
	Storage-2	16.0	
Printing Wing	Printing Room	162.0	385.0
	Service Hall	61.0	
	DTP Staff Room	40.5	
	DTP Equipment Room	40.5	
	WE Room	40.5	
	WC-3, WC-4 Kitchen-2	40.5	
Total Floor Area		1128.0	
First Floor		Unit: M2	
Administration	Hall-2	47.0	346.0
	Editing Room-1	20.0	
	Editing Room-2	20.0	
	Editing Room-3	20.0	
	Editing Room-4	20.0	
	Technical Staff Room-1	30.5	
	Technical Staff Room-2	30.5	
	Program Staff Room	30.5	
	Director Room	30.5	
	Library	61.0	
Kitchen-3, Storage-3, Other	36.0		
Total Floor Area		346.0	
Second Floor		Unit: M2	
Total Floor Area	Mechanical Space, Storage, Other	135.0	
Grand Total Floor Area		Unit: M2	
Grand Total Floor Area		1609.0	

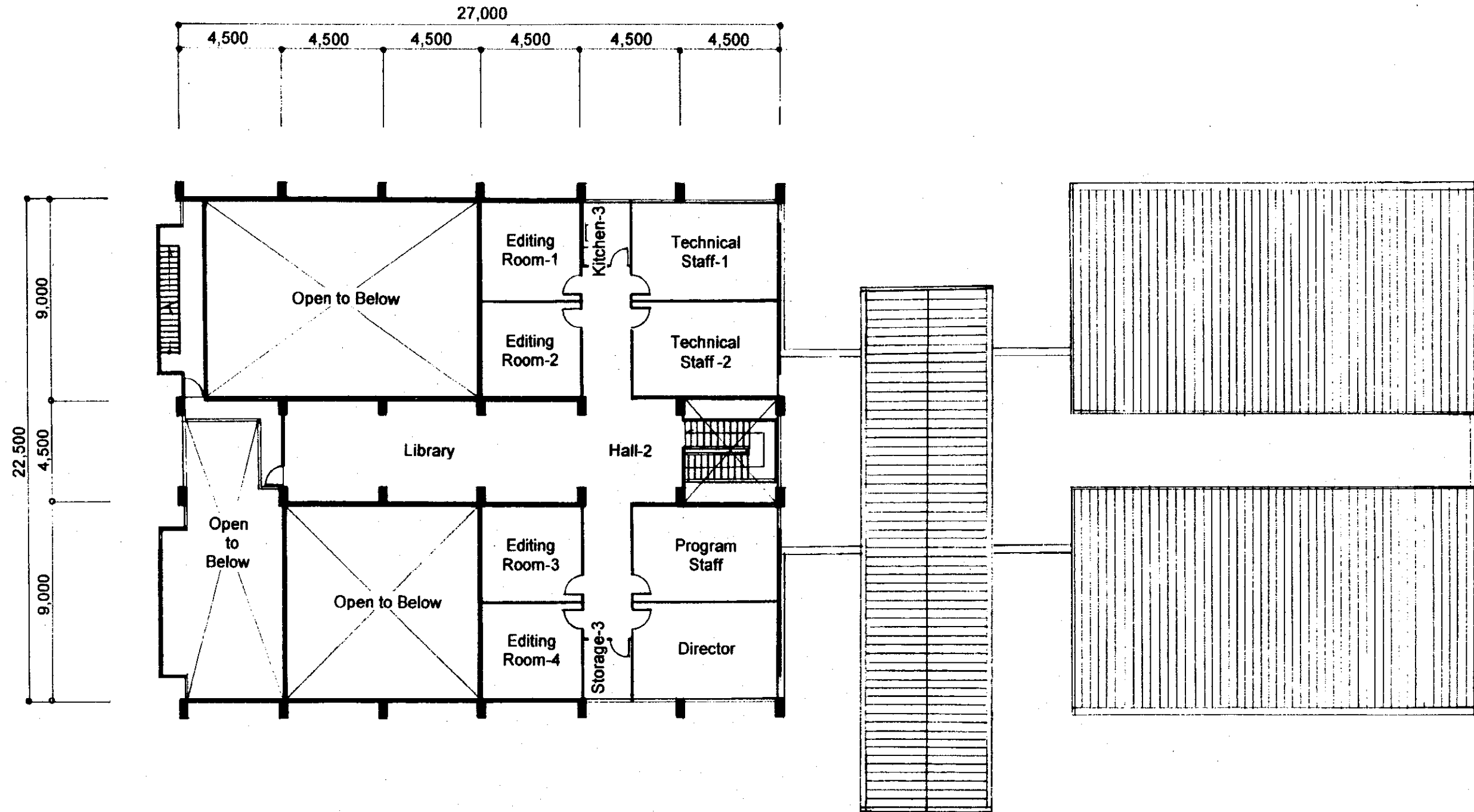
Figure A-8.9.4 Conceptual site layout plan / floor plan



Distance-Learning Support Center

Ground Floor Plan

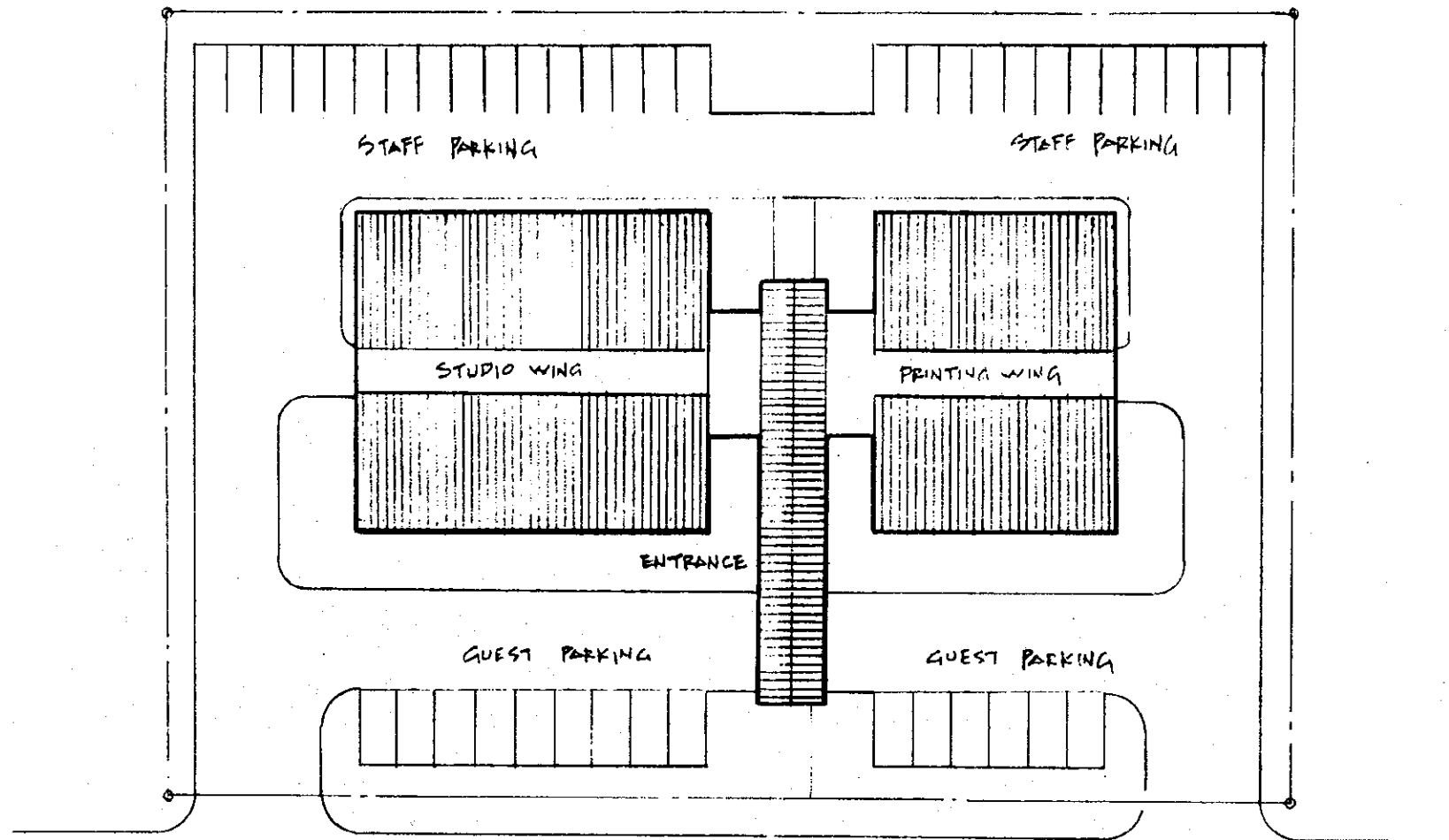
Scale: 1/200



Distance-Learning Support Center

First Floor Plan

Scale: 1/200



Distance-Learning Support Center

Site Area: 5,000m²

Site Layout Plan

Scale: 1/500

8.10 Development of Educational Equipment

8.10.1 Present situation of educational equipment

(1) Investment on educational equipment in the past

Educational equipment is very important for technical education. Especially, in the case of engineering courses, 40% of total lesson hours are prepared for practical training in the workshop.

The equipment for practical training in each PI was taken over by the PIs from the former TIs. Moreover, 6 PIs - Accra, Kumasi, Takoradi, Cape Coast, Ho, Tamale - had been given new equipment for their workshops under financial arrangements from IDA and AfDB during 1995 to 1999. However, nearly 70 percent of the total funds had been supplied to universities - University of Ghana, University of Science and Technology, University of Cape Coast - and 30percent of funds had been provided to the above-mentioned 6 PIs, as shown in Table A-8.10.1 for budget distribution among institutions and in Table A-8.10.2 for targeted technical training areas in polytechnics. This is the only investment in new equipment for PIs so far.

Table A-8.10.1 Budget distribution to institutions from IDA and AfDB funded projects

(Unit: US\$)

		Computer and software	Laboratory equipment	Workshop equipment	Total	Share	
University of Ghana	IDA	546,961	2,819,427	10,662	3,997,520		
	AfDB	0	608,267	12,203			
University of Science and Technology	IDA	372,411	4,616,296	141,185	5,671,126		
	AfDB	0	486,586	54,648			
University of Cape Coast	IDA	295,778	694,018	0	1,229,791		
	AfDB	0	236,809	3,186			
Sub-total of universities					10,898,437		69%
Accra PI	IDA	130,718	589,768	282,060	1,217,234		
	AfDB	0	1,116	213,572			
Kumasi PI	IDA	122,181	375,892	313,606	1,026,118		
	AfDB	0	1,116	213,323			
Takoradi PI	IDA	123,119	312,140	197,113	846,812		
	AfDB	0	1,117	213,323			
Cape Coast PI	IDA	112,938	189,501	206,902	739,854		
	AfDB	0	1,116	229,397			
Ho PI	IDA	112,938	278,725	287,328	909,505		
	AfDB	0	1,117	229,397			
Tamale PI	IDA	70,189	0	0	70,788		
	AfDB	0	0	599			
Sub-total of PI					4,810,311	31%	
TOTAL	IDA	1,887,233		11,213,011	15,708,748	100%	
	AfDB			2,608,504			

Table A-8.10.2 Technical training areas for which equipment was supplied from IDA and AfDB funded projects

No	Equipment for:	Accra	Kumasi	Takoradi	Ho	Cape Coast	Tamale
1	Furniture design	⊙	⊙	⊙			
2	Science laboratory	⊙	⊙	⊙		⊙	
3	Dispensing technology		⊙				
4	Agricultural machinery				⊙		
5	Hydraulics				⊙		
6	Soil science				⊙		
7	Civil engineering laboratory	⊙	⊙	⊙			
8	Construction	⊙	⊙		⊙	⊙	
9	Soil testing	⊙				⊙	
10	Survey		⊙	⊙	⊙	⊙	
11	Electrical (general)	⊙	⊙	⊙	⊙	⊙	
12	Electrical (power)	⊙	⊙	⊙	⊙	⊙	
13	Electrical (training)		⊙	⊙	⊙	⊙	
14	Electronic engineering	⊙	⊙	⊙	⊙	⊙	
15	Electronics (TV, radio)	⊙	⊙	⊙		⊙	
16	Refrigeration and A/C	⊙					
17	Refrigeration (training)	⊙					
18	Audio visual	⊙	⊙	⊙	⊙	⊙	
19	Fluid mechanics		⊙	⊙	⊙	⊙	
20	Heat treatment	⊙	⊙		⊙	⊙	
21	Machine shop	⊙		⊙	⊙	⊙	
22	Mechanics of machines	⊙	⊙	⊙	⊙	⊙	
23	Tools	⊙	⊙	⊙	⊙	⊙	
24	Forging and welding		⊙	⊙			
25	Plumbing and sanitation			⊙			
26	Computers and software	⊙	⊙	⊙	⊙	⊙	⊙

Much of the equipment which had been taken over by the PIs from the TIs is old fashioned, but it has been possible to keep it in good condition for the purpose of training by the full-time instructors, if they have practical techniques and industrial knowledge. Generally, mechanical machines without electronics functions have a long life, provided that they are given enough maintenance by the instructors, because several parts of the machine can be produced in the workshops by the instructors. A long life of more than 40 years for machines is nothing new in Japan. The instructors should have the

responsibility and duty to keep equipment in good condition, in addition to giving guidance to the students. The site survey confirmed that there were excellent instructors at some PIs.

In addition to machine workshops, PIs have electrical and electronics workshops and there are many damaged instruments in these workshops. There is difficulty to give them maintenance at the site by low level technicians. This is the reason for the rapid progress of electronics technology, including the development of ultra small devices, so that manufacturing of spare parts for the old equipment has been discontinued. Moreover those instruments are sensitive to temperature, humidity and dust. The condition of PIs' workshops is not good for electronic instruments. From the interviews with instructors and students, it was learned that instructors do not have enough knowledge of how to operate the instruments. Since they do not give instruction to the students, the instruments may be damaged. Therefore, it is necessary to keep the workshops in appropriate conditions and also to improve the quality of the instructors in order to maintain equipment in good conditions.

(2) Procurement of equipment for practical training

Most of the workshop equipment was manufactured in foreign developed countries and also funded by the developed countries. Industries in Ghana do not produce such kinds of appropriate training equipment and instruments and, since Ghana has been short of foreign currency, it was inevitable that it should have turned out that way. The periodic maintenance and renewal of the equipment is very difficult under the circumstances in Ghana, as mentioned before. The spare parts can be obtained on the same day in developed countries, but in Ghana it is often necessary to wait a long time to receive the spare parts, which have been ordered from abroad. In future, spare parts should be purchased in advance.

(3) Unit cost for equipment

It is desirable that the equipment for practical training should be provided in sufficient quantity in proportion to the numbers of students. However, since in practice it is generally not possible to reach this ideal situation, then various ideas were suggested, such as a schedule of training, the cooperation between institutions and other enterprises for practical training.

Table A-8.10.3 shows the trend in respect of the numbers of students at PIs during the past 5 years. This table indicates a rapid growth in the numbers of full-time students, which increased 4-times of engineering, 12-times of applied science & mathematics and 5-times of management & business studies respectively. The unit cost per student of training equipment, calculated based on Table A-8.10.3, is shown in Table A-8.10.4. The average unit cost for equipment is US\$131/student for all students, with respective values of US\$321 of engineering, US\$119 of applied science & mathematics and US\$10 of management & business studies, calculated based on investment costs in the past 5 years (1995-99). The unit cost per student of engineering is low in comparison to costs in Japan as shown in Table A-8.10.5. The expansion of training equipment should strongly recommended suitable for student numbers along the increasing student enrolment toward the year 2020.

Table A-8.10.3 Numbers of full-time student for polytechnic / each course

Department	Course	Accra	Kumasi	Takoradi	Ho	C. Coarst	Tamale	Sunyani	Koforidua	TOTAL	Gross Rate
Engineering	Electrical Engineering	94/95	136	98	30	0	0	0	0	264	100.0
		95/96	201	106	61	0	50	0	0	418	158.3
		96/97	200	120	114	80	77	0	18	609	230.7
		97/98	309	117	156	146	96	0	55	879	333.0
		98/99	394	139	161	231	139	0	99	1,163	440.5
	Mechanical Engineering	94/95	141	102	51	0	0	0	0	294	100.0
		95/96	268	125	80	0	39	23	0	535	182.0
		96/97	301	130	138	126	65	40	0	800	272.1
		97/98	303	185	142	0	85	55	0	770	261.9
		98/99	240	125	150	0	130	53	0	698	237.4
	Metallurgy	94/95	0	17	0	0	0	0	0	17	100.0
		95/96	0	31	0	0	0	0	0	31	182.4
		96/97	0	58	0	0	0	0	0	58	341.2
		97/98	0	86	0	0	0	0	0	86	505.9
		98/99	0	107	0	0	0	0	0	107	629.4
	Automobile Engineering	94/95	26	40	0	0	0	0	0	66	100.0
		95/96	0	50	16	66	0	0	0	132	200.0
		96/97	0	59	0	0	0	0	0	59	89.4
		97/98	0	60	27	102	0	0	0	189	286.4
		98/99	63	73	35	85	0	0	0	256	387.9
	Building Construction	94/95	114	87	61	0	0	0	0	262	100.0
		95/96	224	117	301	0	18	0	0	660	251.9
		96/97	197	114	134	65	17	0	17	544	207.6
		97/98	188	81	220	91	17	0	60	657	250.8
		98/99	237	88	244	164	65	0	152	950	362.6
	Civil Eng.	94/95	0	0	0	0	0	0	0	1	100.0
		95/96	0	0	33	0	0	0	0	33	3,300.0
		96/97	0	19	90	0	0	0	0	109	10,900.0
		97/98	39	43	156	0	0	0	0	238	23,800.0
		98/99	37	40	198	0	66	0	0	341	34,100.0
	Chemical	94/95	0	0	0	0	0	0	0	1	100.0
		95/96	0	0	0	0	0	0	0	1	100.0
		96/97	0	23	0	0	0	0	0	23	2,300.0
		97/98	0	60	0	0	0	0	0	60	6,000.0
		98/99	0	46	0	0	0	0	0	46	4,600.0
	Agriculture Engineering	94/95	0	0	0	0	0	0	0	1	100.0
		95/96	0	0	0	55	0	0	0	55	5,500.0
		96/97	0	0	0	65	0	20	0	85	8,500.0
		97/98	0	0	0	78	0	2	0	80	8,000.0
		98/99	0	0	0	89	0	86	0	175	17,500.0
	Furniture Design	94/95	0	33	0	0	0	0	0	33	100.0
		95/96	0	57	0	0	0	0	0	57	172.7
		96/97	21	63	0	0	0	0	0	84	254.5
		97/98	0	71	23	0	0	0	0	94	284.8
		98/99	15	80	58	0	0	0	0	153	463.6
	Blocklaying/ Concret	94/95	0	0	0	0	0	0	0	1	100.0
		95/96	0	0	105	0	0	0	0	105	10,500.0
		96/97	0	0	0	0	0	0	0	0	0.0
		97/98	0	0	0	0	0	0	0	0	0.0
		98/99	0	0	0	0	0	0	0	0	0.0
	TOTAL	94/95	417	377	142	0	0	0	0	936	100.0
		95/96	693	486	596	121	107	23	0	2,026	216.5
		96/97	719	586	476	336	159	60	35	2,371	253.3
		97/98	839	703	724	417	198	57	115	3,053	326.2
		98/99	986	698	846	569	400	139	251	3,889	415.5
	Share		29.8	23.2	22.7	11.8	7.0	2.3	3.3	0.0	100.0

Department	Course	Accra	Kumasi	Takoradi	Ho	C. Coarst	Tamale	Sunyani	Koforidua	TOTAL	Gross Rate
Applied Science & Maths	94/95	52	91	27	0	0	0	0	0	170	100.0
	95/96	200	289	90	182	0	0	0	0	761	447.6
	96/97	334	425	178	289	0	27	0	0	1,253	737.1
	97/98	433	445	276	248	0	61	23	39	1,525	897.1
	98/99	439	484	355	315	0	108	95	166	1,962	1,154.1
	Share		711	846	452	504	0	95.6	57.6	100.0	2,766.3

Management & Business Studies	94/95	679	499	133	0	0	0	0	0	1,311	100.0
	95/96	1,029	621	339	445	163	94	0	0	2,691	205.3
	96/97	1,147	751	383	559	259	182	32	50	3,363	256.5
	97/98	1,365	921	506	817	434	265	228	269	4,805	366.5
	98/99	1,325	981	680	665	734	405	875	916	6,581	502.0
	Share		5,545	3,773	2,041	2,486	1,590	946	1,135	1,235	18,751

TOTAL		10,657	8,357	5,751	4,963	2,454	1,421	1,654	1,440	36,697
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Table A-8.10.4 Equipment cost for practical training per student in polytechnics, Ghana

(investment completed during 1995 -1999)

	Number of Students (NHD Courses)	Investment Cost US\$	Cost per Student US\$
1 Accra Polytechnic	10,657	1,217,234	114
2 Kumasi Polytechnic	8,357	1,026,118	123
3 Takoradi Polytechnic	5,751	846,812	147
4 Cape Coast Polytechnic	2,454	739,854	301
5 Ho Polytechnic	4,963	909,505	183
6 Tamale Polytechnic	1,421	70,788	50
7 Sunyani Polytechnic	1,654	0	0
8 Koforidua Polytechnic	1,440	0	0
TOTAL	36,697	4,810,311	131

Note : Data form NCTE

1 Engineering Department	12,275	3,944,455	321
2 Applied Science & Maths	5,671	673,444	119
3 Management & Business Studies	18,751	192,412	10

1 Engineering Department	12,275	3,944,455	321	cost share(82%)
2 Electrical Engineering Course	3,333	721,547	216	ditto (15%)
3 Mechanical Engineering Course	3,396	1,683,609	496	ditto (35%)
4 Automobile Engineering Course	702	721,547	1,028	ditto (15%)
5 Building Construction Engineering Course.	3,178	288,619	91	ditto (6%)
6 Civil Engineering Course	721	288,619	400	ditto (6%)
7 Chemical Engineering Course	129	48,103	373	ditto (1%)
8 Agricultural Engineering Course	395	96,206	244	ditto (2%)
9 Furniture Design Engineering Course	421	96,206	229	ditto (2%)

Table A-8.10.5 Equipment cost for practical training per student in polytechnics, Japan

	Number of Students	Investment Cost US\$	Cost per Student US\$	Remarks
College of Technology in Japan (Total)	48,414	38,750,000	800	Engineering only
Nagaoka National College of Technology	1,046	765,000	731	Engineering only
Takamatsu National College of Technology	807	476,200	590	Engineering only
TOTAL	50,267	39,991,200	796	

8.10.2 Cost estimation of equipment for the Master Plan

(1) Assumptions

Based on outcomes from Table A-8.10.4, the unit equipment costs for existing departments are assumed to grow at the constant rate until 2020, as shown in Table A-8.10.6:

Table A-8.10.6 Growth rate of unit equipment cost for existing departments

	Departments/Pilot Programs	Equipment	
		Unit equipment cost per student (US\$)	Growth rate
1	Engineering	321	0.07
2	Applied science	119	0.05
3	Management & Business	10	0.03

The renewal rates of equipment are assumed by their purpose of usage, as shown in Table A-8.10.7:

Table A-8.10.7 Renewal rate

	Renewal rate		
	5years	10 years	15 years
Existing packaged courses			
1. Engineering Department	0.2	0.5	0.2
2. Applied Science & Maths	0.5	0.5	0.5
3. Management & Business Studies	0.5	0.5	0.5
Pilot programs			
1. Hospitality and Tourism	0.5	0.5	0.5
2. IT and communications	0.5	0.5	0.5
3. Business IT	0.5	0.5	0.5
5. Post harvest	0.0	0.5	0.0
4. Wood processing	0.0	0.5	0.0
6. Manufacturing technology	0.2	0.2	0.2
Teaching material development & distance-learning			
1. Textbooks	0.1	0.2	0.5
2. A/V production	0.1	0.2	0.5
3. Class room	0.1	0.2	0.5
4. Library (local learning center)	0.1	0.2	0.5

Note: Renewal rate is a rate of a necessary new investment to an accumulated investment amount by the year.

(2) Initial investment cost for pilot programs

An initial investment cost for pilot departments was estimated from similar projects in the past, as shown in Table A-8.11.1 in details. The summary result of this estimation is shown in Table A-8.10.8.

Table A-8.10.8 Initial investment cost of equipment for Pilot Programs

	Pilot Programs	Equipment unit cost per class (US\$)
1	Hospitality & tourism	100,909
2	IT & communications	582,727
3	Business IT	257,273
4	Post harvest & food processing	550,009
5	Wood processing technology	696,818
6	Manufacturing technology	747,727
	Total	2,935,464

(3) Initial investment cost for teaching materials development and distance-learning

Project of teaching materials development and distance-learning consists of four components, (1) editing and printing system for textbooks, (2) audio-visual production system, (3) multimedia classroom and (4) local learning center. Multimedia classrooms and local learning centers are established at eight polytechnic. In addition, 10 local learning centers are open at ten technical institutes after 2010. An initial investment cost for teaching materials development and distance-learning was estimated from similar projects in the past, as shown in Table A-8.11.2 to A-8.11.5 in details. The summary result of this estimation is shown in Table A-8.10.9.

Table A-8.10.9 Initial investment cost of equipment for teaching materials development and distance-learning

	Items	(US\$) Equipment cost
1	Editing and printing system for textbooks	1,579,727
2	Audio-visual production systems	4,272,727
3	A/V equipment for multi media class room	103,636
4	A/V equipment for library (local learning center)	128,182 (revise)
	Total	6,084,273

(4) Cost estimation of educational equipment for the Master Plan

By using assumptions and cost estimation of initial investment as discussed above, a result of simulation is shown in Table A-8.10.10 during the Master Plan period. A summary of the total equipment cost is shown in Table A-8.10.11. The detailed simulation on cost estimation of equipment is shown in Table A-8.10.12.

Table A-8.9.10 Cost estimation of equipment for the Master Plan

(US\$1000)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	Share
Existing packaged courses																					
Engineering	510	617	721	867	1,044	3,593	1,214	1,383	1,599	1,849	7,017	2,473	2,860	3,307	3,824	8,918	5,114	5,914	6,838	59,660	25.1%
Applied mathematics	12	114	134	157	184	475	195	218	245	276	1,062	351	395	446	502	1,207	638	719	810	8,140	3.4%
Management/business study	2	45	60	79	107	280	172	219	284	369	1,163	623	809	1,050	1,364	4,443	2,299	2,985	3,876	20,230	8.5%
Total	523	776	914	1,104	1,335	4,348	1,580	1,819	2,129	2,495	9,242	3,447	4,064	4,803	5,690	14,568	8,051	9,618	11,525	88,030	37.0%
Pilot Programs																					
Hospitality and tourism	0	0	0	0	0	206	210	214	624	327	333	442	450	1,619	388	435	487	545	610	6,889	2.9%
IT and communications	0	0	0	0	0	594	606	618	3,287	2,459	2,506	1,364	1,387	6,946	1,493	1,642	1,906	1,987	2,186	28,881	12.1%
Business IT	0	0	0	0	0	282	268	273	1,451	1,086	1,106	1,389	1,415	4,657	1,099	1,231	1,379	1,544	1,729	18,889	7.9%
Post harvest and food processing	0	0	0	0	0	1,122	1,144	1,166	2,310	2,354	2,398	759	770	6,281	1,645	1,842	2,063	2,311	2,588	28,753	12.1%
Wood processing technology	0	0	0	0	0	711	725	739	753	767	780	794	808	3,610	766	842	926	1,018	1,120	14,357	6.0%
Manufacturing technology	0	0	0	0	0	763	778	793	4,307	3,933	4,008	1,795	1,824	5,144	2,189	2,408	2,649	2,914	3,205	36,710	15.4%
Total	0	0	0	0	0	3,658	3,730	3,802	12,731	10,925	11,131	6,543	6,655	28,256	7,579	8,400	9,310	10,319	11,439	134,478	56.5%
Teaching materials development and distance learning																					
Textbooks	0	0	0	1,580	0	0	0	32	190	32	32	32	32	348	32	32	32	32	821	3,223	1.4%
A/V production	0	0	0	4,273	0	0	0	85	513	85	85	85	85	940	85	85	85	85	2,222	8,716	3.7%
Multi media class room	0	0	0	104	829	0	0	19	29	102	19	19	19	39	184	19	19	19	70	1,488	0.6%
Library (Local learning center)	0	0	0	0	75	600	0	14	14	21	227	170	173	176	194	149	29	29	29	1,895	0.8%
Total	0	0	0	5,956	904	600	0	149	745	240	362	305	308	1,502	495	284	164	164	3,142	15,322	6.4%
Grand total	523	776	914	7,060	2,239	8,607	5,310	5,770	15,604	13,660	20,735	10,295	11,027	34,561	13,764	23,252	17,525	20,102	26,107	237,830	100.0%

Table A-8.10.11 Summary of equipment cost for the Master Plan

(US\$ 1000)

		Investment cost	Maintenance cost	Total
1	Existing packaged course	78,011	10,019	88,030
2	Pilot Programs	120,970	13,509	134,478
3	Teaching materials dev. and distance-learning	13,426	1,895	15,322
	Total	212,407	25,423	237,830

Table A-8.10.12 Cost estimation of equipment for the Master Plan (Details)

	(US\$1000)																				Total
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		
Existing packaged courses																					
Engineering																					
No. of students	6,889	7,075	7,216	7,361	7,508	7,658	7,825	7,974	7,227	7,062	6,941	6,802	6,666	6,532	6,402	6,274	6,148	6,025	5,905	130,609	
Unit cost	0.38	0.45	0.53	0.62	0.74	0.87	1.02	1.21	1.43	1.68	1.96	2.34	2.76	3.26	3.85	4.54	5.36	6.32	7.46	46.80	
Annual cost	2,612	3,165	3,810	4,586	5,519	6,643	7,703	8,907	10,300	11,911	13,774	15,929	18,420	21,301	24,632	28,484	32,939	38,031	44,049	302,776	
Newly investment	457	553	644	776	934	1,124	1,060	1,205	1,393	1,611	1,863	2,154	2,491	2,881	3,331	3,852	4,455	5,152	5,957	41,894	
ReNewal						673					4,878					4,495				10,047	
Total investment cost	457	553	644	776	934	1,797	1,060	1,205	1,393	1,611	6,741	2,154	2,491	2,881	3,331	8,348	4,455	5,152	5,957	51,940	
Maintenance cost	52	63	76	92	110	1,797	154	178	206	238	275	319	368	426	493	570	669	782	881	7,719	
Sub-TOTAL	510	617	721	867	1,044	3,593	1,214	1,383	1,599	1,849	7,017	2,473	2,860	3,307	3,824	8,918	5,114	5,914	6,838	59,660	
Applied math/science																					
No. of students	4,887	4,985	5,085	5,186	5,290	5,396	5,296	5,190	5,065	4,984	4,885	4,787	4,691	4,597	4,505	4,415	4,327	4,240	4,156	91,988	
Unit cost	0.12	0.14	0.16	0.18	0.21	0.24	0.27	0.32	0.36	0.42	0.48	0.55	0.64	0.73	0.84	0.97	1.11	1.28	1.47	10.48	
Annual cost	580	681	799	937	1,099	1,289	1,455	1,639	1,848	2,082	2,347	2,645	2,981	3,359	3,786	4,266	4,808	5,419	6,107	48,125	
Newly investment	0	100	118	138	162	190	166	185	208	235	264	298	336	379	427	481	542	611	688	5,527	
ReNewal						259					751					641				1,651	
Total investment cost	0	100	118	138	162	449	166	185	208	235	1,015	298	336	379	427	1,122	542	611	688	7,178	
Maintenance cost	12	14	16	19	22	26	29	33	37	42	47	53	60	67	76	85	96	108	122	962	
Sub-TOTAL	12	114	134	157	184	475	195	218	245	276	1,062	351	395	446	502	1,207	638	719	810	8,140	
Management/business study																					
No. of students	10,890	11,302	11,824	11,857	12,094	12,336	12,169	11,916	11,678	11,444	11,215	10,991	10,771	10,556	10,344	10,138	9,935	9,736	9,541	210,526	
Unit cost	0.01	0.01	0.02	0.02	0.03	0.04	0.06	0.07	0.10	0.13	0.17	0.23	0.30	0.40	0.53	0.70	0.93	1.23	1.63	6.60	
Annual cost	112	154	209	283	383	517	675	877	1,138	1,478	1,919	2,492	3,236	4,202	5,457	7,066	9,201	11,947	15,513	66,880	
Newly investment	0	42	56	74	99	134	158	202	262	340	441	573	744	966	1,254	1,629	2,115	2,746	3,566	15,402	
ReNewal						135					663					2,673				3,491	
Total investment cost	0	42	56	74	99	270	158	202	262	340	1,124	573	744	966	1,254	4,301	2,115	2,746	3,566	18,893	
Maintenance cost	2	3	4	6	8	10	14	18	23	30	38	50	65	84	109	142	184	239	310	1,338	
Sub-TOTAL	2	45	60	79	107	280	172	219	284	369	1,163	623	809	1,050	1,364	4,443	2,299	2,985	3,876	20,230	
Non-tertiary engineering																					
No. of students	366	183	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	549	
Unit cost																					0
Annual cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Newly investment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ReNewal																					0
Total investment cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Maintenance cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sub-TOTAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL (investment)	457	696	818	967	1,195	2,516	1,384	1,591	1,863	2,185	6,881	3,025	3,571	4,225	5,012	13,771	7,112	8,509	10,212	78,011	
TOTAL (Maintenance)	66	80	96	116	140	1,833	197	228	266	309	361	421	493	577	677	797	939	1,109	1,313	10,019	
TOTAL	523	776	914	1,104	1,335	4,348	1,580	1,819	2,129	2,495	8,242	3,447	4,064	4,803	5,690	14,568	8,051	9,618	11,525	88,030	
Pilot Programs																					
Hospitality and tourism																					
No. of students						160	320	480	720	960	1,200	1,520	1,840	2,160	2,419	2,710	3,035	3,399	3,807	24,729	
Newly investment						202	202	202	303	303	303	404	404	404	327	366	410	459	514	4,802	
ReNewal									303					1,160						1,463	
Accumulated investment cost				0	0	202	404	605	908	1,211	1,514	1,917	2,321	2,725	3,051	3,418	3,828	4,287	4,802		
Maintenance cost				0	0	4	8	12	18	24	30	38	46	54	61	68	77	86	96	624	
Sub-TOTAL				0	0	206	210	214	624	327	333	442	450	1,619	388	435	487	545	610	6,889	
IT and communications																					0
No. of students						80	160	240	360	480	600	720	840	960	1,080	1,200	1,320	1,440	1,560	16,962	
Newly investment						583	583	583	2,331	2,331	2,331	1,165	1,165	1,165	1,165	1,224	1,346	1,481	1,629	1,792	19,708
ReNewal									874							5,536				6,410	
Accumulated investment cost				0	0	583	1,165	1,748	4,079	6,410	8,741	9,906	11,072	12,237	13,461	14,807	16,288	17,917	19,708		
Maintenance cost				0	0	12	23	35	62	128	175	198	221	245	269	296	326	358	394	2,762	
Sub-TOTAL				0	0	594	606	618	3,267	2,459	2,506	1,364	1,387	6,946	1,493	1,642	1,806	1,987	2,186	28,881	
Business IT																					
No. of students						80	160	240	360	480	600	720	840	960	1,080	1,200	1,320	1,440	1,560	26,196	
Newly investment						257	257	257	1,029	1,029	1,029	1,286	1,286	1,286	926	1,037	1,162	1,301	1,457	13,602	
ReNewal									386							3,215				3,602	
Accumulated investment cost				0	0	257	515	772	1,801	2,830	3,859	5,145	6,432	7,718	8,644	9,662	10,843	12,145	13,602		
Maintenance cost				0	0	5	10	15	36	57	77	103	129	154	173	194	217	243	272	1,685	
Sub-TOTAL				0	0	262	268	273	1,451	1,086	1,106	1,389	1,415	4,657	1,099	1,231	1,379	1,544	1,729	18,889	
Post harvest and food processing																					
No. of students						120	240	360	600	840	1,080	1,140	1,200	1,260	1,411	1,581	1,770	1,983	2,221	15,805	
Newly investment						1,100	1,100	1,100	2,200	2,200	2,200	550	550	550	1,386	1,552	1,739	1,947	2,181	20,355	
ReNewal									0						5,500					5,900	
Accumulated investment cost				0	0	1,100	2,200	3,300	5,500	7,700	9,900	10,450	11,000	11,550	12,936	14,489	16,227	18,174	20,355	144,883	
Maintenance cost				0	0	22	44	66	110	154	198	209	220	231	259	290	325	363	407	2,898	
Sub-TOTAL				0	0	1,122	1,144	1,166	2,310	2,354	2,398	759	770	6,281	1,645	1,842	2,063	2,311	2,586	28,753	

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	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total	
Wood processing technology																					
No. of students						60	120	180	240	300	360	420	480	540	594	653	719	791	870	6,326	
Newly investment						697	697	697	697	697	697	697	697	697	697	697	690	759	835	918	10,100
ReNewal									0						2,787					2,787	
Accumulated investment cost				0	0	697	1,394	2,090	2,787	3,484	4,181	4,878	5,575	6,271	6,899	7,588	8,347	9,182	10,100	73,473	
Maintenance cost				0	0	14	28	42	56	70	84	98	111	125	138	152	167	184	202	1,469	
Sub-TOTAL				0	0	711	725	739	753	767	780	794	808	810	825	842	926	1,018	1,120	14,357	
Manufacturing technology																					
No. of students						60	120	180	240	300	360	420	480	540	584	637	697	764	837	916	6,330
Newly investment						748	748	748	748	748	748	748	748	748	748	748	748	748	748	748	28,901
ReNewal									449						3,290					3,739	
Accumulated investment cost				0	0	748	1,495	2,243	2,991	3,739	4,487	5,235	6,000	6,748	7,496	8,244	9,000	9,748	10,500	203,512	
Maintenance cost				0	0	15	30	45	60	75	90	105	120	135	150	165	180	195	210	4,070	
Sub-TOTAL				0	0	763	778	793	807	821	835	849	863	877	891	905	920	934	949	36,710	
TOTAL (Investment)				0	0	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586	3,586	120,970	
TOTAL (Maintenance)				0	0	72	143	215	287	359	431	503	575	647	719	791	863	935	1,007	13,509	
TOTAL				0	0	3,658	3,730	3,802	3,874	3,946	4,018	4,090	4,162	4,234	4,306	4,378	4,450	4,522	4,594	134,478	
Teaching materials development and distance learning																					
No. of students of Existing courses				0	0	0	0	0	0	0	0	3,387	4,426	5,421	6,375	7,289	8,164	9,001	9,801	53,864	
No. of students of New courses				0	0	0	0	632	1,392	2,448	3,620	5,016	6,636	8,436	10,556	13,048	14,516	16,151	18,452	82,452	
Total				0	0	0	0	632	1,392	2,448	3,620	5,016	6,636	8,436	10,556	13,048	14,516	16,151	18,452	136,316	
Textbooks																					
Newly investment				1,580																	
ReNewal									158											790	
Total investment cost				1,580	0	0	0	0	158	0	0	0	0	0	316	0	0	0	0	790	2,844
Maintenance cost								32	32	32	32	32	32	32	32	32	32	32	32	379	
Sub-TOTAL				1,580	0	0	0	32	190	32	32	32	32	348	32	32	32	32	821	3,223	
A/V production																					
Newly investment				4,273																	
ReNewal									427						855					2,136	
Total investment cost				4,273	0	0	0	0	427	0	0	0	0	855	0	0	0	0	0	2,136	7,691
Maintenance cost								85	85	85	85	85	85	85	85	85	85	85	85	85	1,025
Sub-TOTAL				4,273	0	0	0	85	513	85	85	85	85	940	85	85	85	85	85	2,222	8,716
MULTI media class room																					
Newly investment				104	829																
ReNewal									10	83					21	166				52	
Total investment cost				104	829	0	0	0	10	83	0	0	0	21	166	0	0	0	0	52	1,264
Maintenance cost						0	0	19	19	19	19	19	19	19	19	19	19	19	19	19	224
Sub-TOTAL				104	829	0	0	19	29	102	19	19	19	39	184	19	19	19	19	70	1,488
Library (Local learning center)																					
Newly investment				75	600						150	150	150	150							
ReNewal										8	60	0		0	15	120	0		0	203	
Total investment cost				75	600	0	0	0	8	210	150	150	150	150	165	120	0	0	0	1,628	
Maintenance cost								14	14	14	17	20	23	26	29	29	29	29	29	267	
Sub-TOTAL				75	600	0	0	14	14	21	227	170	173	176	194	149	29	29	29	1,895	
TOTAL (Investment)				5,956	904	600	0	0	596	90	210	150	150	1,341	331	120	0	0	2,978	13,426	
TOTAL (Maintenance)				0	0	0	0	149	149	149	152	155	158	161	164	164	164	164	164	1,895	
TOTAL				5,956	904	600	0	149	745	240	362	305	308	1,502	495	284	164	164	3,142	15,322	
G.TOTAL (Investment)	457	696	818	6,844	2,099	6,702	4,970	5,177	14,768	12,574	19,389	8,773	9,319	32,654	11,628	20,857	14,833	17,069	22,680	212,407	
G.TOTAL (Maintenance)	66	80	96	116	140	1,904	340	593	836	1,086	1,346	1,522	1,708	1,907	2,136	2,395	2,692	3,033	3,427	25,423	
GROUND TOTAL	523	776	914	7,060	2,239	8,607	5,310	5,770	15,604	13,660	20,735	10,295	11,027	34,561	13,764	23,252	17,525	20,102	26,107	237,830	