Vocational Education and Training Reform in the Republic of Serbia

Manual 8

METHODOLOGY FOR APPRAISAL AND PRIORITISATION OF EQUIPMENT NEEDS, TEACHING MATERIALS AND INFRASTRUCTURE OF THE SCHOOL

Vocational Education and Training Programme – Phase II

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Section 1 (S.1.) School Buildings Infrastructure

S.1.1 Introduction

The physical needs of Serbia's education system after more than a decade of isolation and budgetary neglect and economic mismanagement vastly exceed the scope of easy solution. Balancing the situation of extensive physical needs for system revival there is a basis for rehabilitation of existing schools as well as for the building of new school structures and their further capital maintenance.

This document sets out the arrangements to satisfy the government's agenda for education (Law on the foundations of the Education system) and opportunity for the local community to act according to their statutory role (Law of Local Self-Government). It also identifies the programme of investments needed in school buildings, in line with an agreed framework for prioritisation of needs, the available norms and standards and taking into consideration expected developments on future standards that will be set up for the raising demands on school buildings infrastructure.

It is acknowledged that a successful plan for school maintenance has a direct impact on the raising of student performance through its three main areas of activity: Condition, Suitability and Sufficiency.

Such impacts will include the following:

- Buildings that are not in a good condition may affect the morale and motivation of students / pupils and teachers
- Schools that have adequate, appropriately designed teaching facilities that are equipped to modern teaching and learning standards, will ensure that students / pupils and staff have the opportunity to realise their full potential
- All parts of the school facilities could be utilised by the local community, thereby reducing the costs for investment for school premises
- Insufficient space in a school may lead to overcrowding resulting in difficulties for good quality teaching
- Investment in reducing energy costs will improve the local environment

School buildings are property, meaning fixed assets, as other state and / or municipal property, i.e. buildings, land and utilities (energy, telecommunications, water supply, waste treatment, etc). Therefore school buildings in accordance with their special nature need to be managed paying special attention to:

- Their overall market value developments in the immobile property sector and in line with state rules and legislation on fixed assets (regular and extraordinary maintenance, modernisation in line with new directives for energy, waste, public health and safety)
- Their special utilisation in education, i.e. keeping these premises in an appropriate and safe condition to facilitate the educational processes foreseen for each building according to the rules and regulations for educational institutions (classrooms, workshops and laboratories accommodation, including installations, ventilation, lighting, etc.)

S.1.2. General Background

Any budget available from school external sources (e.g. national and foreign government, EU and other donor agencies) for financing is given with conditions concerning the efficiency and effectiveness of its use in relation to the needs which the financing is planned to fulfil. Therefore an appropriate justification is required to convince the competent body authorised to manage this budget to allocate a budget line for a specific purpose, i.e. school infrastructure improvement as in the case of schools. As part of this process, the competent local authorities and the schools' management need to develop plans for the efficient procurement, management and improvement of capital assets, applying innovative and energy-efficient solutions permanently.

Capital investments constitute a key aspect of raising educational standards and ensuring the safety of students. That means that the personnel in charge of the buildings have to apply and act in line with predefined regular and ad-hoc maintenance guidelines that are normally given (by a municipal department or

school management) to provide appropriate conditions for proper functioning of the facilities taking into account both educational demands and health and safety rules and regulations, i.e. protecting the buildings against earthquake, ensuring fire protection and fire escape and ultimately contributing to the improvement of the overall urban environment.

As financing needs to be programmed and can be made available to cover precisely calculated and thoroughly justified needs, cognisance must be taken of the following:

- The methodologies for assessment of buildings and premises
- The criteria for categorisation and prioritisation of school building needs
- The methods for calculation and justification of the budget required in line with the school priorities
- The arguments necessary for adequate reporting to the decision makers (school management, competent local authorities and the Ministry of Education)

S.1.3 Socio-Economic Background

The necessity of regional development is caused by the fact that most of regions in Serbia are under the average level which means that capacities are not completely used (economic, demographic, natural resources etc.). The state policy of regional development is complementary with other policies in terms of increasing economic conditions, growth and finally, the standard of living.

The following policies are implied:

- The development policy included in the 'Development Strategy of the Republic of Serbia
- The policy for joining the European Union through national strategy
- The policy for poverty reduction within the 'Strategy for poverty reduction'
- The policy for public investments through National Investment Plan

Priorities are divided in four groups:

1. Economic (growth, development, increase of employment and investments, development of small and medium enterprises)
2. Social (poverty reduction, improvement of living standard)
3. Demographic (prevent migrations)
4. Ecologic (environmental protection, obtain sustainable development).

From the economic point of view a main question is how to use capacities of certain regions. Following the development model, the aim is to route investments towards underdeveloped municipalities and targeted sectors such as:

- Education
- Health
- Infrastructure
- Business development (small and medium enterprises)

Education is a key priority for upgrading a general society level and earning new practices. A society based on knowledge is a guiding principle for all highly developed countries.
Investing in human education is the most profitable investment. The path of education development should be led in two directions:

1. Investments in education (primary, secondary, tertiary)
2. Specific training for those who are employed and unemployed

Improvement in educational infrastructure does not mean only purchasing new school equipment, computers or rehabilitation of buildings but also improvement in the education process (acceptance of EU standards, teacher training).

S.1.4. The Education Infrastructure

The following tables present statistics taken from the latest available figures for the School Year 2004 / 2005

Table 1: Primary Education (number of schools/students)

School year	N° of schools		N° of pupils		
	State	Private	Total	Lower grade	Higher grade
2004/2005	3,579	n/a	659,543	324,913	334,630

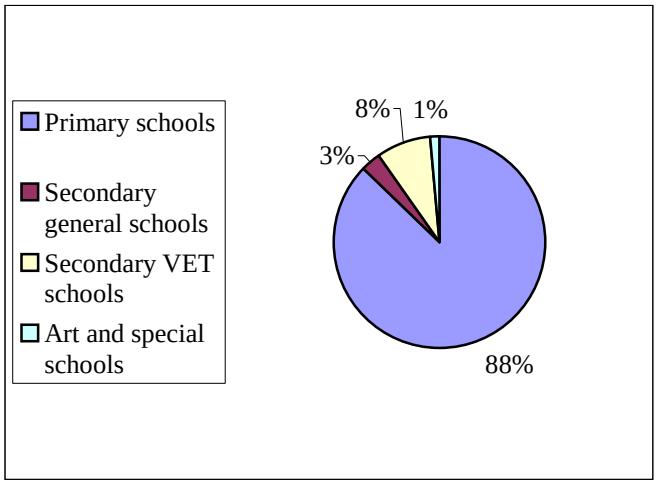
Source: Federal Statistical Office

Table 2: Secondary Education (number of schools/students)

School year	N° of schools		N° of pupils		
	State	Private	Total	Gen.education	VET
2004/2005	480	n/a	297,708	80,643	217,245

Source: Federal Statistical Office

Diagram 1: Distribution of primary and secondary schools



S.1.5 Assessment and Prioritisation

A detailed survey of the existing school premises. The existing school buildings in Serbia comprise about 5.500 structures (with an average surface of approximately 1000 m2 per structure) and constitute a network of primary and secondary schools throughout the country.

The lack of sufficient space in school premises is pronounced mainly in larger towns and in particular for secondary vocational education school buildings. Due to the lack of school surface many schools use additional inadequate premises that do not even meet the minimum pedagogic norms[1] (form and size of classrooms - min 2sq.m./pupil, mobility of furniture, illumination etc.) and hygienic-technical norms[1] (volume of classrooms - min 5sq.m./pupil, distance from blackboard – max 8m etc.).

Generally school facilities (electrical installations, plumbing, sewerage installations etc.) are in a poor condition as a result of the lack of organised maintenance in the past decade. From approximately 5.500 school buildings (according to the EAR Report on Towns and Schools for Democracy):

- 25 % are over 60 years old

- significant refurbishment is required in a large proportion of schools (the number of schools requiring refurbishment fell from 50 percent to 35 percent thanks to the support of the European Agency for Reconstruction, government investments and other donors);
- more than 25 % of schools do not have an adequate sewerage system
- more than 50 percent do not have an adequate water supply
- nearly 25 percent have heating system problems

The **Assessment and Prioritisation, (A&P)**, should cover all significant capital and revenue spending on school premises. Sources on funding to meet the needs of priorities identified through the A&P process should be derived from a number of sources including:

- Local authority's own resources
- Government initiative
- Funds from the Government budget allocated for new schools
- School capital funds and recurrent budgets
- Private finance initiatives (parents, etc)

The A&P should be prepared using working groups with participants from the school(s) and local authority representatives and professionals from competent municipality departments. In recognition of the wider implication for the A&P and capital investment all documentary evidence must be endorsed by the Ministry of Education.

The A&P is a document which should be updated on an annual basis and refer to a five (5) year planning period. The delegation of this duty has to be carried out taking into account any possible future local government re-organisation. Also the A&P process should be supported by training seminars for working group members for helping them to comply with their new responsibilities.

S.1.6. Aims and Objectives

Aims

The aim of A&P is to set out information needed, and the criteria used in order to enable decisions about spending on school premises which will:

- Raise the standards of educational achievement
- Provide safe, sustainable and energy efficient buildings
- Ensure efficient and effective management of new and existing capital assets
- Provide innovative design solutions which reflect the future needs of ICT based education
- Increase Community use of school facilities
- Maximise value for money

Objectives

The main objectives of A&P are to:

- Provide a basis for making decisions on spending priorities, with a consensus obtained on the prioritisation criteria
- Assist Principals on school level in developing plans and coordinating different needs for investment
- Assist local Authorities in using compulsory competitive transparent tendering and ensure that they seek Efficiency, Economy and Effectiveness, that is best value in delivering local services
- Compile lessons learned, disseminate know how to extend practices to other categories of schools

S.1.7. Scope of A & P

- Identify local stakeholders involved in infrastructure maintenance and the related National counterparts and form expert working groups
- Assess existing policies and laws in relation to building management at Municipality level
- Based on rehabilitation activities, complete assessment where buildings do not meet safety criteria and educational needs
- Prepare and agree with the National Authority on a framework for training local stakeholders in collecting information, developing policies, priorities and action plans as part of their statutory role
- Liaise with National Authorities to compile and disseminate methods for efficient and effective use of assets

S.1.8. Roles and Responsibilities

The National Authorities will have overall responsibility for preparing the A&P which they should develop through partnership with Local Authorities and schools. The A&P needs to reflect the needs and priorities of individual schools and take their development plans into account. The National Authorities will have strategic objectives which might not always match the perceived needs of individual schools. In such circumstances consultation across all schools will be important to reach a consensus.

Specific roles and responsibilities of the respective parties would include:

Schools

1. Achieve the identification of school priorities and preparation of outputs (physical and educational)
2. Co-operate in the preparation of the A&P

Local Authorities

1. Develop policies, priorities and action plans and plan the annual investment programmes
2. Compile and disseminate information related to school buildings
3. Promote local partnership
4. Explore alternative funding mechanisms
5. Plan, budget and manage projects
6. Implement monitoring of service delivery

Ministry of Education

1. Provide a policy statement and framework
2. Set priorities and criteria at national level
3. Collaborate closely with working groups on local level

S.1.9. Stages in developing A & P

The A&P planning process can be divided into six distinct stages:

1. Local policy statement (Identify roles, responsibilities and scope of plan)
2. Assessing existing premises (set up the database and compile basic data on each school)
3. Identifying needs (Consider situation, sufficiency and suitability needs and identify areas of concern, consider Authority Plans and School Development Plans)
4. Determining priorities (Develop overview on priorities, prioritise most urgent and serious needs)
5. Feasibility studies (Establish feasibility of potential solutions to priority needs, appraise options and establish economic and effective proposals, investigate funding and procurement arrangements)
6. Implementation, review and evaluation

S.1.10. Local Policy Statement

Local Authorities will need, in consultation with representatives of schools, to produce a statement setting out the framework of respective roles, responsibilities and functions within which the A&P would be developed.

It should cover:

- The scope of the A&P
- Roles and responsibilities of Local Authorities and other partners
- The basis on which information about premises will be collected and analysed
- The priorities of the Local Authority
- The criteria for prioritising needs on the basis of agreed priorities
- The basis for maintaining and reviewing the A&P

S.1.11. Assessing Existing Premises

- **Collecting information (Condition survey)**

Accurate information on the premises is essential to enable the development of a successful A&P. This will include information on location, details of ownership, the size, capacity and type of buildings, the number of pupils, running costs and asset values. It is essential, however, that in gathering data, clear priorities are identified at the earliest stage in order to concentrate on gathering the minimum of information for maximum usefulness.

The information gathered will help to prepare strategies for improving the use and performance of existing assets and maximizing value for money.

Establishing the condition of all school premises within each Authority is necessary to enable repairs and maintenance works to be costed, prioritised and planned.

The surveys should identify the work necessary to bring premises up to a serviceable state of repair and the information will help to inform strategic decisions on larger scale programmes of repair, replacement or improvement of premises.

- **Property information system-Asset Register**

The development of an adequate premises information system is central to good management and planning. It will enable the key factors in decision making-both needs and available resources. Computer applications can now enable data to be assembled and manipulated with relative ease.

S.1.12. Identifying Needs

The investment in school premises can be categorised broadly in terms of condition, sufficiency and suitability as follows:

Condition needs focus on the physical state of premises to ensure safe and continuous operation that may involve building regulations. It has direct impact on educational standards and provides a safe, warm and dry building with a stimulating and attractive environment. Legislative change and rising safety standards also provide challenges such as the statutory requirements associated with access for those with disabilities, safety glazing, asbestos etc.

Sufficiency needs focus on taking account of the demands of other services e.g. community use. In considering sufficiency needs Authorities should think corporately about use of assets. For example, can the school building be used for other purposes such as community or private sector?
Sufficiency focuses on total areas and on the quantity and organisation of places within schools. The primary aim of sufficiency assessment is to offer a fair and consistent method of identifying any surplus or deficit of pupil places in relation to the demand.

Suitability needs focus on the ability of premises to meet curriculum needs. Priorities concerning the premises should relate to the priority needs and their improvement must follow the rising educational standards.

Curriculum analysis and modelling should be employed where appropriate to check that the numbers, types and sizes of teaching spaces are appropriate to the student / pupil numbers and curriculum.

They should cover:

- Efficient space planning to meet curriculum needs
- Increasing use of information and communication technology (ICT)
- Facilities capable of delivering a modern curriculum
- Remedy health and safety problems
- Environmental impact
- Address functional problems with internal spaces
- Modifications to encourage community use of schools

S.1.13. Determining Priorities

The most important and sensitive task is the prioritisation of the most serious and urgent needs. The Authorities will need to include in its policy statement the methodology to be used for determining priorities and it will need to ensure that the methodology has the full support of the schools.

S.1.14. Feasibility Studies

Having prioritised the needs, the Authorities will carry out feasibility studies and consider the costs and benefits of alternative solutions and look at the best way of funding them.

S.1.15. Implementation, Review and Evaluation

Implementation

Its purpose is to:

- Identify works required to maintain the use and value of premises
- Programme the repair and maintenance works to maintain a specified level of performance, to ensure minimum disruption to the operation of the school and to match forecast levels of funding
- Provide a tool for budgeting and financial management

Review

This will require reprioritisation of projects, identification of new needs etc.

Evaluation

This will involve determining how A&P has contributed to improving the quality of capital management and to raising educational standards.

Appraising A&P

The approach to the appraisal of A&P would cover the following:

Quality of data:

- Premises information

- Demand data (e.g. forecast of number of students / pupils)
- Surveys

Performance:

- Matching supply and demand for places
- Outcomes compared with plans and targets
- Impact on educational standards

Track record

- Effectiveness of repairs and maintenance

S.1.16. Management Plan

Property Information System

The development of an adequate property information system is crucial to good management planning because it will enable the key factors in decision making, needs and available resources, to be brought together in an integrated way. Computer based systems are now available that enable these types of information to be gathered, stored and analysed.

Many Authorities already have systems that can meet many of the requirements of the A&P. In such cases the National Authorities will need to decide whether to integrate A&P with the existing system or to invest in a new system (National Authorities may wish to develop A&P database systems that serve more than just the education service).

For the system itself it is essential that information can be extracted easily from A&P and that security is managed appropriately.

S.1.17. Data on School Premises, (see Appendix I)

Adequate premises data on all schools in an Authority's area is central to the development of the A&P.

The basic data requirement is as follows:

- School ID number
- School name
- Number of sites on which the school is located
- Number of blocks forming school buildings
- Gross internal area
- Teaching area
- Number of classrooms, workshops and laboratories

S.1.18. Condition Assessment

Establishing the condition of all school premises within each Local Authority is necessary to enable repairs and maintenance works to be budgeted, prioritised and planned and to provide a basis for developing a long-term maintenance programme.

The condition assessment should describe all elements of the property and not just those where work is necessary (items that are in need of repair or replacement will be entered into a data base and items in good condition where no work is required can simply be described in text). Premises should be assessed block by block, element by element to collect information on:

- Type of premises

- Grading of the existing condition
- Priority grading
- Average costs to repair or renew

Major elements and sub-elements and their classification:

- Roofs (flat and pitched: structure, coverings and insulation, drainage)
- Floors and stairs (structure, screed and finish)
- Ceilings (ground and upper floors)
- External walls (structure, external and internal finishing), windows and doors (framing, glazing, ironmongery)
- Internal walls (structure, finishing), doors (framing, ironmongery)
- Sanitary services (toilets, fittings, waste plumbing)
- Mechanical services (heat source and equipment, heating, distribution, ventilation)
- Electrical services (power, wiring, fittings, lighting, fire alarms, intruder alarms, lightning protection, communications systems)

Premises type is usually classified in condition survey reports as follows:

1. Pre 1918
2. Inter war
3. From 1945-1961
4. Post 1961

The **condition** of each element should be assessed using the following recommended grades:

1. Grade A-Good. Operating efficiently
2. Grade B-Satisfactory. Exhibiting minor deterioration
3. Grade C-Poor. Exhibiting major defects
4. Grade D-Bad. Serious risk

Note: A major element may cover a number of sub-elements of varying condition grades. In such cases the major element will reflect the average of the sub-elements.

The following **priority** grades are recommended:

1. Priority 1. Urgent work that will prevent high risk on health and safety matters
2. Priority 2. Essential work that will prevent serious deterioration and medium risk on health and safety matters
3. Priority 3. Desirable work
4. Priority 4. Long term work
5. **Note:** An element graded condition D will not always match priority 1 (where element is in poor condition but for which maintenance work is not high priority: where elements face future redevelopment, disposal or demolition, adaptation or rationalisation).

An estimate of **costs** should be made at the time of assessment of the cost of repairing or renewing defective elements for bringing the element to Grade-A condition.

Questionnaire for Self Assessment. See Appendix I

S.1.19. New School Construction or Existing school Renovation

Three factors generally trigger a decision to take a serious look at an aging school:

- Health and Safety deficiencies
- Out dated or poorly operating building systems
- Programme changes

Before the Local Authority embarks on a major renovation project, it must determine whether it is better to replace the existing facility with a new school. Sometimes the cost of replacing outdated systems, upgrading health and safety deficiencies and accommodating programme expansions within existing schools far exceeds the cost of building a new facility. However there may be good reasons to renovate an older building rather than build a new one such as a particular architectural character, especially pre-1950 buildings.

Newer schools built in the 1960s and '79s generally lack architectural character, are non-energy efficient and constructed of cheap materials. These are demolished more often or become hand-me-down conversions from secondary schools to elementary schools and visa versa.
For schools built in the 1980s the dilemma is not so much whether to replace or renovate but how to add to the structure in an economical and aesthetically pleasing manner.

Another important reason why older buildings are renovated is because there is no new land available to move the school or the available land is prohibitively expensive.

A final factor is whether a renovation can be undertaken whilst a school is in use. If the goal is to continue to occupy the building, developing a phased construction schedule, which separates construction work from occupied areas is critical.

Renovating can simply be the right thing to do, make the most economical sense or provide a school district with the right space given the available funds.

To build or not. Analyse renovation and replacement to evaluate whether it is more economical or reasonable to renovate an older school rather than abandon and construct new. However, the cost of renovating and older school to bring it up to code may exceed the cost of building a new one.

Consider reusing existing schools that are typically located in an established neighbourhood setting as opposed to buying undeveloped land that does not have the supporting infrastructure, arrangements for bus transportation and other facilities established locations offer. Schools from the 60s and 70s tend to be on larger plots of land to begin with and are usually easier to renovate or extend.

After the decision has been made to renovate or construct a new school the tender dossier is compiled. This is explained in Section 2.

Section 2. (S.2.) Tender Dossier Compilation and Evaluation

S.2.1 Introduction

This section deals with the preparation of all documentation and procedures from the initial project concept to the final award of contract. In The Republic of Serbia school renovation or new build contracts are awarded through a Public Procurement Contract. Submission of tenders are requested by the following types of tenders.

Economic operator. Any individual or legal entity, State or privately owned, or a group of such entities, lawfully, supplying goods, services or undertaking works and complying with specific criteria related to personal status, capacity to exercise its professional activity, technical and / or professional capacity, compliance with quality insurance standards and with environmental protection standards.

- Open Tender — Any interested economic operator has the right to submit an offer.
- Restricted Tender — Any economic operator has the right to candidate and, only selected candidates will have the right to submit the offer.

The procedural steps for implementing a project tender are as follows:

Step I – Expression of Interest

For a selected or restricted tender there is an additional preliminary procedure. This is the ***"Expression of Interest".*** which is basically a fax or e-mail sent to the identified companies requesting their confirmation of interest in tendering for the project. This simple task can save time and therefore money by removing the unnecessary task of sending documentation to uninterested parties.

Step II – Invitation to Tender

Once the participating companies have been recognised a *Contract Tender Meeting* is arranged where they are issued with the ***"Invitation to Tender".***

Included (but not limited to) in this package is the following documentation and information :

- The covering letter signed by the Client's authorised representative including the official request to bid, tender period and other relevant information.
- Project location and description.
- Site visit(s), available during the tender period.
- General Conditions of Contract.
- Conditions of Particular Application. This is an extended document to the Conditions of Contract distinctive to the particular contract. It will include, but not be limited to, data governing local contract influencing factors, retention clause, liquidated damages or penalty clauses, Defects Liability Period (DLP), final inspections and retention release, currency, method of payment (percentage or quantity against unit rate), material procurement advance (if applicable), commencement and completion dates etc.
- Sample Form of Agreement.
- The Technical Specifications.
- Basic Contract Drawings.
- The Bill of Quantities including rate coverage explanation (see Notes 2.)
- Financial Guarantee (if applicable).
- Bid Validity Period.

Step III – Tender Submission

A. The tender period, date, time and place of submission will have been stated in the covering letter or the Conditions of Particular Application. The tenderer will be informed that the bids must be submitted in a sealed envelope marked with the contract name, reference number and the tenderer's Company name.

Information and documents to be submitted by the contractor shall be described in either the cover letter or the Conditions of Particular Application and will include but not limited to:

- Company headed covering letter.
- Company information including :
    - Company registration details.
    - Names and CVs of Directors.
    - Company financial status.
    - Company fact sheet including similar work undertaken.
    - Available equipment and staffing.
- Construction methodology (if requested).
- Programme of Works.
- Any special conditions.
- The completed Bill of Quantities.

Step IV – Tender Opening

The opening of the bids will either be carried out in an open public meeting with all participating economic operators present or in a closed meeting of the Tender Evaluation Committee. This committee shall be made up of selected official representatives of the Contracting Authority.

On opening each envelope a *Preliminary Examination of Bids and Determination of Responsiveness* will be carried out which includes :

- The Contractor meeting the eligibility criteria.
- Documents have been signed by an authorised representative of the economic operator.
- If required, the relevant contract securities.
- The completed Bill of Quantities.

Step V – Tender Evaluation and Contract Award

The tender Evaluation Committee is a group of selected officials and experts which assist the Contracting Authority in evaluating the tender proposals submitted by the tenderers and in determining the most economically advantageous offer, which it stressed, may not necessarily be the lowest financial offer. A declaration of impartiality and confidentiality is signed by each Committee member. Any member who has a past or existing link with any tenderer must declare it and withdraw from the selection process. All Committee members must have a good command of the language(s) in which the tender is submitted.

Before starting the evaluation itself, the Committee meets for a preparatory session to discuss and agree on the interpretation of the criteria and "evaluation matrix" to be used for the technical and financial evaluations.

On opening the envelopes in the public tender opening meeting, only the final tender sum for each bidder shall be recorded. The lowest six to nine (depending on the number of bidders), will then be short-listed under *"Short List No. 1",* the remaining bids being put aside.

Before a detailed evaluation the following checks will be carried out :

- A correction of mathematical errors.
- BOQ final page is signed and stamped.
- Application of any discounts.

The lowest six (say) contractors' bids will then be entered in a database and marked under the following criteria on a "1" to "5" basis. "1" being very bad to "5" being very good.

- Contractor's Locality
- Financial Status
- Adequate Staffing and Supervision.
- Adequate Equipment
- Construction Methodology (if requested).
- Programme of Works
- Similar Work Experience
- Tendered Price

Further criteria may be added if circumstances require it.

The top three highest scoring companies will then be entered on *"Short List No. 2".*

A visit to each of the company's premises may be undertaken by representatives of the Evaluation Committee in order to interview the Director(s) and examine the establishment, staff, equipment and relevant resources.

In case of an unanimous decision the winner will be invited to meet the Committee for the ***"Award of Contract".***

Negotiations will be finalised, for example periods of mobilisation and demobilisation, contract advance, contractor's conditions and any other relevant details. Should no successful agreement be reached, negotiations will be closed and the second company on *"Short List No. 2"* will be contacted for similar discussions.

In the unlikely scenario that no agreement with any of the three top bidders is satisfactorily reached a case for the contract going to re-tender must be considered.

Notes on the Bill of Quantities and payments for contractors :

Rates and Costs

Day-Work Rate.	This is a rate submitted by the Contractor in his bid for additional work authorised by the Engineer and paid on a daily basis. Strict labour time-sheets must therefore be kept in order to record the accurate, cost effective expenditure.
Rate-Only Item	This is a rate for an item included in the original Bill of Quantities, which not necessarily will be used. Therefore there is no quantity and no price carried forward to the totals.
Contingency Item	This is a percentage sum of the total (5% or 10%) which takes into account unforeseeable activities instructed by the Engineer. Normally this expenditure must be agreed with the Client if excessive.
PRELIMINARY AND GENERAL SUM	**THIS IS A LUMP SUM WHICH ALLOWS FOR A CONTRACTORS ESTABLISHMENT, INCLUDING SITE BUILDINGS, OFFICES ETC.**

Section 3. (S.3.) Project Cycle Management in School Development Projects

S.3.1. Introduction

Project Cycle Management (PCM) is the term given to the process of planning and managing projects and programmes. It is a system that is being increasingly used by development organisations. Development projects sometimes fail because they are badly planned and do not take account of important factors, particularly the needs and views of stakeholders. PCM is based around a project cycle which ensures that all aspects of the project are considered. A central value of the PCM method is that aspects of the project are reconsidered throughout the project cycle to ensure that any changes which have occurred are included in the project design. As a result projects are more likely to be successful and sustainable.

Whether it is a renovation of existing schools or a new build project the implementation procedure should follow the established system of project cycle management.

A project is a series of activities aimed at bringing about clearly specified objectives within a defined time-period and with a defined budget. This definition covers a variety of project types in terms of size, objectives, focus and methodologies. However there are many basic similarities.

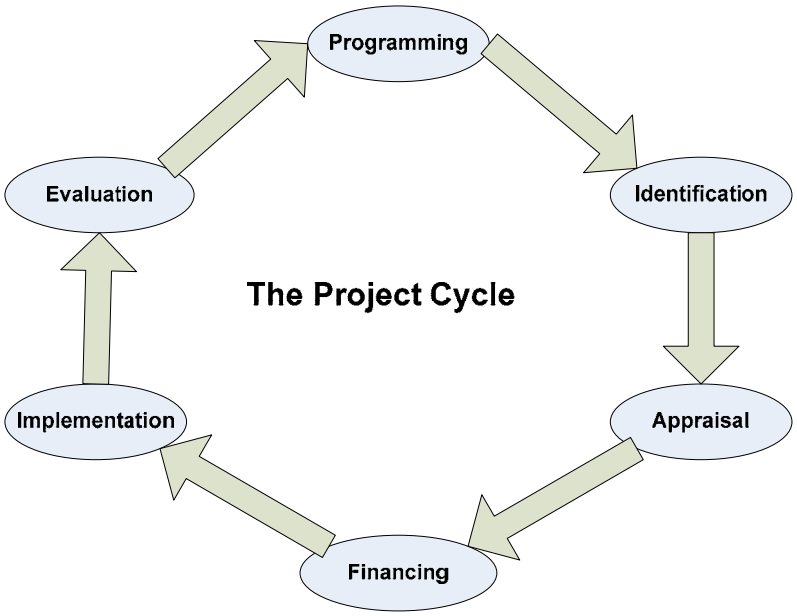
The ‘project cycle’ is a way of viewing the main elements that projects have in common, and how they relate to each other in sequence. The precise formulation of the cycle and its phases may vary but the basic components follow a similar cycle.

S.3.2. The Project Cycle (PCM)

Most International Agencies now adopt a project cycle management approach when designing and implementing development projects. The aim of PCM is to improve the management of projects and programmes, by ensuring that all relevant issues and conditions are taken into account during design and implementation. In application PCM consists of a set of designs and management concepts, techniques and tasks that is used to support informed decision making.

Educational projects have to conform to a range of policies and strategies, (e.g. gender, community participation, curriculum, environmental impact etc.) and criteria which have been adopted by the agency and / or government body.

Diagrammatically the cycle is represented as shown below



and explained as follows:

- **Programming** The establishment of general guidelines and principals for co-operation, agreement of sectoral and thematic focus and outlining of broad ideas for projects and programmes.

- **Identification.** Within the programme framework, problems, needs and interests of possible stakeholders are analysed, ideas for projects and other actions are identified and screened. The outcome is a decision on whether or not the options developed should be studied in more detail.

- **Appraisal (or preparation).** All significant aspects of the idea are studied, taking into account stakeholders' views, relevance to problems, feasibility and other issues. Logical or results-based management frameworks, and activity and implementation schedules, are developed and the required inputs calculated. The outcome is a decision to take the project forward or not.

- **Financing.** Based on the appraisal a decision is taken on whether or not to fund the project. This negotiation or approval stage may involve both the implementing agency and other stakeholders. However, financial decisions may be taken at different points in the cycle, e.g. at the end of the identification or appraisal phases, depending on the particular procedure being followed.

- **Implementation.** The agreed resources are used to carry out the planned activities and achieve objectives. Progress is assessed though monitoring to enable adjustment to changing circumstances. At the end of the implementation, a decision will be made whether to close or extend the project.

- **Evaluation.** The assessment of the projects achievements and impact examines the relevance and fulfilment of objectives, efficiency, effectiveness, impact and sustainability. It leads to a decision to continue. Change or terminate a project, and its conclusions and recommendations are taken into account when planning similar projects.

S.3.3. Disaster Risk Management in the Project Cycle

Disaster risk management should be factored into all stages of the project cycle. The initial planning stages of the cycle, (programming, identification, appraisal), are the key entry points at which disaster risk issues can be factored into projects. However disaster risk in the other stages of the cycle should be recognised.

Many tools that are potentially useful in introducing disaster risk management when considering say a new school development (e.g. economic appraisal, environmental appraisal, availability of teaching staff, existing municipal infrastructure and social impact assessment), are likely to be deployed extensively during the appraisal phase.

S.3.4. Main Elements in Project Appraisal

Area of Appraisal (or preparation)	Key Issues /Features	Planning Tools/entry Points for incorporating disaster risk reduction
Situation analysis	• Policy and programme context :policy objectives and strategies of the Agency planning the project, national/local governments and other international donors and agencies working in the country or district concerned. • Review of relevant initiatives (completed, ongoing and planned) by the Agency and others, lessons learned, complementary and linkages to proposed project. • Stakeholder analysis : views of all who might be affected by a project, positively and negatively, and how they could be affected. • Institutional capacity assessment of institutions responsible for project implementation. • Problem analysis : identifies the state and negative aspects of an existing situation and establishes cause / effect relationships.	• Information on significant natural hazards affecting the project, collected and analysed. • Problem analysis. • Preliminary stakeholder analysis. • Initial environmental screening. • Examination of economic rationale for the proposed intervention. • Scoping (or national level) vulnerability and capacity analysis. • Scoping of main social impacts. • Assessment of construction standards, relevant land use and building code legislation, implementation capacities and construction capabilities.
Project description and implementation arrangements	• Analysis of project purpose and objectives, identifying achievable solutions to the problems • Strategy selection : analysis and description of strategies to be used for achieving the objectives (and rejected alternatives approaches) • Target groups : location and characteristics • Project components, activities and implementation schedule • Inputs and costs • Expected outputs, outcomes, impact • Performance indicators, monitoring and evaluation systems • Coordination and management structures, organisational procedures • Proposed financial management/financing plan • Accompanying measures by government and project partners	• Objectives analysis and overview analysis of alternatives • Develop understanding of target groups through further vulnerability and capacity analysis and social impact assessment methods • Determination of hazard safety objectives of any physical structures and related measures to ensure that selected building design and implementation arrangements satisfy these objectives • Development of an environmental management plan and monitoring programme • Development of public involvement programme and engagement of stakeholders • Development of a risk management plan and risk monitoring arrangements
Feasibility and sustainability	• Economic and financial viability : economic cost-benefit or cost-effectiveness analysis, rates of return • Environmental impact of the project, environmental management plans • Technical feasibility, adoption of relevant standards, use of appropriate technologies • Socio-cultural aspects : recognition of local norms and attitudes, stakeholder consultation, participation by beneficiaries, gender equality, targeting of support for vulnerable groups • Governance : policy support, institutional and management capacities to deliver and sustain	• Detailed investigation of key features of natural hazards in project area and their potential impact on project and communities • Environmental assessment and evaluation including environmental analysis of alternatives • Economic appraisal, including economic analysis of alternatives • Thorough vulnerability and capacity analysis • Detailed sustainable livelihoods

	project outcomes • Risks : key factors outside the direct control of project managers that could have a negative impact on the project, now or in the future, possible adverse effects of the project on community resilience, risk management mitigation arrangements	assessment and analysis involving field data collection. Multi stakeholder analysis and design workshops • Comprehensive social impact analysis • Detailed analysis of project site selection, construction design and related implementation capacity • Analysis of risks and assumptions

Section 4. (S.4.) School Design Concepts

Part A - General School Planning

S.4.1 Architectural and Behavioral Concepts

In modern school design the path from concept to completion is lined with countless decisions, some extremely effective others just to remain, and rightly, in obscurity. Each decision, from overall budget allotted for the project to the colour of the library walls can affect whether the students or staff members who spend their days in the building perceive it as a place that enhances learning or as just another structure filled up with desks and chairs.

Before determining the best way to meet a school's facility requirements, officials need to be clear on the school's mission and culture. School architects and designers should discuss design concepts with educators and other participants. Consultation is best conducted with fairly senior, or architecturally experienced teachers who feel able to take decisions and are more likely to produce useful input. Concepts presented should include:

- The school building should contribute to the aesthetic sensibility of the child by showing him standards beyond those of his home.
- Good clear organisation, an easily legible plan and full accessibility.
- Effective use of the site and public presence as a civic building wherever possible in order to engender local community pride.
- A layout that encourages broad community access and use of out of hours where appropriate.
- Accord with the principles of character, continuity and enclosure, quality of public space, ease of movement, legibility, adaptability and where appropriate diversity of use.
- Attractive external spaces with good relation to internal spaces, offering appropriate security and a variety of different settings.
- Flexible design that will facilitate changes in policy and technology and which allows for expansion or contraction in the future where appropriate.
- Attractive in design, comparable to that found in other quality buildings with a view to inspiring students, teachers and parents. Harmonisation with surrounding buildings and landscape.
- Good environmental conditions throughout, including appropriate levels of natural light and ventilation.
- Circulation that is well organised and sufficiently generous.
- Spaces that are well proportioned, efficient, fit for purpose and meet the needs of the curriculum. Functional and maintainable, economical to run and respectful of the environment.
- Sustainability from conception through final completion and long term school management. Maximum environmental and social benefit with cost assessments that reflect the whole building life cycle such that the investment can be properly maintained.
- Wide interesting corridors with plenty of natural lighting, possible inclusion of Sunscoop tubular roof lighting system.
- Excellent audio, visual conditions in classrooms and technical areas.
- Robust materials that are attractive, that will weather and wear well and are environmentally friendly.
- Assurance that capital costs are competitive and savings can be achieved on running costs.

S.4.1.1. Shared Space

Modern designs need to accommodate computers and ensure accessibility. Schools are now being built with larger classrooms, but at some point, the additional square meterage begins to strain the construction budget. One solution that frees up space in classrooms is for schools to create shared spaces where teachers and staff members can store many of the items traditionally filling the shelves and cupboards in classrooms. However classrooms cannot continue to grow. A grade-level planning centre can be created that provides bulk storage and a place where teachers can share curricular materials.

S.4.1.2. Sustainability

As students and communities become more environmentally conscious, sustainable concepts become a matter not just as conserving energy and saving money, but also of teaching students. It can be part of the educational process.

Sustainable design calls for using environmentally friendly materials when building and outfitting a facility, using construction methods that do not harm the ecology, and designing spaces and using systems that use energy most efficiently. Ultimately sustainable design will be a requirement that schools insist on.

S.4.1.3. Outdoor Landscape

School administrators tend to focus on their faculties, but the surrounding landscape also plays a key role in providing a high-quality educational environment.

It is the first image students experience when they visit the school. It's where they are going to spend a lot of their time when not attending classes. In school design it has become accepted to create a better environment on campuses for students. The trend is for more green space, more trees and moving parking areas to the perimeter of the site.

S.4.1.4. A Variety of Spaces

At most schools a need still exists for classrooms to accommodate traditional classroom lectures. However as teachers use more varied approaches to instruct students more effectively and as technology allows students to work independently, schools require more varied spaces.

A school department is likely to need a large lecture hall, traditional classrooms, seminar rooms, project-based learning rooms that may accommodate only eight or ten students and individual carrels in libraries and media centres for independent learning.

S.4.1.5. Student-Oriented Space

Modern schools have begun paying closer attention to the spaces and amenities offered to students as they travel from class to class. In secondary schools especially, designs are emphasising commons and other gathering spaces to make buildings more inviting for the students. Kids have a mall mentality; they are not going to accept less from their school. Designers should try to situate facilities so that students spend more time at school instead of just taking classes, catching the bus and going home.

S.4.1.6. Technology

The advance of technology allows schools to design facilities to deliver instruction more efficiently. Consideration should be given to media-retrieval capabilities, which allow teachers in classrooms to use the school's computer network to recover audio and video materials from the school's library, media centre or from off site. The ability for schools to store information electronically can free up space in the facility.

S.4.1.7. Community Use

When designing new facilities the architect should be mindful that the school may want to give the community or organisations opportunities to use the gymnasium, auditorium, library, computer lab or other spaces. This may affect how large the facilities are, where they are situated in the design and how they are paid for. On the final point long term income could be generated by hiring out these facilities.

To provide community access without jeopardising the security of the school building, the school can be designed so that the public has access only to the public-use sections of the facility.

S.4.1.8. Security

As schools become increasingly vulnerable to violence there has to be an increased emphasis on ensuring construction provides the needed level of security.

Schools should be constructed with a secure entrance, the only access to the building being through or adjacent to the main office. CCTV observation should seriously be considered. Many faculties especially in the US are using the concepts of Crime Prevention Through Environmental Design (CPTED).[1]

S.4.2. School Design Particular to Vocational Training

Focus the technical areas design on the proposed vocational training curriculum.

- Car maintenance areas. Provide overhead lifting apparatus, roller shutter doors for vehicular access, pits for under vehicle inspection, hydraulic ramps etc. Mesh reinforced concrete flooring to carry additional weight. Power floated flooring painted with protective covering.
- In all workshop areas consideration for storage, security and functionality to be at the core of the design.
- Bricklaying training area to be an open workshop allowing student's room to practice their skills.
- Most efficient use of natural light for energy savings and safety reasons.
- Stairs and disabled access to allow students to possible upper mezzanine to classrooms for IT, social studies and theory side of vocational courses.
- Above the brick and block work on the ground floor level consider composite wall panels.2 The insulation to provide heat retention during winter months and keep the building cool during the summer.
- Inside the workshops the block work to be faced off and painted.
- Provide adequate power sockets and internet access points for on line, IT training.
- Provide effective drainage systems particularly for "wet areas".
- Provide efficient student washing facilities adjacent to the work areas.

S.4.3. Structural and Drainage design

a) Take particular cognisance of all geotechnical and sub-soil surveys of the area during foundation design.
b) Design all foundations, columns, beams, slabs and roof structures in accordance with internationally accepted design procedures.
c) Incorporate engineering standards taking cognisance of the following realistic constraints. Economic, environmental, sustainability, material and labour skill availability, ethical, health and safety and security.

[1] See : http://www.cpted-watch.com/
[2] See : http://www.meadowburke.com/pdf_files/MB_Composite2000.pdf

S.4.3.1 Drainage

- Storm water drainage to be designed wherever possible in line with geographical topography.
- Design storm water and foul drainage systems avoiding any chance of contamination.
- Design of all storm water and foul water drainage to be in accordance with internationally accepted design procedures.[3]

S.4.3.2 Roof Design

- Evade wherever possible flat roof design, this will avoid the possibility of leakage and ponding. Also a pitched roof is usually more aesthetically pleasing.
- Roof slope helps determine the appropriate materials for the roof. A high pitched roof will allow products such as shingles or tiles that will not be suitable on a low pitch roof. Conversely a single ply membrane or a built up roof will not be appropriate for a high pitch roof.
- Reinforced thermoplastic membrane roofing systems[4] are ideal for low pitched application. They are extremely durable, easily installed, leak proof, resistant to fire and high winds and virtually maintenance free.
- Consider revolutionary roofing systems. One such being the liteTILE[5] Roofing System, system requires just two tiles per square metre of coverage and is one seventh the weight of conventional tiles.

The tiles are dry fixed and each 1.67m. tile weighs only 6.6kgs. covering 0.59 m^2. and can be laid to a pitch of 10^o. This means the roof truss centres can be placed at greater distances than is required for traditional roofing materials. Fast and simple installation saves costs and time. The tiles are tested to withstand winds of up to 195 Km./hr.

The tiles are not subject to unsightly moss and lichen growth. A unique fungal inhibitor incorporated in the tile surface prevents moss and lichen growth thus prolonging the life of the roof.

This roofing system is particularly adaptable to school buildings.

- Exterior environmental conditions will have a significant influence on the type of roofing system. In cold climates the dangers of icing and water back up through shingle systems must be addressed. High wind areas may require systems and applications that prevent blow offs.
- Interior usages and conditions may also influence the selection of roofing systems. A roofing system suitable for a classroom wing may not be suitable for a swimming pool because of humidity.
- Fire codes will affect roofing material choices. Most model codes for educational facilities require at least a minimal resistance to surface flame spread. Although most roofing systems provide this resistance wood shingles or shakes must be treated with flame retardant materials to bring them into compliance.[6]
- Aesthetic considerations may also play a role in the selection of roofing systems. Materials such as asphalt shingles, wood shakes, metal, or tiles will generally result in a more residential scale and allow more colour, texture and interest in the roof.
- Consider in the design of the roof maintenance and access to services such as HVAC systems, water storage tanks and drainage pipes and gutters.

S.4.4. Classroom Design

Three Fundamentals in a Learning Environment.

1) **Students should be able to see everything that is presented visually.**
2) **Students should be able to hear everything that is presented audibly, free from noise and distortion.**

[3] See : http://www.co.san-diego.ca.us/dpw/docs/drainage/drainagedesignmanual0705.pdf
[4] See : http://www.aecinfo.com/1/category/00/35/15/category_1.html
[5] See : http://www.buildingtalk.com/news/cat/cat114.html
[6] See : http://www.fpl.fs.fed.us/documnts/pdf1989/white89a.pdf

3) **Students should be comfortable in their learning environment, including air flow, room temperature, and appropriate furniture.**

S.4.4.1 General Learning Space Characteristics

- The intended purpose and pedagogy (including type of teaching methodology to be supported) proposed for the room.
- Physical dimensions, room length, width, proportions and ceiling height.
- Space requirements including square metres per student station, teaching area, available spaces vs. classroom capacity.
- Room characteristics including windows, proximity to exterior or interior noise, impact of building structure and lighting.
- Furnishings including type, density, flexibility, mobility, comfort, sustainability and student desktop needs.
- Technology including type and degree of sophistication, power and cooling requirements, future expandability and format changing.
- Specific equipment placement parameters including location of projection equipment and screens, student sightlines and sight angle requirements, equipment maintenance and security.
- Writing surfaces including marker board usability, readability and maintainability.
- Acoustics including room properties, isolation from unwanted noise and the effects of HVAC and mechanical systems.
- Accessibility including room and its approaches, furnishings and equipment, student and teacher considerations.

S.4.4.2 General Learning Space Design

- In new construction structural columns must not be sited within the seating area nor shall they obscure the sightlines to the teacher or projected images.
- Ceiling height in classrooms should be a function of proper architectural proportion, acoustic properties and occupancy as well as a function of projection screen heights and sightlines. Provide adequate ceiling heights, minimum of 3 metres for standard classrooms. However as a rule of thumb generally the larger the room the higher the ceiling.
- Classrooms should be designed to maximise the seating capacity and the number of different seating arrangements.
- Entrances into the classrooms and the flow of traffic should be confined to the rear of the room, or if not possible, at the sides away from the instruction area.
- Recess out-swinging doors into the room to avoid projecting into corridor circulation.
- Teacher consoles should be located so as not to obscure the students' sightline of the projection screen(s) and marker board(s).
- Provide window shade systems or blinds to darken the room.
- Folding walls should not be used in classrooms because of the difficulty in maintaining adequate sound separation between classrooms.

S.4.4.3 Seating Density

Seating density is a product of room configuration, the "teaching zone" and A/V equipment usage. Seating density should promote efficient space utilisation while supporting instruction by providing appropriate sight lines, permitting verbal exchange among students and with the teacher. In many classrooms however, satisfactory sight lines to the screen will require additional space for students.

S.4.4.4 Learning Space Configuration

Experience generally suggests a length / width ratio for the average classroom is 3:2. However for lecture or discussion rooms it is preferred that they are wider and shallow rather than narrow and deep. Rooms

designed for effective use of monitors or projection screens should be orientated towards the short wall creating a deeper narrower room.

Seating for handicapped users and wheelchair locations should be dispersed in the learning space where more than one location is required. Minimum handicapped seating space shall be 76 cms. Wide by 122 cm deep. Ramps must not have slopes exceeding 1:16

Ceiling height should be determined based on the height of the projected image, which is 1/16th the distance of the farthest student from the projection screen. To that dimension add 122 cms. To the bottom of the image. For example, in a typical general purpose classroom in which the farthest student sits 9 metres from the screen, the height of the projected image will be 1.5 metres, to which 1.3 metres (above the floor) will be added, making the ceiling height at the front of the room 2.8 metres.

S.4.4.5 Finishes

- Classroom finishes should be chosen with room function, acoustical and architectural characteristics, as well as custodial, durability and sustainability of the room in mind. Floors should be non-slip and easy to maintain. Should carpeting be used this should not be located in wet or washroom areas.
- Where all hard floor surfaces are used, compensate with acoustical ceilings, wall panels or other means to limit movement volume.
- Walls should have durable, non-glare finishes. Soft materials such as acoustic panels where they are used, should be mounted as high as possible to avoid accidental damage or vandalism by room users. Chair rails or wall protective features should be provided in rooms where moveable chairs are located up against the wall area.

- Reflectance. The following are recommended reflectivity levels :

Ceiling light reflectance	:	80% - 90%
Floors light reflectance	:	30% - 50%
Wall light reflectance	:	50% - 60%

S.4.4.6 Acoustics

- **Poor acoustics are among the top complaints in learning spaces.**

- Numerous factors determine the speech intelligibility in a particular classroom including :

  - Where the building and room are situated.
  - Noise originating from A/V equipment, adjacent spaces, room users or building / ventilation systems.
  - The size and shape of the room.
  - The rooms' placement relative to other interior spaces.
  - Surface treatment (which determines sound absorption).
  - Construction of the ceiling, walls and floor.
  - Number, type and location of sound source and the strength of sound they produce.

  - Noise from passing vehicles, internal building and hallway noise, all significantly detract from the learning experience and must be addressed through the design to minimise noise transmission through surrounding walls, ceilings and floors.
  - To achieve the desired noise reduction, select construction materials and assemblies with appropriate **Sound Transmission Class (STC)**[7] Ratings for the slab, roof, interior and exterior walls including doors and windows.
  - Extending walls slightly above ceilings and adding sound insulation over the ceiling at the perimeter of the room is inadequate to prevent the passage of sound.

[7] See : http://www.sota.ca/stc_info.htm

- Where possible, position doors into adjacent rooms as far apart as possible and avoid positioning doors in hallways directly opposite doors into other learning or sound sensitive / generating areas.
- At the design stage identify noisy areas (mechanical and electrical rooms with equipment of transformers, gyms, cafeterias or music areas) and use buffer areas (corridors, storage rooms etc.) to separate these areas from critical learning spaces and noise sensitive areas. Take into account that many learning areas use audio equipment that produce high sound levels that may be transmitted to adjacent classrooms.
- Building utilities and services emit constant or intermittent sounds to the classroom. The sound level from these sources should not fluctuate significantly nor create annoying buzzes, rattles or whines. Even sound rated transformers when enclosed in small rooms produce interference.
- **Signal to Noise Ratio (SNR).**[8] SNR indicates the intelligibility of spoken information by comparing the loudness of the sender's voice (signal) to the background-sound level (noise) at a particular location (receiver's ear). Excessive background noise levels caused by HVAC systems or other exterior sources seriously degrades intelligibility, even when the reverberation is suitable. This ratio can also be improved by providing carefully considered early sound reflections (eg. Wall shaping and finishes), reducing speaker-to-listener distance (SDL) and minimising excessive reverberation time (RT).
- **Speaker-to-Listener Distance (SLD).**[9] This also affects audibility. As the distance between speaker and listener increases, the loudness of the signal, and therefore the **SNR** decreases.
- **Reverberation Time (RT).**[10] This also affects the intelligibility of speech**.** By raising the overall "sound rattle" in the room, it lowers the **SNR** by overlapping the original signal with reflections that muddy or blur the sound of subsequent words or sounds. The proper balance of hard/reflective and soft/absorbent for room surfaces can greatly reduce the reverberation time in a classroom, which is a critical factor in improving intelligibility in the classroom.
- A hard ceiling or surface above the forward teaching zone (either a flat ceiling or angled soffit) helps reflect the sound to the back portions of the room. In larger rooms, the addition of central ceiling reflector surface also may be advantageous to aid two way discussions

S.4.4.7 Acoustic Specifications for Learning Areas

Sound Transmission Coefficient (STC)[11] should be as follows:

A. Higher STC ratings and special wall-construction details must be included for all walls, elevated slabs, roof and exterior walls including doors and windows, whenever classrooms are located adjacent to, above or below functions that generate a significant amount of noise.

B. Recommended STC ratings :

1. For learning spaces adjacent to offices or conference rooms a minimum **45 STC.**
2. For learning spaces adjacent to another learning space, corridor (with the classroom door closed) or to the outdoors, minimum **50 STC.**
3. For learning spaces adjacent to common use areas, public use areas and large wash rooms, minimum **35 STC.**
4. For learning spaces adjacent to music or other performance space, elevator shafts and other equipment rooms, cafeteria, mechanical (and electrical where large transformers are present) rooms and physical education areas, minimum **60 STC.**

C. Ambient sound levels measured at 120 cms. At all points throughout the classroom space should have the following **Noise Criteria Ratings (NC).**[12]

[8] See : http://en.wikipedia.org/wiki/Signal-to-noise_ratio
[9] See: http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=PubMed&list_uids=14663347&dopt=Abstract
[10] See : http://www.saecollege.de/reference_material/pages/Reverberation%20Time%20Calculator.htm
[11] See : http://personal.cityu.edu.hk/~bsapplec/sound3.htm
[12] See : http://www.acousticalsolutions.com/education/pdfs/Noise_Criteria.pdf

1. Classrooms: **NC 35 or less, preferably NC 25-30 if affordable.**
2. Auditorium / lecture hall: **NC 25 or less.**
3. Studio / Distance education originating or reception room: **NC 20 or less.**

D. The acoustic design should produce a preferred signal to noise ratio of **+15** for normal speech without amplification.

E. Walls, floors and ceiling assemblies should have a mix of partially absorptive and partially reflective materials to reflect the teachers' voice to all areas of the room. The increased use of modern A/V equipment generally demands less reverberant spaces.

Suggested reverberation time (RT60) in unoccupied rooms should be:

1. Classrooms under 285 m^3 RT60 **of 0.4 to 0.6 seconds.**
2. Classrooms between 285 m^3 and 570 m^3 **RT60 up to 0.7 seconds.**
3. Tiered lecture halls and larger conference rooms that also may be used for instruction **RT60 of 0.85 to 1.20 seconds,** to be confirmed by the acoustician for intended uses.

S.4.5 School Lighting

Light fixtures and lamps should be specified for energy efficiency, low heat generation, easy maintenance and cleaning and meet specific needs supporting instruction. As modern day teachers rely on computers and projection systems to a greater extent, flexible lighting capabilities become essential. Classroom lighting should permit a range of levels from dark to bright, as well as permitting note taking while projection equipment is in use.

S.4.5.1 Day-lighting

Good day lighting design requires understanding a building's local climate and use patterns and the location, placement, and shading of windows and skylights relative to their solar orientation. A good day lighting system provides:

- Balanced, diffused, glare-free daylight from two or more directions.
- Sufficient light levels for the tasks in the space.
- Operable shading devices to reduce light intensity for audio-visual programmes and computer work.
- Windows for interest, relaxation and communication with outdoors.
- Exterior shading devices as needed to minimise solar heat gains during the summer / cooling season.

The concept of cool day lighting is a systematic approach to day lighting design that ensures the day light is controlled through a combination of glazing systems such as Low-E,[13] (Low-emittance, a low-E coating, microscopically thin, virtually invisible, metal or metallic oxide layers deposited on a window or skylight glazing surface primarily to reduce the U-factor by suppressing irradiative heat flow), shading systems and architectural design. The result is a building that uses significantly less energy than an ordinary school by simultaneously reducing lighting and cooling loads. However to be effective day lighting must be supplemented by automatically controlled electric lighting that dims or turns off in response to daylight levels, or if affordable, occupancy sensors switch off / on devices automatically.

[13] See : http://lightingdesignlab.com/articles/glazing/glazing.htm

S.4.5.2 Electric Lighting

For the greatest energy efficiency and best colour rendering, school lighting should employ either fluorescent T-8 or T-5 linear lamp technology with electronic ballasts. The latest T-8 lamps, called *second generation*[14], produce greater than 10% more light per watt than original T-8 lamps and 50% more light per watt than the old T-12 lamps, (still the most common used in older schools). Second generation T-8 lamps are currently about 30% more expensive than ordinary T-8 lamps, but their superior colour and light output are worth the cost and they last about 20% longer.

In a typical classroom, the added cost of purchasing second generation lamps (as compared to T-8 generic lamps) is about €4.00 per year. However if the additional light from the lamps is utilised through good design practice, the classroom will use about 200 less watts and will save about €40.00 per year in energy costs.

High Intensity Discharge (HID) lamps[15] should be used primarily outdoors (in parking areas, athletic fields and high wattage exterior lights) and some interior applications. Metal halide lamps are strongly recommended (as opposed to high pressure sodium) for their good colour rendering and white light, which provides better night vision.

Until recently HID lamps were used in gyms, pools and other spaces with high ceilings. With the advent of T-5 HO and multiple compact fluorescent lamps however indoor applications for HID lamps should be chosen carefully and only after considering a fluorescent alternative.

The reason is that fluorescent systems generate more light per watt and provide superior colour. The exception is high colour-rendering ceramic metal halide lamps. These new lamps are not nearly as energy efficient as fluorescent lamps, but they are the most efficient source for display lighting and a few other specialty applications where colour rendering is important.

S.4.5.2.1 Good Coefficient of Utilisation (CU)

The CU takes into account the way a luminary works within a particular space. This is especially important with indirect lighting systems, which have an excellent CU in a room with a flat ceiling 3 metres above the floor but have a reduced CU at higher ceiling heights.

S.4.5.2.2 Design using the Latest Recommendations

The Illuminating Engineering Society of North America (IESNA), lighting handbook, 9th. Edition, contains recommendations for lighting levels, (foot-candles or lux). These levels and their applications can result in lower energy use when properly applied. A good reference is *Recommended Practice for Lighting for Educational Facilities (IESNA)*[16].

S.4.5.3 Lighting Sources for School Uses

Light Source/System	Mean Lumens Per Watt	Luminaries	Type of School Space
Fluorescent T-5 linear with programmed start electronic ballasts (60, 90, 122 and 152 cm. lengths.	91	Specialty lighting, such as under cabinet, suspended indirect, wall washing.	Classrooms, offices, multipurpose rooms, libraries
Fluorescent T-8 second-generation linear with electronic		General lighting in troffers, suspended lighting	Classrooms, offices, multipurpose rooms, lockers, toilets, stairs, libraries, utility areas,

[14] See : http://www.edfacilities.org/pubs/pubs_html.cfm?abstract=lighting
[15] See : http://en.wikipedia.org/wiki/High-intensity_discharge_lamp
[16] See : http://www.edfacilities.org/pubs/lighting.pdf

instant start ballasts (60, 90, 122 and 152 cm. lengths).	92	systems, wraparounds, strips.	hallways, corridors, labs, music rooms, shops, studios.
Fluorescent T-5 HO linear with programmed start electronic ballasts. (60, 90, 122 and 152 cm. lengths).	81	Specialty lighting applications where high lumen output is required.	Gyms, pools, libraries, offices, multipurpose rooms.
Compact fluorescent triple tube lamps. (18, 26, 32, and 42 watts) with electronic ballasts.	50 - 72	Downlights, sconces, wall washers, utility lights, wall brackets, table and task lamps	Lobbies, offices, multipurpose rooms, toilets, halls and corridors, utility spaces, exterior canopies, walls, bollards, utility applications.
Pulse start, metal halide lamps. (250 watts or higher).	55 - 78	Industrial style downlights, parking lot lights, roadway lights, large wallwashers, specialised uplights, flood-lights, sports lights.	High ceiling interior spaces (some gyms, pools), parking lots, sports fields, and other pole mounted exterior lighting.
Pulse start ceramic metal halide lamps *150 watts or lower) with electronic ballasts.	35 - 65	Track and recessed display lighting	Feature displays

S.4.5.4 Use of Natural Day-lighting

A specific element in maximising the use of natural daylight is to include features that will stimulate the education of the children and capitalise on the sustainability of the architecture.

The natural daylight element can be exploited by the inclusion of in-plane roof lights in the classrooms. Such a system, Glidevale Sunscoop,[17] gives a cost effective solution. It is a simple hemispherical form from the outside and is aesthetically pleasing. A Fresnel lens in the ceiling diffuser can be included to give an additional spread of light and provide an interesting appearance.

This system is ideally suited to providing natural lighting to schools. One such example is an additional two floor classroom block to Caerleon Comprehensive School in Wales. The architect wanted to design a facility that optimised natural daylight inside, proven to improve learning, was quick to build yet complimented the existing buildings on the campus. He chose an insulated metal 15^{o} pitched roof, in blue to match the established blue felted roof of the main school building.

Some 16 x Glidevale 250 mm. dia. Sunscoop tubular rooflights provide natural daylight into the first floor corridor, which otherwise would have artificial lighting only.

Research shows learning is improved when natural light is maximised with the school environment. Rooflights themselves allow up to three times more natural daylight in than an equivalent sized vertical window. The roof mounted Sunscoop dome “catches” natural daylight, reflecting it down a specular silvered aluminium tube into the room below. Sunscoop claims 95% reflectivity into the building, with a softer, more natural light. The tube includes “LSD” (low sun deflector) that intercepts light even when the sun is low in the sky and would normally miss the sunscoop’s mirror tube helping reduce the need for supplementary artificial lighting and the subsequent increase energy costs.

S.4.6 School Heating

Legal Requirements (UK)

The Education (School Premises) Regulations 1999[18] set out the legal requirements for minimum temperature in schools. These are:

[17] See : http://www.glidevale.com/Downloads/Sunscoop%20Tubular%20Rooflights.pdf
[18] See : http://www.opsi.gov.uk/si/si1999/19990002.htm and
http://www.teachers.org.uk/resources/pdf/school_premises.pdf

- **18^{0}C.** in areas of normal level of physical activity associated with teaching (i.e. ordinary classrooms).
- **21^{0}C.** in areas of lower than normal activity (e.g. sick rooms).
- **15^{0}C.** in areas of higher than normal activity (e.g. gymnasia, washrooms).

The Regulations require that schools have heating systems capable of maintaining these minimum temperatures and also school classrooms are heated up to at least temperatures for as long as the rooms are used for their normal purposes.

The law also requires that sufficient thermometers should be conveniently available (although not necessarily in every room) to enable staff to check temperatures in the work place.

S.4.6.1 Types of Heating Systems

- Oil or gas fired central boilers feeding radiators
- Under-floor heating
- Municipal Central Heating System
- Biomass fuelled Boilers.

The first three of the above systems are commonly used and will not be described in detail under this School Design Concepts document. However Biomass fuels are becoming increasingly popular because of their low emission, non-polluting properties.

S.4.6.2 Biomass School Heating, Overview

The benefits of biomass heating systems are reflected through the environmental impact of local communities and municipalities' public obligations. Biomass fuel turns readily available waste products into clean and efficient energy. Sustainable forest initiatives and wood manufacturing by-products provide cost effective pellet fuel manufacturers with low cost materials by retrieving biomass materials from these programmes.

Pellet heating systems provide a low-net CO_2 solution, because the quantity of CO_2 emitted during combustion is equal to the CO_2 absorbed by the tree during its growth. With modern high efficiency burners other emissions such as NO_x and volatile organic compounds are low making this one of the most non-polluting heating options available.

S.4.6.3 Biofuel Combustion Systems[19]

S.4.6.3.1 Grate Combustors

Techniques based on grates (such as inclined grate, travelling grate, chain grate or vibrating grate), the fuel is usually fed automatically onto the grate by gravity. As the fuel bed moves, moisture is driven off initially followed by ignition, burning and finally cooling when the ash is removed. The air supply below the grate is often sectioned so that the flow rates and pressures of the primary combustion air to each section can be independently controlled. These systems also require a fairly high proportion of air supplied above the grate as secondary air. Temperatures above the bed normally range between 800^o C. and 1000^{o}C. In the stationary grate design, ashes fall into a pit for collection. In contrast, a travelling grate system drops the ash into a hopper.

S.4.6.3.2 Compact Hopper Fed Boilers[20]

[19] See : http://www.biomasscombustion.com/
[20] See : http://www.welsh-biofuels.co.uk/oilvpellet.htm

These are automatic biomass boilers for wood pellets complete with fuel hopper, boiler and burner in a compact unit. Depending on the size heat output ranges from 37,500 BTU/h (11 Kw.) for a 500 litre hoper size to 632,000 BTU/h (185 Kw) for a 1000 litre hopper. A medium size school would require approximately 500,000 BTU/h.

Some advantages of this design are:

- Thermal efficiency of 90%
- Stainless steel combustion chamber
- Fuel scraper system for reliable and precise feeding of fuel
- Large ash pans
- Ceramic hearth for high temperature combustion

Biofuels, Wood Pellets

Wood pellets are a type of fuel generally made from compacted sawdust. They are usually produced as a bi-product of sawmilling and other wood transformation activities. Wood pellets are extremely dense and can be produced with low humidity content (below 10%) this allows them to be burned with high combustion efficiency. Their regular geometry and small size (25/30 mm. long x 6/8 mm. diameter), allow automatic feeding with a fine calibration. They can be fed to the burner by auger feeding or pneumatic conveying.

Their high density also permits compact storage and rational transport over long distance. They can be conveniently blown from a tanker to a storage bunker or silo at the customer's premises.

The ash from wood pellets produces an effective fertilizer.

Pellet Fuel Characteristics

- **Density.** Consistent hardness and energy content (minimum 640 Kg/m^3)
- **Dimensions.** Length approx. 25 mm. diam. 6 to 8 mm. Assuring predictable fuel amounts and prevention of fuel jamming.
- **Fines.** Limited amount of sawdust from pellet breakdown. Avoids dust when loading and problems with pellet flow during operation. (Amount of fines passing a 3.175mm screen no more than 5% by weight).
- **Chlorides**. Limited salt content (no more than 300 parts per million) avoids stove or vent rusting.
- **Maintenance**. Less ware and tear and low ash content results in less frequent boiler maintenance.
- **Moisture**. Maximum 8% moisture content standard.

S.4.6.5 Pellet / Oil Comparisons

Wood Pellets	***Oil***
Supply	**Supply**
• Schools can enter into long term fuel supply contracts ranging between 3 and 10 years. • Contracts guarantee regular fuel deliveries.	• Long term future of oil cannot be guaranteed. • Global oil markets are unstable and as recent events have proven are subject to serious disruptions normally resulting in price increases.
Price	**Price**
• Suppliers offer a choice of contracts. A "tracker" contract at a price 10% lower than oil price or fixed contract for a specified period.	• Price of heating oil constantly changing. European price is predicted to be over 0.87 euro per litre in 2007.
Maintenance	**Maintenance**
• Suppliers of boilers offer equipment upgrades as part of maintenance contracts.	• An oil boiler requires more maintenance by qualified specialists and in long term not as cost effective.

Sustainability	Sustainability
• Wood pellets are carbon neutral and as such are exempt from the Climate Change Levy. • Long term future of wood is assured. • A saving of 15% of the total fuel costs will be made per year if energy efficient measures are implemented by utilising wood fuel heating. Wood fuel systems work differently to oil, the system turns down and not off. Therefore the building is kept at a constant temperature which reduces vast amounts of energy required to heat the building back to its set point. • The wood fuel heating option supports the heritage and special environment of developments adding to the environmental credentials of facilities.	• Oil is a fossil fuel. • Oils long term future cannot be guaranteed. • Energy efficiency measures will not guarantee annual savings as the price of oil increases. • Many oil companies are looking towards sustainable forms of energy as a part of their long term strategy for energy provision as oil resources deplete.

S.4.7 School Sanitary Design

S.4.7.1 Design Concepts to Consider

- Usage of large, dark colour ceramic tiles that are impervious to soil and stains on the floors and lower walls to reduce the amount of grout and to facilitate easy cleaning with a wide variety of systems.
- Use epoxy adhesive and grout on floor and wall tile areas.
- Adequately slope floors to multiple floor drains for fast run off of liquids, use drains that are self priming.
- Use easy to clean and repair, graffiti-resistant partitions, such as high quality stainless steel or glazed ceramic tiles with dark epoxy grout. Avoid particle board that is sensitive to water or metals that will quickly rust.
- Place as much of chrome fittings and piping behind the walls as possible.
- Replace paper towels with electric hand driers mounted high off the floor.
- Keep items such as stall legs, toilets, urinals, waste bins etc. off the floor for easy cleaning.
- Provide additional ventilation so odours are quickly removed.
- Provide additional lighting so the room does not look dark and dingy.
- Install self cleaning and disinfecting tiles on floors and walls to help prevent odours due to bacterial growth.
- Provide electrical outlets at least 45 cms. off the floor, every 2.5 m. around the room.
- Install a specialty floor covering that is impervious to urine, such as quarry tile or epoxy below urinals. Provide adequate floor slope towards one or more centrally located floor drains under the urinals.
- Install automatic, no touch lights, faucets, urinals and toilets.
- Install jumbo-roll, covered toilet roll dispensers to reduce service frequency. Mount them high on the partition.
- Locate storage units near or between washrooms for easy access.

S.4.7.2 Storage Room

- Provide adequate space for storage of equipment and supplies. Don't clutter the space with water heaters, electrical panels and alarm systems..
- Install a floor drain and a seamless vinyl, epoxy or quarry tile floor.
- Install a floor mounted mop sink.
- Install electrical outlet socket.
- Provide adequate ventilation and lighting..

These are just a sample of possible cost saving measures that can be utilised when school buildings are to be constructed or rehabilitated. Building with cleaning in mind has not been an issue in the past, but this will change as costs increase and research continues to confirm the health benefits of a soil free indoor environment.

S.4.8. Energy Efficient Schools

Most schools spend more money on energy each year than on school supplies. This can be changed by lowering energy bills using readily available, energy efficient lighting and HVAC systems. Many of the same design features that help to lower the school's energy consumption also serve to improve the learning environment. Daylighting[21] for example is a common system used in energy efficient schools to deliver natural light to classrooms. This energy feature significantly reduces electric lighting usage as well as heating and cooling loads.

S.4.8.1. Sustainable Design Strategies (See also Part B)

S.4.8.1.1 Energy Efficiency

- Design an energy-efficient building envelope
- Install high-efficiency heating and cooling equipment
- Install high-efficiency lights and appliances
- Choose building materials with low embodied energy
- Design schools to use renewable energy including passive solar heating, daylighting and natural cooling

S.4.8.1.2 Resources Conservation

- Install water efficient equipment
- Ease of occupants to recycle waste
- Design for durability and long life
- Value the site's existing resources
- Use building products made from recycled materials

S.4.8.1.3 Environmental Quality

- Avoid ozone depleting chemicals in mechanical equipment and insulation
- Avoid pesticides and other chemicals which might leak into the groundwater
- Avoid materials that will offgas pollutants
- Locate buildings to minimise environmental impact
- Protect trees and topsoil during site work

S.4.9 Guidelines for High Performance School Design

S.4.9.1 Site Design

Orientate the building to maximise solar access to boost effectiveness of daylighting strategies, reducing the need for electric lighting, heating and cooling loads. Water requirements can be reduced by incorporating natural vegetation in the site design.

S.4.9.2 Daylighting and Windows

Reducing heating and cooling loads due to daylighting strategies often enables the heating, cooling and HVAC systems to be downsized. High performance windows with low-e glazing help to minimise heat gain in warmer months and heat loss in colder.

[21] See : www.rebuild.org/attachments/solutionCentre/NBPMDaylight_WindowsChptr.pdf

S.4.9.3 Energy Efficient Building Envelope

Increased insulation in walls and ceilings help reduce heat loss and improve comfort. Light coloured exterior walls and white roofs help reduce cooling loads. These factors also contribute to reduce size and cost of HVAC systems.

S.4.9.4 Renewable Energy Systems

The use of solar electric and wind technologies in conjunction with battery storage can provide security lighting, emergency power supply or a source of steady power for computers and other sensitive equipment.

S.4.9.5 Lighting and Electrical Systems

Use of controls in daylit spaces can automatically reduce or increase light levels as needed. Occupancy sensors automatically turn off lights in unoccupied spaces. These options slightly increase construction costs but pay back through energy costs savings.

S.4.9.6 Rooftop Microturbines[22]

A microturbine located on the school roof could be an alternative source of power especially for low demand like security lighting and battery charging. Rooftop turbines are designed to pay for themselves after about five years of moderately favourable wind conditions.[23]

S.4.9.7 Geoexchange Systems[24]

Schools can generate their heating and cooling needs more efficiently by choosing a geoexchange system over a traditional boiler and chiller.

S.4.9.8 Environment Sensitive Building Products

Indoor air quality can be improved by minimising:

- Volatile organic compounds in paints, carpets and adhesives
- Formaldehyde in plywood, particleboard and composite units

S.4.9.9 Water Conservation

Rainwater collection systems incorporated into the school design can provide water for toilet flushing and irrigation. Increase in construction costs offset by long term reduction in water and energy costs.

S.4.10 Energy Smart Classrooms

S.4.10.1 High Sidelighting

Use light shelves or louvers with high clerestory glazing to improve sunlight distribution. A horizontal light shelf or horizontal lovers can bounce sunlight deeper into a room while reducing glare near a window. The shelf or louvers will shade part of the lower window while scattering sunlight up off the ceiling.

[22] See : http://www.renewabledevices.com/swift/SWIFT%20Rooftop%20Wind%20Energy%20System.pdf
[23] See : http://www.fuelcells.org/info/library/micropower.pdf
[24] See : http://www.greenbuilder.com/sourcebook/groundsource/

S.4.10.2 Central Toplighting

Electric lighting often needs to be integrated with central daylighting schemes to effectively illuminate interior walls. Central toplighting, which features electric lighting wall wash fixtures, provides a high level of benefits:

- With good diffusion creates even, balanced daylight across the classroom
- Has been correlated with higher standardised test scores among students
- Saves electric lighting energy if the electric lights are switched off or dimmed in response to the daylight
- Can save 40% to 80% energy use during daylight hours

S.4.10.3 Wall Insulation

Vary the insulation with the type of wall material as well as climate

- For wood framed walls, in all climates install a minimum of R-13 cavity insulation (US),[25] also install R-7.5 sheathing in cool and humid, cool and dry climates.
- For metal framed walls in all climates, install a minimum R-13 cavity insulation, also install R-3.8 sheathing in hot and humid, hot and dry climates
- For mass walls install R-7.6 insulation in hot and dry / humid climates.

S.4.10.4 Roof Insulation

- For insulation above the structural deck install R-20 insulation, thickness varying according to type
- For attic and other spaces, install R-38 insulation in all climates except cold and humid climates where R-60 should be used

S.4. 10.4.1 Cool Roofs

- In air-conditioned buildings, use a roof surface that is light in colour (high reflectance) with a non-metallic finish (high emissivity)
- Asphalt roofs with a cap sheet and modified bitumen roofs should be coated with a liquid-applied material such as white elastomers, white polyurethanes or white acrylics
- Metal or concrete roofs should be coated with white paint
- Single ply roofing products include white CPE (chlorinated polyurethane), white CPSE (chlorosulfonated polyurethane) and white TPO (thermoplastic polyefin)

S.4.10.5 Troffer Lighting[26]

Spaces with low ceiling (less than 3.0 m.) can use fluorescent troffer lighting. Fluorescent troffers are designed to replace an acoustical tile in a grid ceiling system. There are three common troffer types:

- Lens troffer, covered on the down-facing side with a plastic lens
- Parabolic troffer, enclosed on the down-facing side by a metal louver having aluminium blades
- Basket troffer, partially covered on the down-facing side by a perforated basket

[25] See : http://resourcecenter.pnl.gov/html/ResourceCenter/139.html
[26] See : http://www.warehouse-lighting.com/ParabolicTroffer.htm

Parabolic and basket troffers can be used, but lens troffers are generally preferred because of their light distribution and economy. Systems operating at 1 watt /0.1 m^2 will generate between 538 lux and 645 lux with the desired uniformity.

S.4.10.6 Resilient Flooring

Linoleum flooring is durable and produced from minimally processed renewable materials. It is an alternative to vinyl composition tile (VCT) flooring which is made of non-renewable resources. Concerns have been raised about environmental degradation associated with the production of VCT. True linoleum is made from biodegradable materials such as linseed oil, cork and wood dust and does not contain the petrochemicals and chlorine found in vinyl and VCT flooring, not the plastisisers found in vinyl sheet flooring. Low toxic adhesives and coating minimise indoor air pollution and related health risks. A commonly used flooring exhibit is Marmoleum,[27] a natural organic linoleum product made primarily from raw materials.

S.4.11 School Exterior Spaces

The exterior planning and landscaping of a school reflects an ecological, aesthetical and environmentally acceptable locale for students to relax and study. Furthermore the outside of the school building is visible to the public eye and hence an important portrayal of the schools image to the community.

The intention of good school exterior space design is to provide us with the most cost effective and creative solutions to the school design concerns, from security to outdoor recreation and study space. The Designer must address the pedestrian circulation and safety, separation of vehicular traffic, site maintenance, drainage, signage, lighting and other exterior uses of the site.

By creating a sustainable green space around the school reflects a positive image to the community. A school site that is inviting and well used has fewer maintenance and vandalism problems.

A successful school site is one that can be used 365 days a year and creates as many chances to learn outside the walls of the building as it does inside. The Designer must maximise the use of the school area to its highest potential while creating a safe environment with a range of uses for student and the community alike.

S.4.11.1 Design Opportunities

S.4.11.1.1 Materials

Because of the increasingly intensive use of schools, new materials should be explored which will stand up to the challenges of increased year round usage. The example of the pressures that playing areas are subjected to must be considered an opportunity to explore other options for surfaces which are capable of withstanding intensive use.

S.4.11.1.2 Exterior Space Design

These days less exterior space is left on the ground which have traditionally been associated with usable exterior space. We have to consider the use of the tops and sides of buildings as viable spaces for play and use. Also schools are now becoming more multi-level, exterior programme areas can now be developed at a variety of levels.

[27] See : http://www.themarmoleumstore.com/framework/DesktopDefault.aspx?menu_id=265&ssm=1

S.4.11.1.3 Solution Types

Generally exterior spaces can be broken into six separate and distinct types of spaces given in any school design. Following are examples. Importance of designing exterior spaces is the understanding how they relate to and compliment each other. Under the concept of “diverse environments”, rethinking how these spaces can interact with one another, be used at different times of the day and their interaction with interior spaces should be creatively addressed to maximise the value of each.

S.4.11.1.4 Entry to the Site

This includes entry gates, car drop off areas, bus parking or any other aspect of arriving at or entering the school.

S.4.11.1.5 Exterior Meeting Places

This includes hang-out spaces where students meet before and after classes, general assembly and short term play spaces.

S.4.11.1.6 Dining Areas

Includes shading and sheltering elements. Currently dining spaces are specifically dining. Future planning might include cross over programming allowing this space to be used at other times.

S.4.11.1.7 Active / Play Space

Typically separate from other type of spaces and often located at the edges of the school site planning overall. These spaces generally vary in size and need according to age group.

S.4.11.1.8 Passive / Study Places

Outdoor classrooms, smaller, quieter exterior spaces where classes can occur, students can hang out, study or talk in small groups or by themselves.

S.4.11.1.9 Ecological / Teaching Areas

These may include temporary programming ideas like “culinary kitchens”, vegetable gardens or water recycling features. Generally these spaces would be developed to promote understanding and enjoyment of the outdoors, ecology and the environment we live in.

S.4.11.2 Guidelines

S.4.11.2.1 Space Utilisation

Work with the increasing density of tight spaces with an expanded concept of how to use the school buildings and a “programmable” open space. Roof gardens, parking structure tops and other areas not traditionally associated with exterior space can be used to generate viable, creative and essential exterior spaces.

S.4.11.2.2 Diverse Environments

The concept of diverse environments for the exterior spaces of new projects should seek to provide a variety of spaces satisfying the requirements of differently scaled activities and events.

S.4.11.2.3 Sustainable Practices

Introduce Sustainable Practices considering the well being of and impact on, the environment. Maintenance and Overhead Budgets, and the life cycle costing of the school.

S.4.11.2.4 Strong Design Concepts

Architects and designers should develop strong design concepts. Strong concepts may generate alternative and additional funding.

S.4. 11.2.5 Landscaping

Engage in landscape design issues early in the design process. Do not relegate it to the leftover space resulting from building planning.

S.4.11.2.6 Soft Spaces[28]

Try, where permissible to create 'soft' spaces in the project – especially on smaller sites where paving is prevalent.

S.4.11.2.7 Perimeter Boundary

Consider the perimeters of the schools. Rethink walls and fences to reduce the omnipresent sense of barricading. Re-approach traditionally cheap ways of making a fence and treat them in a new and unique way.

S.4.11.2.8 Trees

Create a conspicuous presence of trees. Find a way to be inclusive and protective of them and set aside funding for their maintenance.

Part B - Sustainable Schools

S.4.12 General Overview

The environment of a given educational facility has a considerable effect on the daily activities of those using the facility. Students, teachers, and staff can't always verbalise what they like about the physical details of a building but they recognise the effect the building has on them. Research has shown that the condition of a school building definitely affects students achievement and student behaviour and that there are elements of facility design that are perceived to improve the learning climate.

For example one study found that in classrooms with the most daylighting, students learning progressed 20% faster in mathematics and 26% faster in reading than similar students in classrooms with the least daylighting.

[28] See : http://asumag.com/mag/university_flexing_times/

S.4.13 Principles of Sustainable School Design

S.4.13.1 What is Sustainable Building Design

- Sustainable building design is applied good sense – an aspiration to build to the highest quality and functional standard, with maximum environmental and social benefit and with cost assessments that reflect the whole building life cycle such that investment can be properly maintained.

- Sustainable building design means applying a set of design parameters which have often had insufficient attention in the past :- functional requirements now and in the future, user needs and aspirations, resource consumption, material sourcing, location and access, impacts on stakeholders including building users and local community, life cycle operation and costs, maintainability, building life and end of life, pollution, waste, biodiversity and health.

- The process of procurement, design, tendering, construction and handover is a vitally important aspect of delivering buildings that can be sustained. Many projects suffer from a failure to think through design consequences in cost and management terms. There are many examples where this results in crucial aspects being edited and undermining of project objectives late in the process. This is not inevitable but requires strong commitment, planning and considerable expertise if targets are to be achieved.

The intended outcome are buildings that :

- Minimise adverse social, environmental and economic impacts by being efficient to operate, effective in their use of resources, minimising waste and pollution and protecting occupant health and the wider environment during construction, operation, re-use and at the end of their useful life.

- Enhance positive social and economic impacts by providing an environment that is fit for purpose, more responsive to individual, business and community needs and requirements, more flexible and functional, maintainable and cheaper to run and more respectful of the environment on which we all ultimately depend.

S.4.13.2 The Importance of Sustainable Building Design

Sustainable buildings provide a potentially capable system for addressing a range of modern challenges such as:

- The high cost of infrastructure and security of energy supply.
- Increasing cost of waste disposal.
- Continuing European pressure to cut pollution.
- The rising incidents of allergies and asthma, especially in children.
- Growing concern over the effects of global warming.
- Increasing expenses of maintaining and operating public buildings.
- Pressure on biodiversity.
- Pending increase in utility charges.
- Manufacturing of sustainable building products for import substitution.

S.4.13.3 Features of a Sustainable School

The following bullet points are not strict rules to be enforced on all school designs but are meant more of helpful guidelines for consideration.

- Aesthetically pleasing design.
- Meets the functional needs of the school and integrates with the wider community through consideration of shared and communal facilities and mixed use development.
- Recognises people as the most important asset of a school.
- Enhances the teaching and learning environments through healthy and vibrant internal environments including excellent levels of natural light and ventilation and quality external environments that facilitate outdoor activities.
- Does not endanger health of the occupants, or any other parties, through exposure to pollutants, the use of toxic materials or providing host environments to harmful organisms.
- Is responsive to local community needs, requirements and ambitions.
- Enhances biodiversity locally by landscaping based on best practice guidance by not using materials from threatened species or environments.
- Does not cause unnecessary waste of energy, water or materials due to short life. Poor design, inefficiency or poor construction and manufacturing procedures.
- Uses materials that are environmentally benign in manufacture, use and disposal.
- Is affordable to run and simple to mange and maintain in a benevolent manner.
- Does not consume a disproportionate amount of resources, including land during construction, use or disposal.
- Uses renewable and recycled and recyclable resources wherever possible.
- Is flexible to facilitate changes in demographics and technology and allows expansion or contraction in the future, where appropriate.

S.4.14 Key Sustainable Design Issues

S.4.14.1 Creating Healthy Environments

- Consider the impact of the indoor environment on the well being of the students and staff.
- Students and staff appreciate a view and daylight. Consider at the outset the impact of the layout and building depth.
- Avoid materials that contain Volatile Organic Compound's or other pollutants.
- Implement a cleaning procedure that uses non polluting materials.
- Locate noisy equipment away from sensitive areas.

S.4.14.2 Promoting Biodiversity

- Materials should be used with minimum adverse impact on biodiversity.
- Maximise habitat creation and minimise disruption to local flora and fauna.
- Try to produce a low maintenance working system.
- Treat pollutants locally.
- Use native species for landscape planning.

S.4.14.3 Supporting Communities

- The project should enhance the local environment by quality design and provision of improved facilities.
- The local community should be consulted and their concerns respected.
- Consider the throughways from the building and how it might impact on local communities.
- Avoid disruption to the community during construction and post completion.
- Look to sourcing materials and skills locally.

S.4.14.4 Minimising Pollution

- All materials and products should have minimal adverse environmental impacts at all levels from sourcing to end of use.
- Products should be fit for their purpose and produce no health risk over their lifecycle.
- Products should be controllable, maintainable for long efficient use and facilitate safe recycling in all or part and ultimately safe disposal.
- Products should have minimum dependence on non renewable resources over their lifecycle.
- Materials should have minimum embodied toxicity and have long maintainable life with ultimate safe and efficient recycling or disposal.
- Materials such as paints or finishes should be free of chemicals.
- Use local materials if possible and as close to their natural state as possible.
- Locate building near to low-impact transport network.
- Consider the availability of public transport infrastructure and encourage its use.
- Consider joint usage between the project and the local community such as sports or library facilities.
- Discourage through traffic or parking.
- Use landscape design as an integral part of minimising the adverse impacts of transport and enhancing the positive elements such as cycle ways and pederstrianisation.

S.4.14.5 Resource Effectiveness, Energy & Water

It makes environmental and economic sense to minimise water, energy consumption and sewage outfall to reduce infrastructure and minimise costs in use associated with energy, water and sewage charges.
There are many opportunities to improve energy and water utilisation and offset demand. Considerations should be based in usability and whole life costs. For example, toilet effluent is manageable

Avoid forms of recycling that raise the overall costs and introduce the need for chemical treatment.

Rainwater harvesting can be used to offset demand and contribute as part of a SUDS[29] strategy.
SUDS offer excellent potential to improve landscape design quality and enhance biodiversity.
All proper precautions regarding legionella bacteria are now well documented.
Identify local sources of heating and cooling such as incineration or aquifer
Cooling.

S.4.15 Maintaining the Investment

There is evidence to suggest that sustainable buildings are more expensive than standard construction. Indications show 0 % to 3% for the lower ratings and up to 10% for the higher. Elements include increase in design time and the cost of higher performance products and environmentally friendly materials.

Sustainable building design involves a balance between up-front capital expense, on going running costs and maintenance, eventual decommissioning and dismantling.

[29] See : http://www.ciria.org/suds/background.htm

Sustainable buildings provide significant social, financial and environmental benefits over their life that conventional buildings do not. Design decisions should reflect this lifecycle.

There is apparently an overemphasis on capital costs. We are culturally driven to seek short term gains at the expense of the longer term. As a consequence life cycle benefits of maintenance, productivity and resource effectiveness are overlooked in favour of short term capital returns and cost savings.

It should be acknowledged that a large number of beneficial features have little or no additional capital costs., e.g. site and window orientation and strategic approaches to the layout plan and form to reduce cable and pipe runs.
Suitable options such as high levels of insulation or passive design may cost more in the design phase but can be offset by the reduced cost of a smaller mechanical system or by designing it out altogether.

Part C - Schools for Special Needs

S.4.16 Introduction

The education of children with special educational needs is a key challenge for the future of school design. It is vital to the creation of a fully inclusive society in which all members see themselves as valued for the contribution they make. We owe children – whatever their particular needs and circumstances – the opportunity to develop to their full potential, to contribute economically, and to play a full part as active citizens.

It is essential to provide a high quality of design in learning environments for all pupils, especially for those children and young people who have special educational needs (SEN) and disabilities. When building schools for the future, it is important for designers to implement a strategic vision to provide learning opportunities and challenges that lead to positive outcomes for all pupils. Inclusive design can enable and empower children and young people to participate in life at school and in the wider community.

S.4.17 Definition

Students with special needs have disabilities of an intellectual, physical, sensory, emotional, or behavioural nature, or have a learning disability or have exceptional gifts or talents.

S.4.18 SEN Inclusive Design

- places people at the heart of the design process
- acknowledges human diversity and difference
- offers choice where a single design solution cannot accommodate all users;
- provides for flexibility in use
- aims to provide buildings and environments that are convenient, equitable and enjoyable to use by every one, regardless of ability, age and gender.

S.4.18.1 Basic Questions

The task is now to look at these design issues in more detail and ask basic questions about the following design criteria. The aim is to raise issues about the implications of becoming more inclusive.

Adequate Space and Provision of Spaces

- What space is needed
- Is it possible to modify existing space to accommodate students with special education needs and disabilities within the school building and grounds?
- How can areas be used flexibly or new spaces created in order to provide the specialist spaces needed, such as rooms for physiotherapy. Or counseling, medical rooms and storage for equipment.
- Can the organisation of the school be adjusted to relieve any pressure of space?

Becoming more inclusive involves ensuring that there is adequate space to accommodate students with SEN and disabilities within the general areas of school buildings and grounds. It is important to address the need for space for circulation and for students who use wheelchairs or sticks, both in corridors and teaching spaces. A student with a physical disability may feel distressed in a busy playground. Creating quieter play areas and extra seating may help solve the problem.

As well as finding creative ways to flexibly use and manage general school areas, it is also important to consider provision of specialist areas such as therapy rooms, storage areas for communication aids and fully accessible toilets.

Physical Movement

Can students with mobility impairments get safely around the school?

Students with mobility difficulties may face physical barriers such as steps, narrow doorways and long corridors. Students may also find difficulty leaving the school safely in case of emergency such as fire

Wayfinding

Can students orientate themselves and find their way around the school buildings and grounds. Whether the students are familiar with the area and what information they have been given about it will also affect their journey. Some students may not use the written word. For them the use of colours, textures and symbols within wayfinding systems become especially important.

Students with certain forms of autistic spectrum disorder can suffer increased levels of anxiety if the building is difficult to understand which can lead to stress and challenging bahaviour in the classrooms.

S.4.19 Design of Facilities

S.4.19.1 Entrances

- Entrance areas should be easily distinguished by their design, location and lighting.
- Signs including tactile signs should be used to mark the entrance area. Landmarks and design features such as planting, seating and tactile paving should be arranged to provide obvious route ways.
- Routes to the entrance area should be accessible and outdoor surfaces suitable for wheelchair users.
- Door furniture should be easy to grip and operate, and the force required to overcome the power of the door-closer should be kept to a minimum.
- Thresholds should be flush and, if possible, absolutely level.

- Floor surfaces at exterior doors should provide a firm flush entrance mat and care taken to avoid tripping hazards.
- If necessary, the entrance should offer a transition zone where students with visual impairments can adjust from a bright exterior to a more subdued interior space.
- Any reception point or information hatch should be clearly signed, have a lowered section, be well lit and provide hearing assistance. Downlights should be carefully covered over reception desks where students with hearing impairments may need to lip read.
- Waiting areas should be generous with room for parents, carers, visiting therapists, and space for wheel chair users.

S.4.19.2 Dining Spaces

There is a growing interest in dining areas being places where students learn more about nutrition, develop good eating habits and have the chance to relax. However the situation can be difficult for students who have special nutritional requirements or who have difficulty eating by themselves.

- All students should be able to eat in a dignified manner with their peers if they so choose.
- Extra circulation space may be required to allow for students using wheelchairs or who have mobility impairment.
- Additional space may be required to provide parking space for wheelchairs.
- Space may be required for assistants to sit alongside students and assist with eating.
- The height of serving counters should take into account the needs of students using wheelchairs.

S.4.19.3. Medical and Therapy

There is a wide range of medical and treatment rooms that may need to be developed. Medical rooms should have adequate space for:

- Students to move around freely, park their wheelchairs, be examined in comfort and privacy and take medication or other treatments.
- Assistants who may be needed to help students manoeuvre themselves.
- Storage for medication, records and information and additional equipment such as hoists and showers.
- Areas for visiting therapists and counsellors to conduct their practice.

S.4.19.4. Personal Care

There is no fit-all ergonomic design for toilets, washbasins or showers. Different students have different needs. Some might require one or two assistants to help them. Some might transfer laterally by themselves from a wheelchair to the toilet, requiring grab rails, back supports and other fittings. Others may just require grab rails for balance and clear signs on taps, towels and other equipment.

S.4.19.4.1 Toilets

- Toilets should be located so that students travel distance is not too great and routes are accessible.
- Toilets must be clearly signed.
- At least one toilet should be large enough to accommodate electric wheelchairs, assistants, and necessary equipment such as hoists and specialised fittings such as grab rails.

- There are many detailed design guide lines for toilets[30] which should be carefully followed and tested.
- The colour, or tone of the background, fittings and any aids, such as grab rails should be contrasted.
- Ceramic tiling and shiny floors may cause reflections and glare which might be confusing.
- The door of any toilet compartment should have the capacity to be opened outwards to ensure that entry can be gained even in event of someone falling and blocking the doorway.
- The lock mechanism, and whether there is a lock on the door, should be adapted recognising the student's design needs and cognitive abilities.
- Floors should be slip resistant.
- Alarm systems should be installed at different levels, so students can call for assistance.
- A method should be established through the location of equipment and for staff for responding for any call for assistance from a student using a toilet.

S.4.19.5 Outdoor Landscapes

There is a growing interest in the creation of stimulating and varied school landscapes. Areas such as outdoor classrooms and sensory gardens are being included in school grounds alongside carefully designed seating areas, paths and planting.

- It is important to create a variety of spaces, including areas for small group discussions and quiet reflection.
- Boundaries need to be created between different activities, especially between higher and lower energy activities. These need not always be solid boundaries : seating, low planting and changes in surfaces can all give messages conveying what activities students can carry out in an area.
- As with indoor areas, consideration should be given to the nature of outdoor surfaces in terms of safety, colour, grip, texture and other characteristics.
- Toxic plants should be avoided and spiky plants arranged so that students can easily identify them.
- Methods of maximising the sensory experiences of students should be explored. Scented plants, wind chimes, textured walls and seating, grassed areas, robust and accessible furniture could all be included in the school grounds.

S.4.19.5.1 Play and Sport

Play is intrinsic to learning. To enable students to participate in the full range of play and leisure, outdoor games and sporting activities, it is important to consider :

- Accessible changing rooms should include adequate space for assistants to help students change and shower in privacy.
- The ways in which play and sports areas can be made more accessible for students will vary according to their needs and aspirations.

S.4.20 Sensory Environments and Temperature

Environments can be designed so as to provide stimulating sensory experiences and comfortable temperatures for students. Sight, hearing, smell, touch and taste are the five most familiar senses. A sixth sense, the haptic has been identified. This refers to the kinds of feelings you receive through the skin and frame of the body as you lie against a log, or sense water pushing past your hand.

[30] See : http://www.nea.gov.sg/cms/ehd/public_toilet_guide.pdf

There is a great deal of scope for thinking how all these sensory experiences can be enhanced. Research carried out by the Learning through Landscapes[31] showed how all students benefit from school grounds that are furnished with scented plants, seating that is pleasant to the touch, and installations such as wind chimes that create interesting sounds. Certain groups of students, such as those with communication or learning difficulties, may find such stimulation and exploration of the senses especially pleasurable and important to their educational development. For all students, especially younger children, it is important that they are given the chance to explore the world through their haptic sense.

Temperature is another important consideration. One example, students with limited mobility may not generate as much body heat as a fully mobile child and need higher room temperatures. Another student who is hyperactive may require relatively cool environments. In designing schools for special needs, these issues must be born in mind when maintaining heating systems, installing new systems and exploring ways of adjusting room temperature levels using items such as fans, blinds and additional heating systems.

[31] See : http://www.ltl.org.uk/

Appendix I. Questionnaire for self-assessment (schools)

Table I. Project Identification

School Name:		**No.**	**00**
VET Sector:		**Ref.**	
Address			
Contact: **Contact person(s), Title, Tel/Fax, Email**			

No of Pupils:		**No of Teachers and management staff**	

Municipality:		**Region**	
Address			
Contact: **Contact person(s), Title, Tel/Fax, Email**			

1.1. General Technical Data

Year Construction	
No. of Buildings	
No. of Floor	
Type of Construction	
Existing original drawings. Y/N	
TOTAL "NIFA" Area[1] (m^2)	
Classrooms (No. and total area)	
Laboratory (No. and total area)	
Workshops (No. and total area)	
Toilets (No. and total area)	

[1] Net Internal Floor Area (NIFA) – Net usable area measured to the internal finish of the external walls.

Table II. Existing Condition of the Building

NOTES: Please describe the existing conditions of each item. Refer to the obligatory norms and regulations applying to Serbia.

Watertight construction	Existing conditions of roof, thermal insulation, guttering, external openings (doors, windows). Safety regarding the quality of roof material (presence of asbestos)
Heating and ventilation	Existing conditions of heating installations, gas supply and/or fuel storage; Ventilation in toilet facilities and educational premises.
Sanitation and water supply	Existing conditions of toilet facilities. Adequacy in terms of standards i.e. ventilation, equipment, number of toilet facilities versus number of students; Sewage and/or septic tank; Water supply and distribution, safety regarding the quality of pipes (presence of lead).
Electrical installation	Existing conditions of supply; distribution panels; safety of power points and lighting; Earth bonding protection, Lightning protection.
Disable persons access	Existence of disabled persons' access i.e. ramps, handrails; adapted toilet facilities.
Fire protection	Existing conditions of fire escapes, Fire sectioning, alarm, Emergency lighting, Fire hydrant; Proper signage; Fire protection means (i.e. fireproof doors etc.);

Table lll. Rehabilitation Works Required

NOTE: Please define the expected works limited to the categories as laid down in the table "existing conditions". If you already have a detailed description including technical specifications and costs, please attach a copy to this questionnaire.

Rehabilitation Works	*Description of the works required*
Specific VET requirements	*In addition to rehabilitation works, indicate any special needs related to the specific premises: Required IT related installations, specific electrical installations, specific flooring, painting, ventilation, fire protection, requirement for internal re-arrangement of rooms or other needs (pls describe):.*
Maintenance	*If relevant, requirements for adequate building maintenance tool kits and training;* *Requirements for sufficient spare parts and storage facility arrangements.*

Table IV. Equipment Required

NOTE: Describe for each category the list and quantity of the required equipment. If you have already a detailed description including technical specifications and costs, please attach a copy to this questionnaire.

IT and reproduction equipment	Computers, software, LAN equipment, Scanners, Printers (laser, inkjets), Digital cameras, Copiers etc.
Presentation and teaching equipment	Overhead projectors**,** Laser beam projectors**,** Screens**,** Flip over charts, White and/or black boards etc.
Laboratory & workshop equipment	Measurement equipment**,** Tool kits, machines (electrical, mechanical, optical, medical etc according to the specific sector)
Consumables	Paper for copying, print outs**,** Transparencies for presentation**,** Cartridges for printers**,** Blocks for flip over charts**,** Floppy disks**,** CDs RW, etc.

Table V. Cost Estimate in Euro

NOTE: Please fill the table below only if you have an accurate estimation based on technical documentation

Rehabilitation works	
Specific requirements	
Maintenance	
TOTAL REHABILITATION	

IT and reproduction equipment	
Presentation and teaching equipment	
Laboratory & workshop equipment	
Consumables	
TOTAL EQUIPMENT	

Total Overall Cost Estimate	**Euro**

Table VI. Other Comments

Indicate here any additional information deemed relevant to justify the emergency of the required works and equipment acquisition.

Table VII. Relevant Photographs

Insert here photos of the school and if relevant, photos of the major problem to be addressed through the rehabilitation works.

REVIEW TEAM

NOTE: signature of the Director is mandatory, other working group members may be indicated if relevant.

Working group	Names	Signature
School Director		
Municipal representative		
		Date:

Section 5 : Procurement of Equipment and Teaching Aids

S.5.1. Introduction

Since the start of the industrial revolution, production has been a key wealth creator in the economy. In the last 20 years through the technological developments in all sectors, and mainly recently, when the use of mobile communication and internet access spreads out, services based on ICT boosted immensely the high technology based economic activity. Now, more than ever, the continuous consideration and adjustment to the exciting emerging technological advancements in education is the only way to increase the possibilities of young people to access challenging and rewarding careers in their professional orientation.

Advances in areas such as process speed, precision, flexibility, efficiency, reliability and control are made possible by new technical and technological equipment and process development, which are themselves evolving rapidly. It is vital that young people should be made aware of their potential, and be encouraged to participate fully in this increasingly awesome world of technology.

The national education actors should support schools' ideas to develop specifications and recommendations for contemporary curriculum oriented equipment in schools.

S.5.2. Background for the development of policy and strategy for educational equipment

Through this it may be expected that, with enhanced school teaching technology resources and the support of social partnership initiatives, more students can eventually benefit from experiencing real industry and production standard design, manufacturing techniques, a professional environment and the realisation of their own ingenuity.

This should lead to more young people being inspired, motivated, and better prepared towards careers in industrial production and services in the market oriented economy, as well as in civic institutions. Therefore policy and strategies need to focus stronger on well developed initiatives to promote greater general knowledge, more understanding and appreciation of the technological developments and transfer of updated skills to young people through the selection and involvement of appropriate modern technological equipment for all people in the educational institutions.

S.5.3. Aims and goals for policy development – The national curriculum

Since rapid technological development started in the 80's and 90's a minor revolution has taken place in teaching and learning associated with educational and didactical equipment. Access to the relatively new technologies and contemporary equipment has enabled students to more than live up to three important general aspects of the VET curricula aims, namely:

- Participate in tomorrow's rapidly changing technologies
- Intervene creatively to improve the quality of life
- Become autonomous and creative problem solvers and designers

It is now possible for schools to simulate the concept of concurrent curriculum whereby social partners and future employers can have on line access to the curricula drafts and include their comments and modifications simultaneously. The concept of concurrent education with pupils and teachers able to use contemporary equipment oriented to the labour market demands, to develop practical skills, to integrate knowledge and understanding is opening up fantastic opportunities to develop teaching and learning appropriate for the 21st century.

The world-wide technology developments which have taken place over recent years are now being reflected in many schools. At its very best, the use of technical and technological equipment has enabled pupils across all key stages to develop knowledge, skills and processes so needed by contemporary occupational standards, namely:

- The ability to model, adapt and develop ideas as an interactive process
- The development of holistic thinking

In understanding the need for quality and precision standards, it is worthwhile noting that for many students,

the use of new contemporary equipment has dramatically raised:

- Their ambition in tackling activities which are unrestricted by the acquisition of traditional hand skills
- Their educational esteem, giving some students a fresh start in the educational process
- The value of examination performance and their degree

For teachers there has also been the opportunity to:

- Reassess the notion of student abilities
- Rethink the nature of basic skills, knowledge and understanding required by students living and working in the 21st century
- Consider the appropriate progressive development of these skills across all key stages
- Develop new and appropriate teaching strategies

Any new curriculum development initiative however is leads to a wide range of challenges, that need to be met.

These challenges can be indicatively summarised under the following headings:

A. National level

• The raising of the political awareness and understanding of this important initiative and the associated financial implications of accessing 21st century technologies

• The development of new assessment, monitoring and evaluation strategies which truly accommodate both the labour market needs and the impact of new technologies on practice

• The co-ordination of the many exciting curriculum development projects taking place in schools and colleges

• Helping equipment suppliers to develop a clearer understanding of the educational needs of the users of their products

B. School level (Local Community)

- Developing the perception of senior school staff, and the local community of the importance of contemporary educational equipment to the development of the country's economy
- Prioritising the development of practical skills and student access to contemporary equipment
- Stimulating cross-phase developments to ensure progression and continuity
- Monitoring the development and nature of world-wide technology and education practice

S.5.4. General Strategy for specific equipment selection

The main **objectives** of the general strategy for specific equipment selection are:

- The strategy must be replicable for all educational sectors in VET
- The strategy has to have form and quality to enable self-monitoring and evaluation
- The strategy has to specify appropriate items and laboratory/workshop arrangements to support the educational goals on specific knowledge and skills required of the new and/or revised curricula of the schools or training institutions.

The **content** of the general strategy for equipment selection should refer to the following aspects:

A. Curriculum review

- Review of the educational goals of each curriculum and respective occupational profile(s) by the actors directly involved in the procurement cycle i.e. key managerial and teaching school staff, any external procurement and technical experts and, in the case of sector specific school equipment, as the case of the VET project, representatives of the school associations per sector.

- If applicable, consolidation of similar educational goals in terms of targeted knowledge and skills, taking into consideration similar needs of other existing occupational profiles in the schools/training institutions within the same sector.
- Information on practices abroad in schools/training institutions in the same or similar sector with comparable educational needs.

B. Professional occupation environment screening

- Indicative review of actual production practices, labour market demand and professional equipment in companies with activities in business sectors in need of personnel with such knowledge and related skills, taking into consideration advice from representatives of the related businesses in the sectors, as well as from the social partners.
- Indication of expected technological developments in these business sectors. Such a forecast should refer at least to a medium term perspective (3 to 5 years) and if possible include evidence on expected equipment life time and reliable information on emerging new technological developments in relation to similar equipment.

C. Market research and equipment selection

- Market research for specifying appropriate equipment scale/size and use in schools (i.e. full scale professional, didactic equipment and workshop, simulation – demonstration).
- Identification of potential suppliers, examination of origin issues if necessary (i.e. EU origin rules), preparation of final technical specifications and budgeting.

D. Selection of procurement procedure

The selection of procurement procedure depends usually on the financing source and the related legislative framework and rules, e.g.

National procurement rules and regulations, if the financing is coming from the government, a national financing institution or local private donors

- International private donors or agencies i.e. World Bank and other banks, United Nations, humanitarian organisations, European Union (see EU procurement rules and regulations, EC website, Procedures and Standard Documents, Practical Guide (PRAG) for international procurement contracts: http://www.europa.eu.int/comm/europeaid/tender/gestion/pg/index_en.htm).

S.5.5. Equipment standards, selection guidelines and criteria

The initiative to promote modern curricula cannot achieve its full potential unless students have access to the type of equipment that can be used to transform theoretical knowledge into practical skills, verifying the functionality of a pupil's educational values.

In order to enable the students to use the new technologies, schools will have to carefully select and invest in new equipment and instruments appropriate for the use by students but at the same time simulate up to date job requirements. The following points below aim at assisting teachers in determining the type of equipment that will meet their requirements and provide information on the detailed questions that should be addressed before compiling the technical requirements for the specific supplies in order to maximise the chances to select finally the most appropriate equipment that satisfies the educational needs.

S.5.5.1. Standards

The starting point for establishing the standards and type of school equipment is to analyse the National Curriculum and the individual occupational profiles.

In the case of the procurement cycle foreseen within the framework of the VET Reform project a number of meetings were held between representatives of the Ministry of Education and Sports – Republic of Serbia, school principals and teachers, members of the schools' associations, experts for curriculum development, advisors for text books and teaching materials and international experts on educational reform to discuss and agree on the level of equipment to be included in the technical specifications for the procurement. The baseline approach followed was to specify a range of standard equipment that provides the necessary

functionality needed by all schools within the same sector to enhance the teaching of practice based subjects associated with the specific field of work, e.g. mechanical engineering, agriculture and food processing, electro-techniques, construction, health, etc.

Equipment of the type being proposed also enhances the manufacturing facilities for the school as such and complements the teaching methodology across a range of subjects. The intent is for schools to adopt standard machines that will satisfy their requirements. This approach would increase the production volumes for these types of machines. This again will reduce the price of standard equipment to a more affordable level for schools that operate on modest financial budgets.

The modern process of training supposes an adequate provision of teaching materials, laboratory and workshop equipment (equipment). The free market offers at this point in time a very diverse range of equipment for many commercial and industrial needs. The available financial resources for procuring such equipment are limited. This places a large burden on those who are charged with the task of ensuring that money is spent carefully and wisely to provide good quality training in the occupations in order to satisfy the industrial and commercial needs of the country now and in the future.

Equipment procurement should support the education process in that the curriculum should drive equipment needs rather than the reverse. Allowing institutions to have a greater say in procurement gives them greater autonomy to decide the equipment needs to satisfy the requirements of the training standards and the curriculum.

Competent staff should review the training standards and the curriculum for their area of specialisation in order to judge in an appropriate way the present and future requirements for equipment. The responsibility for the successful interpretation of the training standards and the curriculum into appropriate and accurate equipment specifications lists should ideally be done in co-operation with the teachers and practitioners who are involved in delivering their respective part of the curriculum. In some instances there may be cases where the authors of the curriculum are the same people responsible for supervision of the delivery of the equipment.

It should be remembered that appropriate and accurate equipment specifications should be compiled for BASIC EQUIPMENT. The interpretation of BASIC EQUIPMENT in the context of this presentation broadly means equipment that will be needed over and above existing serviceable equipment to deliver training programmes for the various occupational areas and which is classified as capital intensive items. Small and lower value items i.e. hand tools like hammers, screwdrivers, saws etc. would normally be purchased by the school using its own resources.

S.5.5.2. Selection guidelines

When deciding upon the equipment needs to satisfactorily deliver the curriculum, consideration should be given to the following selection guidelines:

a. The equipment specified should fulfil the stated requirements and relevant training standards in relation to the expressed educational needs

- Does the equipment satisfy the general and basic training needs, as well as the acquisition of the specific key skills foreseen by the curriculum and respective occupational profile and with regard to the training standards in terms of range and outcomes?

b. The equipment is of appropriate size

- Is there a requirement in the training standards and curriculum for trainees to use full-size, scaled down or didactic equipment?
- Can the required training outcomes be achieved with scaled down or purely didactic equipment?
- Will the trainees be capable of converting easily to full size equipment after training?

c. Installation within the institution

- Is there a requirement to provide additional space to accommodate new or modified (in case of upgrades-extensions) equipment?
- Can replaced equipment be accommodated in obsolete left over premises from the safety point of view or should it be transported out of the school to an appropriate location or sold (i.e. recycling, overhaul, etc.) ?

- In the case of a new or modified workshop or laboratory does the existing available space and its layout provide the possibility to arrange a safe working environment?

d. Utilities, health and safety

- Is there adequate access to the necessary utilities for the equipment and sufficient capacity (power, gas, water, waste disposal, etc.)?
- Is there adequate protection within the existing infrastructure in line with the appropriate health & safety standards foreseen for the activity planned and the equipment to be used to protect the trainees and school staff? At this point it is worth mentioning that certain health & safety issues are related to the building and its installations and need to be resolved in co-operation with the competent building maintenance and/or rehabilitation staff of the school or external experts.

e. Running costs (maintenance, service, utilities and consumables)

- Does the school/training institution have the financial capacity to support the estimated running costs of the desired equipment?
- Does the school/training institution have the necessary skills and appropriate resources available for the necessary ongoing service and maintenance following the expiry of the warranty period?

f. Readily available supply of spare parts

- Will the equipment have the necessary support from the manufacturer or supplier in terms of spare parts for a sufficient period depending on the specific equipment expected or foreseen life cycle?

g. Readily available supply of raw materials

- For the performance of certain training activities some equipment may require special raw materials. Is there a readily available supply of such materials at a “reasonable” cost or can “standard” materials be supplied locally (possibly donated i.e via co-operation with local authorities or business actors)?

h. Adequate storage of associated ancillary equipment

- Some fixed equipment is supplied with ancillary adaptations. Are there adequate and secure storage facilities for such equipment?

S.5.5.3. Preconditions and selection criteria

Following the selection guidelines in 2.4.2., the following desired preconditions and main selection criteria should be taken into consideration:

A. Preconditions to support equipment use

The following factors play an important role in assuring that schools have sufficient support to overcome any possible emerging obstacles that could jeopardise the training delivery during the school period:

- Efficient use of the new equipment makes it necessary that all appropriately qualified teachers should have access to the equipment. Each teacher should take the responsibility to be trained in or to spend the necessary time to familiarise him or herself with the new equipment before use. It should be a requirement towards the suppliers to deliver appropriate and sufficient training and include the related costs in the overall price of the supplies.
- Available competent school staff should be appointed to take the responsibility and perform the duties in their occupational area to ensure the safe and efficient running and maintenance of the equipment.
- For the procurement procedure national/local authorised service availability is an important aspect to request, especially taking into consideration high value equipment i.e. CNC machines, agricultural mechanisation, milk processing plants, geodesy equipment, wood processing, offset printing facilities, etc.
- The schools should be motivated to assure co-operation with the local authorities (municipalities) and negotiate appropriate ways to be supported in relation to the following:
    - Although the cost of maintenance, spare parts and general supplies are to be the responsibility of the school/training institution the co-operation with local authorities on supplies of low value items, spare

parts and consumables (hand tools e.g. screwdrivers, hammers etc., printing material e.g. paper, cartridges, etc.) if not donated, at least could help the schools to achieve a good price and quality.
- Support in maintenance of school facilities and appropriate access to utilities i.e. power and water supply installations and costs

➢ The schools should be motivated to assure co-operation with the regional/local businesses and social partners and sectoral school associations to ensure support with know-how and guidance on:

- Equipment selection, procurement, use and maintenance
- Curriculum development/improvement in line with skills required in the labour market
- On-the-job-training arrangements i.e. in the final year of the educational cycle and demonstration of the equipment use in professional – industrial environment and modern facilities. Therefore it is important when specifying equipment that some account is taken of the level of modern facilities that economic agents have at their disposal.

B. Selection criteria

B1. Value for money

1. Equipment must represent good value for money, not necessarily the cheapest price. Factors such as technical features, training provision, warranty conditions, service support, ease of use, and such should all be considered when selecting equipment.
2. It should be designed to be robust and durable in service, incurring minimal routine maintenance costs.
3. Equipment should operate with low running costs, particularly related to consumable items and serviceable parts.
4. The quoted price should include all the equipment needed to use the machine in the classroom, including samples of essential consumable items, delivery to site and installation kit.
5. Specific standard training requirements, the venue and number of training places, both on-site and at the manufacturer's facilities should be established and if necessary included in the price of equipment.
6. Any extra costs that might be incurred in training more teachers or instructing them in how to exploit the equipment's advanced technical features must be stated as an additional expenditure.

B2. User friendliness

1. Use standard components where appropriate, that can be easily purchased and replaced in the event of equipment failure.
2. Use readily available tooling, clamping devices, thread reels, baking trays and other consumable items.
3. Equipment should be designed to be user serviceable, with preventive maintenance being undertaken by the user following clear instructions provided in the service manual.
4. In the specification prime contractors must provide a declaration on estimated life in normal use, based upon recommended maintenance procedures. (Normal use is estimated to be 1,000 hours per year).
5. The quotation for new equipment should include a statement on the replacement price for consumable maintenance items, giving details of life expectancy and possible service charges.
6. Equipment should be safe and easy to clean at the end of a session.
7. After initial training and under appropriate supervision, pupils should be able to have personal control of the machines and equipment.
8. Equipment should be supplied with a user-friendly service manual. The equipment and manual must have consistent terminology It should be well written, with clear instructions and documentation on how to install the equipment and undertake routine preventive maintenance tasks, including straightforward repairs.
9. The purchase price should include user-friendly operating instructions and self-training packages for teachers to learn how to operate the equipment safely. This should also include practical examples on how the equipment can be used for producing articles that fulfil requirements at different key stages of the national curriculum.
10. The purchasing price of the equipment must include the necessary control software and hardware

needed to transform files of items (i.e. technical drawings) created on an existing SW i.e. computer-aided design package into another and/or in printed form.

11. Software should be supported with self-help menus that allow users to readily identify and solve common problems that might be encountered by inexperienced operators.

B3. Technical standards

1. There is the risk with some forms of equipment i.e. information technology that they become obsolete in a very short time and may no longer have the capacity to satisfy the training needs required by the labour market. Care should be exercised when specifying high-risk equipment to ensure that it has an "acceptable" life span.
2. All equipment must have a detailed product specification that defines the operating parameters and technical performance of the machine. (Equipment should be warranted against this specification).
3. Interfacing software must be suitable for trouble free installation on a range of computers and networks commonly used in schools.
4. Once set-up, when the equipment is intrinsically safe, it should be able to run to the end of the machining cycle.
5. All equipment must be designed to have short set-up and changeover times.
6. Machines should incorporate easy to operate work-holding devices.
7. The equipment as supplied must meet and satisfy all ***the national and international safety, health and environmental requirements***.
8. Lists of additional items should be compiled that are related to ***individual health and safety requirements*** that refer to the protection of teaching staff and students from the operation of certain type of equipment i.e. earplugs, safety glasses, safety boots, helmets etc.
9. All equipment must be clearly ***CE marked*** and have a "Manufacturer's Declaration of Conformity" issued with the machine. The "Manufacturer's Declaration of Conformity", validates that the product conforms to the essential safety requirements.
10. All products must conform to all the relevant European Directives.
11. Equipment must have all the necessary safety features integrated within the machine.
12. Machines must be fitted with appropriate health and environmental protection equipment.
13. The equipment should have plug-compatible hardware and software interfaces that link directly to a standard PC (Personal Computer) equipped with the appropriate software tools.
14. Suitable computer-aided design packages and machine software systems must be fully integrated, providing a seamless link.
15. Software systems must be supplied ***without*** 'dongle' protection that restricts multiple users of the software.
16. The equipment, where appropriate, should be fitted with self-protection devices that limit possible damage from inexperienced operators.
17. Noise levels under free-running conditions must be attenuated to the appropriate levels needed for a classroom or in some instances a school workshop environment. However normally such data are to be found at national school building and classroom standards
18. All electric motors must stop in compliance with the CE regulations.
19. All equipment must be fitted with an accessible emergency stop that mechanically isolates the electrical supply from the machine.
20. The life of all drive motors should be rated for continuous duty cycles.
21. The duty cycle of spindle motors must be stated in the specification and fitted with thermal over-rides and/or other appropriate devices to protect them from damage.
22. Equipment must be designed to operate with minimal levels of vibration.
23. Power supply of equipment (depending on the kind of equipment in line with the planned use) should

operate using 220 volts, single phase 13-amp AC or alternatively for equipment requiring high power levels should be 380 volts three phase AC or DC.

24. Service requirements and consumable maintenance items must be identified with a visible cost structure for parts and repairs. Where necessary, suppliers should offer an appropriate service level agreement based on the availability of equipment to the teacher and response time to repair defective equipment.
25. Options for updating technology and/or increasing functionality may be available for possible specification upgrades/modifications to the standard equipment. These provide experienced teachers with more sophisticated facilities.
26. Installation on site should be able to be performed safely and not require on site specialist support, unless included in the price of equipment.
27. All equipment that needs to be 'levelled' in storage areas must be fitted with suitable jacking screws to level the equipment and if required, appropriate fixing method to secure it in place.
28. Suitable benches should be available from equipment suppliers, if required. These must be robust enough to carry the weight of the machine, a suitable working height for diverse pupils using equipment, and fitted with appropriate wheels and locking devices if the machine is to be transported to different classrooms.
29. Equipment as it leaves the manufacturer should be complete, suitably packed to protect it from physical and environmental damage when being transported, and be ready for immediate installation.
30. All equipment must be warranted by the prime contractor to meet the performance specification for their particular machine.
31. All equipment should be warranted against failure in respect of parts and labour for a minimum of one year. This work will be carried out on site or by the equipment being returned to the factory.
32. Faulty equipment, which cannot be used for teaching during the warranty period, should be rectified within seven working days.
33. Companies supplying equipment must hold replacement parts for a minimum of ten years. In this period parts should be available within five working days and warranted against failure for 12 months from installation.
34. Companies offering to sell equipment must be represented by a person who has extensive knowledge of the machine and associated software systems, is fully experienced on how to operate it and is fully aware of the environmental, health and safety requirements for students using their equipment in schools.
35. It is recommended that prior to the final selection teachers should ensure that short-listed suppliers are able to demonstrate in real time how their equipment can fit within the curriculum requirements. This trial must confirm that the equipment meets essential teaching requirements.

In order to support the stakeholders in filling in the list of required pieces of equipment a typical process is shown in the next table. The table suggests the activities to be performed, the questions to answer, recommendations and results in order to be able to make the best final decision.

TABLE: Steps for equipment needs assessment of a training institution (school, adult training centre, college, etc.)

Activities	Questions	Recommendations	Outcomes
1. **Analyse how your institution should respond** dynamically and flexibly to the changing requests of the local and regional community and consult the existing local/regional development plans and the domains in which professional training is to be accomplished 2. **Consult the occupational/ professional training standards** and the curriculum and relate them to the training of the occupational domains offered by the institution 3. **List the current needs** of the institution 4. **Compare** the current needs with those in other institutions offering the same curriculum 5. **List by occupational domain the current and future needs** in terms of equipment	• Does your institution, at present, respond to the changing requests of the local and regional community? • If not, then how can your institution respond to the changing requests of the local and regional community? • Has the institution its own development plan available and formulated in line with requirements for inclusion into the existing local/regional development plans? • Does the existing equipment satisfy the present and future training needs in terms of the training standards and the curriculum? • Are the current needs of your institution being met in terms of equipment? • How well does your institution meet the current needs compared to other institutions • If other institutions are meeting their needs more effectively than your own institution, what are they doing differently to achieve this • What sources and resources will be required to aid the identification of the equipment needed	It is suggested that schools/training institutions form small working groups of curriculum/training deliverers to conduct the activities listed in column one. Each group could be chaired by a senior member of staff to make effective and efficient use of the available time. Members of each working group should be familiar with their own area of occupational standards. It is recommended that the process of identifying needs should not take an extended period of time.	A **report** presenting the condition of the equipment in the institution using the provided Template 1 below or one of similar design A **list** using Template 2 below given as a guide to show the relationship between equipment needs and the needs expressed in the training standards and curriculum

TEMPLATE 1

ASSESSMENT OF THE EXISTING LABORATORY AND WORKSHOP EQUIPMENT CONDITION

NAME OF SCHOOL _____ **REGION/COUNTY** _____

NAME OF DIRECTOR _____ **No: ON ROLE** _____

ECONOMIC AGENTS _____ **OCCUPATIONAL DOMAINS** _____

TABLE OF EXISTING LABORATORY AND WORKSHOP EQUIPMENT AND CONDITION

EQUIPMENT ITEM	BRIEF COMMENTS ON CONDITION AND SERVICEABILITY

EQUIPMENT ITEM	BRIEF COMMENTS ON CONDITION AND SERVICEABILITY

TEMPLATE 2

RELATION OF EQUIPMENT NEEDS TO THE TRAINING STANDARDS /CURRICULUM ACTUAL NEEDS

EQUIPMENT NEEDED	AREA OF TRAINING STANDARDS/CURRICULUM APPLICABLE

EQUIPMENT NEEDED	AREA OF TRAINING STANDARDS/CURRICULUM APPLICABLE

Concluding summary on concluding summary of equipment selection guidelines

Balancing level of needs

There will be many questions an institution may want to ask itself and other related actors concerning the equipment it may require to deliver a satisfactory training programme in accordance with the Training Standards/Curriculum which is at the same time interesting and appealing to the students/pupils. What is important among many other points is to keep a sense of proportion in the demands for equipment.

Prioritisation of needs in line with available budget

The money available is usually limited and to be able to have an opportunity of being successful in the acquisition of the equipment needed it will be necessary to prioritise. The most wanted equipment should be listed first.

Attention to compatibility

If the equipment required is to be used in combination with any input or output of another piece of equipment, it is important to pay special attention to the compatibility of all technical parameters of all parts of this equipment to ensure their smooth interaction.

Balancing equipment size in line with the required scale of use

Make sure to select the right size of equipment in line with the curriculum requirements of the specific target group and needs i.e. simulations and didactic equipment for young people in schools, small scale/size demonstration equipment for colleges, small scale professional equipment for practical adult training especially if practical training on industrial equipment can be assured as on-the-job training in local enterprises and/or through local partnerships.

Maximise equipment utilisation possibilities – universal use

Try to combine where possible the use of equipment across domains or occupations to be able to use available resources more efficiently and effectively, i.e. maintenance (cost, personnel time), consumables, budget available, etc.

Remember that you can acquire financial and technical support more easily when you are compiling lists of equipment and needs for support; if your demands are sensible and well justified; and if the request and plan of use is concrete and well presented with a minimum volume of documentation.