EDUCATION POLICIES AND STRATEGIES

# Education Policy & Strategy Simulation Model EPSSim Version 2.1

## User's Guide



United Nations Educational, Scientific and Cultural Organization

#### Inside this guide

This guide contains four chapters and one annex:

Chapter 1 "Introduction" describes the EPSSim simulation model and the basic steps to get it started.

Chapter 2 "Fundamentals" introduces a few basic concepts of simulation and major formulae used for simulation in general and for EPSSim in particular. Some parts of this chapter are taken from a document *Educational planning through computer simulation* in order to better help delimit the scope of the topic.

Chapter 3 "Components of EPSSim 2.1" explains the various components of EPSSim in its version 2.1 including enrolment projections, and the generation and consultation of scenarios.

Chapter 4 "Additional adaptation of EPSSim 2.1" presents a few tips on how to customize EPSSim 2.1 according to your country's context and education system, making use of a number of utilities and macros.

The "Annex" defines a number of indicators that are most frequently used in the field of education simulation.

#### Information:

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## Contents

Chapter 1. Introduction	1
What is EPSSim? Flows of EPSSim	2
Getting started	3
Chapter 2. Fundamentals	7
Simulation in a few words Different types of simulation Logical path of "demographic" simulation models Basic stages of computer simulation Simulation scenarios through extrapolation, exploration and forecasting Major formulae for computer simulation.	7 9 10 11
Chapter 3. Components of EPSSim 2.1	15
Chapter 3. Components of EPSSim 2.1 Preliminary phase Pre-simulation exercise Projections for simulation Further utilization	. 15 . 15 . 18
Preliminary phase Pre-simulation exercise Projections for simulation	. 15 . 15 . 18 . 21
Preliminary phase Pre-simulation exercise Projections for simulation Further utilization	. 15 . 15 . 18 . 21 . <b>25</b> . 25
Preliminary phase Pre-simulation exercise Projections for simulation Further utilization <b>Chapter 4. Additional adaptation of EPSSim 2.1</b> Utilities	. 15 . 15 . 18 . 21 . 25 . 30

#### **Terms and conventions**

The different typefaces used in this guide are as follows:

	The vertical bars () are used in order to separate the individual commands of the menu in the path leading to the final command in the menu path. For example, "File Save" refers to the command you choose by opening the File menu, then choosing Save.
Monospace	This typeface represents a filename (e.g. simulation.doc), the name of a worksheet (e.g. PRIM), a text as it appears on the screen or any text or number you must type.
Note	Notes give additional information on a topic or more technical detail on specific subjects
Тір	Tips include helpful suggestions and shortcuts
Italics	This typeface indicates a reference to a subtitle of this guide or a heading of EPSSim subcomponents
Bold	This typeface indicates a command to choose from different "popup" boxes (dialog box, check box, etc.) in EPSSim
Blue- coloured cell	The blue-coloured cells in EPSSim are the spaces to be filled in or overwritten with the baseline data and policy options of your country's education system

## **Chapter 1. Introduction**

Compared to other socio-economic sectors, educational development involves more difficult and multidimensional problems. Faced with financial constraints, governments are not able to meet [...] broad social demands without adopting restrictive measures within the education sector in order to rationalise the use of allocated resources. In the dynamics of educational management of student flows, as well as that of public finance, they have to make difficult decisions to regulate the utilisation of resources, without in any way leading to serious disruptions and dysfunctions. Because there are too many actors, variables and the interrelations between these, it is necessary to have not only a reliable information system but also an objective forecasting tool to facilitate policy consultations regarding financial constraints and their consequences [for] educational options.<sup>1</sup>

This guide is designed to facilitate better understanding and use of EPSSim (pronounce [ep'sim]), a generic simulation model for education planning. It is a companion manual to a UNESCO publication entitled "Educational planning through computer simulation", issued in 2001. This guide is particularly helpful for using and applying the version 2.1 of EPSSim.

#### What is EPSSim?

EPSSim stands for Education Policy and Strategy Simulation. It is a generic simulation model developed by UNESCO in 2001 in order to contribute to the planning and programming of development actions of national education systems. UNESCO conceived this policy simulation tool with a view to providing technical and methodological support to national administrations and specialists in education ministries in their efforts for the formulation of credible education development plans and programmes, in particular in the context of the Education for All (EFA) movement.

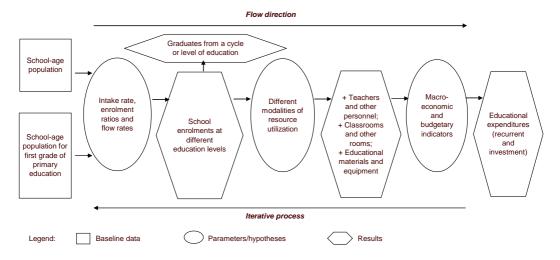
Being generic, this model, therefore, does not correspond to a specific education system, but constitutes a generic tool with some built-in elements, which can facilitate its adaptation to a particular national education system. It is designed in such a way as to serve as a tool for demonstration and training on the design of medium and long-term education policies and strategies. With slight adaptation, it can also be used for testing the feasibility of the overall education policy of a given country. However, this model needs careful restructuring and necessary adaptation if one wishes to use it as a tool for designing a solid education policy or even a detailed action plan for medium

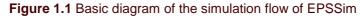
<sup>&</sup>lt;sup>1</sup> Educational planning through computer simulation. 2001. (Education policies and strategies, ED-2001/WS/36.) Paris, UNESCO.

to long term educational development. EPSSim version 1.0 was issued originally in 2001. EPSSim 2.1, released in 2005, is an enhanced version, which is likely to evolve further and be improved in the future.

#### Flows of EPSSim

EPSSim is a "demographic" model, in which the enrolment-related targets are taken as the decision (independent) variables and educational expenditures are calculated as a consequence of achieving these targets. The characteristics of 'demographic' vs. 'budgetary' models are explained in Chapter 1 (Section on *Different types of simulation*).





As shown in Figure 1.1, EPSSim proceeds with computing the projected intake, enrolment and flow rates on the basis of the population data and in light of enrolmentrelated policy options. The ensuing number of enrolments by level and type of education, combined with the current and future modalities of resource utilization (teaching staff, equipment, infrastructure, etc.), enable the generation of the estimates of future requirements of teachers, non-teaching staff, instructional materials, educational facilities, etc. These projected requirements, together with cost-related data and parameters, provide information on financial requirements and the possible financing gaps for achieving education policy goals.

The above computation is processed in a similar sequence from primary to secondary to higher education. The so-called early childhood care and education (ECCE) and non formal education, whose delivery pattern differs from that of the more 'formal' education system, are nonetheless capable of being simulated in EPSSim 2.1.

#### Getting started

EPSSim is a modelling application that is developed using Microsoft® Excel. In other words, you need the Excel programme installed on your computer in order to run this simulation model (i.e. files with an .xls extension). The filename of EPSSim 2.1 simulation model, in its generic form, is EPSSimV2i.xls.

When you open (or double click) this file, you will be prompted by a dialog box asking you to choose an option: **Disable Macros** or **Enable Macros** (see Figure 2.1). You choose **Enable Macros** in order to open this file and to be able to use a number of macros that are required to run EPSSim.

Security Warning	and the second second	×
"G:\DOCS\GENERAL\EFAFT: macros.	I\HQ Workshop\V2_1\EP5:	SimV2i,×Is" contains
Macros may contain viruses macros are legitimate, you r		
Disable Macros	Enable Macros	More Info

#### Figure 1.2 Security warning dialog box

Figure 1.3 The introductory window of EPSSim 2.1

🔀 Mi	icros	oft Exc	el - EPS	Sim¥2i.	xls					~		
:2	Eile	Edit	⊻iew	Insert	Format	Tools	Data	Window	EPS Simul	ation <u>H</u> elp		
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10												
11												

**Tip**: If EPSSim opens without prompting the Security Warning (Figure 1.2), it means that the security level of your Excel programme is not defined as **Medium** and that the model was opened without activating the necessary macros. In order to use macros, choose, on the Menu Bar of the Excel programme, Tools | Macro | Security... The Security Level to be selected is **Medium**, and then select **OK**. You need to reopen the Excel programme and the simulation model in order to use EPSSim properly.

A new menu called 'EPS Simulation' is created on the Menu Bar, as indicated by a dialog box when opening the simulation model and also shown in Figure 1.3. This is the menu from which you can operate all the major functions of EPSSim.

Figure 1.4 displays the menu items as well as some submenu items that you can choose in order to conduct different operations on EPSSim 2.1. You can access, for example, EPSSim Quick Help or the Glossary (*What's This?*) or conduct a simple exercise (on preschool education) to familiarize yourself with the logic and major steps of simulation (*Pre-Simulation Exercise*).

In order to conduct an actual simulation of your country's education development, the first step is to enter the population data (which you can fill in by choosing EPS Simulation | Population Data | Population Projections). After a careful review of the "architecture" of the simulation model, you can input the statistical and policy data of your own country in order to conduct a real simulation of your education system.

1 & B B . 1 .	What's This?	•	Ab	out EPSSim <u>1</u>	
	Pre-Simulation Exercise	F	EPSSim Quick Help 2		
DE	Population Data	F	Sho	ow the Glossary <u>3</u>	
ulation model, click	Simulation/Projections			T	
"EPS Simulatio	Cost Projections	F.			
y the baseline year, i.e. th	Show Charts		data		
1	Print <u>R</u> esults				
ting macros. In order to e	Scenarios	*	/ated,		
ar "Tools", then select "M	Utilities				

#### Figure 1.4 'EPS Simulation' Menu

The physical and cost projections can be displayed in the form of charts or printed out by level of education or by category of information (**Show Charts** or **Print Results**). EPSSim allows you to create a number of scenarios depending on the policy options you designate on the projection worksheets.

EPSSim contains a number of useful, built-in utilities on a number of frequently-used analytical tools, which have been designed by means of macros within Visual Basic for Applications (VBA).

All the components of EPSSim and the use of the utilities will be explained in detail later in this guide (cf. Chapter 3).

When closing or exiting EPSSim and prompted "Do you want to save the changes you made to ...?", you can select **Yes** and choose File | Save as... in order to save, on the hard disk of your computer, the simulation model with a different name (for example, EFASim.xls).

### **Chapter 2. Fundamentals**

This chapter explains a selection of basic notions and concepts of simulation in order to help better understand and delimit the scope and potential of EPSSim. Those who are familiar with the topic of this chapter can skip to the next one dealing specifically with the content of EPSSim 2.1.

#### Simulation in a few words...

A simulation model is a tool par excellence for scenario planning. It is used to test the viability of an education policy and strategy, and to propose alternatives that can help cope with dynamic and changing environments. Scenario planning in education is a non-predictive means of examining a variety of possible futures either for the development of the whole education system or specific issues of interest.

The simulation method is widely used as a strategic planning and management tool allowing for evidence-based policy dialogue. The scenarios, designed as results of a long process of trial and error by taking into consideration the policy options, the technical feasibilities as well as the financial constraints, feed into constructive policy and social consultations about a common future.

The simulation contributes to ensuring holistic educational development, coherence in the development of sub-sectors, and a better understanding of the implications of particular policies and strategies, by facilitating the projection of pedagogical and institutional inputs, as well as the financial resources which these imply.

#### **Different types of simulation**

There are two distinct classifications of simulation models, depending on either the model's specificity (generic vs. country-specific) or its approach (demographic vs. financial model). These classifications, however, should not exclude the variety of many other subcategories that can exist in between.

Generic vs. country-specific models: Generic models are sometimes called "readyto-use" models, and country-specific models are often called "tailor-made" models.

The generic approach is used in designing simulation models which contain components common to a majority of education systems. They do not

correspond, therefore, to any particular country's education system. With careful adaptation, such models can however make it possible to approximate the pedagogical, physical, and financial consequences of a policy.

The country-specific approach is used in order to assess the consequences of a particular country's education policy options, and to identify, in greater detail, the development actions required to implement the stated policy. Country-specific models take into account the structure and specific details of an individual country's education system.

Generic models have the advantage of being operational as soon as the baseline data and main objectives are inputted, but have a limited power as detailed programming tools. In contrast, "tailor-made" simulation models, designed on the basis of close collaboration between decision-makers and specialists reflect a particular country's situation and its educational policy, but such models require a much longer time to prepare and to verify.

**Note:** In recent years, some generic models (often applied with necessary adaptation) have gained popularity. This is due (but not limited) to the following factors: (i) time and resources required to develop country-specific models; (ii) the ability to make cross-country comparisons of enrolment and resource projections by means of some adapted, generic models; (iii) the flexibility of some generic models to different contexts.

**Demographic vs. financial models**: The second classification is between "demographic" and "financial" models, with multiple variants in between. These two types of models are designed according to two opposite methodological approaches: financial models use public spending on education as the decision variable, and demographic models estimate educational expenditure as the result of the simulation.

In the financial or budgetary models, one is first concerned with determining an acceptable budget ceiling for education as a proportion of the State's overall budget. The computer calculates backwards to obtain likely enrolment targets. In the demographic models, the enrolment-related targets (independent variables) are laid down *a priori* and the computer calculates the resultant, necessary financial resources.

In reality, the principal simulation parameters — the enrolment and budget parameters — are interdependent. Whichever modelling approach is used, the options concerned in the initial scenario undergo several changes before leading to a balanced result. The search for a scenario that corresponds to the policy, leads the planner to repeatedly test different options for the two types of principal variables which are considered either as causes or consequences. The final decision is made by considering the implications of each parameter, and the scenario to be adopted finally results from a reasoned choice of the possible variables to be applied, both upstream and downstream in the course of the calculations.

For instance, in demographic models, the financial resources calculated as requirements for achieving the enrolment targets may prove unsustainable within a certain macro-economic and fiscal framework. In this case, one needs to review the parameters of input mix (student/teacher ratio, class size, textbook/student ratio, etc.) until one achieves a feasible expenditure level. With financial models, the budgetary ceiling specified as the decision variable for a certain level of education may not make it possible to achieve a policy goal, such as an adequate teachers' training. In this case, one would adjust the aforementioned parameters of input mix in order to reduce the education costs per pupil to train more teachers.

**Note:** EPSSim, as explained above, is a demographic model, which computes the financial requirements as a consequence of a rights-based education policy. The major preoccupation of this model is the search for budget feasibility in the course of responding to the social demand for education.

#### Logical path of "demographic" simulation models

There are different paths that can be taken in developing simulation models using a "demographic" approach. However, the following three-step, generic path is common to most "demographic" simulation models.

- **First of all, enrolment forecasts are made**: The simulation starts by modelling access to and participation in education. One specifies the gross intake rate (GIR) and the model calculates the gross enrolment ratios (GER). In other words, in order to increase the enrolment ratios, managers will increase Grade 1 entrants. It is then possible to measure the progression of students from one grade to the next by specifying the flow rates (promotion, repetition and dropout), as well as the transition rates from one level to the next, in order to estimate the number of students per school-year and per school grade. This exercise will provide enrolment projections per year for the period being forecast (5, 10 or 15 years), and these can be broken down by private or public schools, by gender, by rural and urban areas, etc.
- Secondly, enrolment projections enable the further forecasting of other "physical" inputs: On the basis of the enrolment projections per year, it is now possible to calculate the following "physical" inputs: the number of teachers, classrooms, textbooks as well as any other physical educational requirements. This is thanks to the combination of several parameters specified in the model such as the supervision ratios, the number of weekly teaching and learning hours, etc.
- Thirdly, the simulations of "physical" inputs will lead to financial estimates: The objective of a simulation model is the quantification of the adopted education policy decisions. The quantified data on human, physical, and financial resources provided by the simulation model facilitate policy dialogue concerning the budgetary implications of the decisions taken by the authorities. The

quantitative forecasts of educational development depend not only on the policy objectives, but also on the budgetary and macro-economic projections of the country. If the financial estimates relating to the education sector prove too high in relation to the financial affordability of the country, one starts again and reviews the simulation models. In consultation with relevant educational authorities and other stakeholders, one changes the parameters and searches for alternative education development options.

#### Basic stages of computer simulation

There are three principal stages to follow in the process of simulating educational development paths. These are: the collection and organization of the baseline data on which projections will be based, the definition of hypotheses to be tested on the baseline data, and the production of projected estimates as the result of such testing. Please refer to Section on *Formulae for computer simulation*, which describes how the formula of annual growth rate is applied for the sake of simulation.

Figure 2.1 presents three stages of simulation as well as the different terms used to describe them. It is worth noting that in designing the different stages, some terms, called related terms, have at times been used indiscriminately in this guide.

**Note**: The construction of a simulation model can involve several stages of development depending on the national context. However, three logical stages (the constitution of the baseline data, the quantifying of policy goals, and the projection of results) are the three key moments in the construction of a simulation. Furthermore, these three logical stages correspond to the three chronological phases in the preparation of an education development plan or programme.

	Stage 1	Stage 2	Stage 3
	Baseline data	Hypotheses	Results
Definiti on	The raw data and the initial values of parameters at the base year	The education policy options and choices, expressed as benchmarks in a given time horizon	The forecasts extrapolated from the baseline data to achieve the hypotheses (or simulation parameters)
Other related terms used	Diagnosis; Analysis of current situation; Initial values of parameters	Policy options; Goals or Objectives; Targets; Hypotheses; Parameters; Decision variables	Projection results; Result variables; Outputs; Forecast; Consequences; Implications

Figure 2.1 Terms used for the three logical stages of simulation

In developing a simulation model, each stage can be conveniently presented on a worksheet of the spreadsheet software in order to facilitate data entry, the verification

and the monitoring of related information at each stage of the simulation. Figure 2.2, apparently similar to Figure 2.1, gives an example of how the different stages of simulation may be arranged across columns on a worksheet.

Figure 2.2 Arrangement of simulation stages across columns of a worksheet

Columns 1	Columns 2	Columns 3		
Baseline data	Parameters-objectives	Results		
i.e. all the initial values of the	i.e. the intermediate or final values of the goals/objectives	i.e. the projection results in human,		
parameters at the base year	to reach in a given time- horizon	physical and financial terms		

#### <u>Simulation scenarios through extrapolation, exploration and</u> <u>forecasting</u>

The simulation model makes it possible to construct objective scenarios on which to base policy dialogue and thereby facilitate the discussion of feasible education policy alternatives. On the basis of major education policy orientations, several educational development scenarios can be constructed. The simulation model is first used as an extrapolation tool, then as an exploration tool, and finally as a forecasting tool. Although there is no single pattern followed in the construction of a development scenario, nevertheless we can identify a commonly used method characterised by these three principal stages.

- **Baseline scenario (extrapolation)**: The first type of scenario, which can be called a "baseline" scenario, consists of a simple projection of (or extrapolation from) past trends. It is about determining the consequences of the current education policy if it remains unchanged over the planned period. This scenario makes it possible to weigh the consequences of a laissez-faire policy against alternative sector development scenarios and to foresee desirable changes.
- Alternative scenarios (exploration): The second stage consists of developing two or three alternative scenarios based on the simulation parameters resulting from the application of new policy objectives. These scenarios enable to determine the consequences of adopting new education sector development policies. The financial implications of adopting the different policy objectives are explored, enabling informed policy dialogue. It is at this stage that the feasibility of the different policies and strategies is considered. The budgetary consequences of these different policy options are calculated and thus inform policy dialogue, the aim of which is to reach consensus (or compromise) on the education policy. Once the different options have been carefully weighed, one of the scenarios progressively will emerge as a reference scenario.
- **Reference scenario (forecasting):** The third phase is the adoption of one of the previously considered scenarios, or even a scenario resulting from the combination of several alternative scenarios. Once the technical and financial

feasibility of the reference scenario has been confirmed, it is refined with further information on which an action plan can be based. It becomes the reference scenario for the education sector development plan, making it possible to programme both the necessary development actions and their attendant financial resources.

#### Major formulae for computer simulation

Education simulation can make use of virtually all education-related statistics and indicators. Population data as well as a few indicators for expenditure are also required in order to identify and assess the budgetary and macro-economic implications or the affordability of the education policy. The most common indicators used in education simulation models, including EPSSim, are listed and described in the Annex.

Based on these indicators, most simulation models, including EPSSim, apply the annual growth rate to compute increases or decreases in enrolments, teachers, classrooms, instructional materials, etc. For example, in order to project gross intake rates (GIR) from 2004/05 through 2015/06, one can apply a growth rate and use the following three-step path:

Step 1: Choose the classical formula to compute the growth rate

Formula:

• 
$$GIR_{Grade1}^{2015/06} = GIR_{Grade1}^{2004/05} * (1+r)^{11}$$
  
•  $(1+r)^{-11} = \frac{GIR_{Grade1}^{-2015/16}}{GIR_{Grade1}^{-2004/05}}$   
•  $1+r = \ln \frac{GIR_{Grade1}^{-2015/16}}{GIR_{Grade1}^{2004/05}}$ 

• 
$$r = 11 \frac{GER_{Grade1}^{2015/16}}{GER_{Grade1}^{2004/05}} - 1$$

Where:

 $GIR_{Grade1}^{2004/05}$  = Gross intake rate to Grade 1 (e.g. primary education) in the school-year 2004/05

 $GIR_{Grade1}^{2015/16}$  = Gross intake rate to Grade 1 (e.g. primary education) in the school-year 2015/16

r = Annual growth rate of GIR (gross intake rates) over the 11-year period from the school-year 2004/05 through the school-year 2015/16

**Step 2**: Transcribe this formula of annual growth rate into an Excel formula, i.e. a function that is used in the Excel environment:

- Annual grwoth rate =  $(GIR_{Grade1}^{2015/16} / GIR_{Grade1}^{2004/05})^{(1/11)-1}$
- $D27 = (B27/E27)^{(1/11)} 1$

Where:

 $B27 = GIR_{Grade1}^{2015/16}$ , i.e. the gross intake rate to Grade 1 (e.g. primary education) in the school-year 2015/16, is placed in Cell B27 of the Excel Worksheet (see Figure 2.3)

 $E27=GIR_{\rm Grade1}^{2004\,/\,05}$  , i.e. the gross intake rate to Grade 1 (e.g. primary education) in the school-year 2004/05, is placed in Cell E27 of the Excel Worksheet

D27 = Annual\_growth\_rate

**Note**: The cells referred to here are the actual references of EPSSim's worksheet called PRIM, you can open by choosing EPS Simulation | Simulation/Projections | Primary Education.

Step 3: Apply this Excel function to compute the GIR of each year (see Figure 2.3)

• 
$$GIR_{Grade1}^{2005/06} = GIR_{Grade1}^{2004/05} * (1 + Annual growth rate)$$

• 
$$GIR_{Grade1}^{2006/07} = GIR_{Grade1}^{2005/06} * (1 + Annual growth rate)$$

In other words,

- F27 = E27 \* (1 + D27)
- G27 = F27 \* (1 + D27)
- ...

Where:

 $F27=GIR_{Grade1}^{2005\,/\,06}$  , i.e. the gross intake rate to Grade 1 (e.g. primary education) in the school-year 2005/06, is placed in Cell F27 of the Excel Worksheet

 $G27=GIR_{Grade1}^{2006/07}$  , i.e. the gross intake rate to Grade 1 (e.g. primary education) in the school-year 2006/07, is placed in Cell G27 of the Excel Worksheet

#### D27 = Annual\_growth\_rate

Figure 2.3 Application of the formula of annual growth rate in EPSSim

:	<u>Eile E</u> dit	<u>V</u> iew ]	insert F	ormat <u>T</u> oc	ols <u>D</u> ata	Window	EPS Simul	acion <u>H</u> elp		
	D27	•	<i>f</i> x =IF	F(AND(\$B2	7=0;E27	7=0)(0;(B)	27/E27)^(1/0	027)-1)		
		A		В	С	D	E	F	G	Н
1	PRIMARY	EDUCAT	ΓΙΟΝ				1			
2										
3					Target	Annual	Baseline			
4				Hypotheses		increase	2001	2002	2003	2004
5				(Decision)	of years	rate 🖊	2002	2003	2004	2005
25	Gross in	take rate				1				
26	Gross in Public					1	96%	96%	96%	95%
26 27				95%	13	-0,2%	<b>96%</b> 97%	<b>96%</b> 97%	<b>96%</b> 97%	<b>95%</b> 97%
26 27 28	Public	C		95% 95%	13 13	-0,2% 0,1%				
26 27	Public Male	e					97%	97%	97%	97%
26 27 28	<b>Publi</b> o Male Femal	e					97% 94%	97% 94%	97% 94%	97% 94%

This method of projecting the GIRs is applied in EPSSim for other categories of inputs as well: flow rates, teachers, class size, student/teacher ratios, buildings, and even expenditure, with slight variations across the indicators. In other words, most indicators presented in the Annex have been projected in EPSSim, using, as far as possible, the same methodology as described above.

## **Chapter 3. Components of EPSSim 2.1**

#### **Preliminary phase**

This chapter describes, step by step, each of the components (or menu items) of EPSSim 2.1, which can be accessed from the drop-down menu **EPS Simulation** (see Figure 1.4). The method for opening and running EPSSim has been explained in Chapter 1, Section on *Getting Started*.

Once you have got into the simulation model, you can have access to the menu item **What's This?** from which you can consult either **EPSSim's Quick Help** describing the basic steps for using this simulation model or the glossary of major indicators and their brief definitions as used in EPSSim 2.1 (Figure 3.1). Select **Next** or **Previous** in order to consult the different parts of the dialogue boxes.

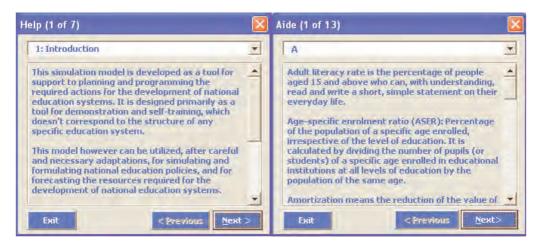


Figure 3.1 Two dialog boxes: EPSSim Quick Help and Show the Glossary

#### Pre-simulation exercise

The second menu item is **Pre-simulation exercise**. This part can help EPSSim users to practice a quick, simple simulation on pre-school education and to be familiarized with the EPSSim environment and terminology. This module is particularly useful for those with no experience of simulation models.

#### Figure 3.2 List of baseline data and policy options for a pre-simulation exercise

Baseline Data and Policy Options
----------------------------------

Baseline Data and Policy Options Baseline Data		Policy Options		Descriptor	
Gross enrolment ratio by age	Baseline	By when?	Goals	Descriptor	
2001 Age 3	M=4000; F=3500	2015		<= Age-specific GER	
Age 4	M=4000; F=7000	2015		<= Age-specific GER	
5				<= Age-specific GER	
Age 5	M=15000; F=13000			<b>o</b> .	
Age 6	M=30000; F=27000	2015	80.0%	<= Age-specific GER	
Preschool education staff	0.500	0045	05		
2001 Number of sections	3,500	2015		<= Pupils:educator ratio	
Number of teachers	3,020	2015		<= Pupils:section ratio	
Teaching personnel				<= Teacher attrition rate	
Category 1	1,500	2005		<= as % of the total	
Category 2	1,000	2005		<= as % of the total	
Category 3	500	2005		<= as % of the total	
Category 4	20	2005		<= as % of the total	
Non teaching staff				<= Attrition rate	
Admin & support staff	150	2015		<= as % of the total number of teachers	
Other staff	200	2015	15.0%	<= as % of the total number of teachers	
Materials and equipment		From			
Kids		2001			
Age 3		to	1	<= Book per kid	: Same
Age 4		2015	1	<= Book per kid	: Same
Age 5			1	<= Book per kid	: Same
Age 6			1	<= Book per kid	: Same
Educator					
For age 3				<= Book per educator	: Same
For age 4				<= Book per educator	: Same
For age 5			2	<= Book per educator	: Same
For age 6			2	<= Book per educator	: Same
Facilities			3.0%	<= Building amortization rate	
2001 Number of classrooms	3,300		1	<= 1 classroom for 1 section	
Other rooms	350		15%	<= as % of classrooms	
Costs and financing					
2001 Teachers (Wage, etc.)					
Category 1	1.0			<= as multiple of GDP per capita	: Same
Category 2	1.2			<= as multiple of GDP per capita	: Same
Category 3	1.5			<= as multiple of GDP per capita	: Same
Category 4	2.0		2.0	<= as multiple of GDP per capita	: Same
Other Staff Costs					
Training	10.0%			<= lump sum as 10% of total salaries	: Same
Admin & Supervision staff	2.0			<= as multiple of GDP per capita	: Same
Workers & others	0.7		0.7	<= as multiple of GDP per capita	: Same
Instructional materials					
For kids	1.5			<= \$ average per material	: Same
For educators	2.0		2.0	<= \$ average per material	: Same
Other running costs					
Maintenance	50		50	<= \$ average per room	: Same
Water & electricity	100			<= \$ average per room	: Same
Miscellaneous	70		70	<= \$ average per room	: Same
Constructions & other investments					
Constructions	2,000			<= \$ average per a new room	: Same
Equipment	200			<= \$ average per a new room	: Same
Other maintenance costs	100		100	<= \$ average per a new room	: Same
Macro-economic data					
2001 GDP per capita	\$800				
GDP ('000)	14,112,017			<= Annual GDP growth rate	
National Budget ('000)	2,116,803	2015	16.0%	<= Total Budget/GDP	
Education budget ('000) Preschool education budget ('000)	359,856 7,000	2015 2015		<= Education/Total budget <= Preschool/Education budget	

In order to practice this preliminary exercise, choose EPS Simulation | Pre-simulation exercise, then select **Background**, **Population data** or **Simulation**. The descriptive part and the list of baseline data and policy options (Figure 3.2) of **Background** comprise the contextual information on the exercise and can be used for entering statistical and policy data once you have got into the worksheet EXER2 (EPS Simulation | Pre-simulation exercise | Simulation).

To enter the baseline data or the information on policy options, one can click one of the four option buttons of the worksheet (see Upper Left-hand in Figure 3.3): **Data Column Only** displays Column E only, which accommodates the green-coloured cells to be used for entering the baseline data. **Hypo Columns Only** displays Columns B, C and D, which contain the blue-coloured cells to be used for entering the policy options. **Show All Columns** displays all columns, including those containing the projected results by year.

**Tip**: One can start by clicking the option button **Data Column Only** in order to enter baseline data onto the blue-coloured cells. You can then click **Hypo Columns Only** in order to input policy options. Alternatively, if you wish to enter baseline data and policy options while all the columns are displayed, click **Show All Columns**.

	A	В	С	D	E	F	G	Н
1	SIMULATION OF PRE-PR	IMARY I	EDUCAT	ΓΙΟΝ				
2	🔿 Data Column Only							
3	O Hypo Columns Only		How many	Annual	Baseline			
4	🔿 Data & Hypo Columns Only 🚽	Goals	years?	increase	2001	2002	2003	2004
5	Show All Columns	(Decision	variables)	rate	2002	2003	2004	2(
13	Preschool enrolments by class					0	0	
14	Male				0	0	0	
15	Section of 3					0	0	
16	Section of 4					0	0	
17	Section of 5					0	0	
18	Section of 6					0	0	
19	Female			1	0	0	0	
20	Section of 3					0	0	
21	Section of 4			1		0	0	
22	Section of 5					0	0	
23	Section of 6				N 7	0	0	
24					$\mathbf{\nabla}$			
25	Gross enrolment ratio by class				0,0%	0,0%	0,0%	0,0
26	Male				0,0%	0,0%	0,0%	0,0
27	Section of 3			0,0%	0,0%	0%	0%	0
28	Section of 4			0,0%	0,0%	0%	0%	0

#### Figure 3.3 Worksheet of the simulation exercise

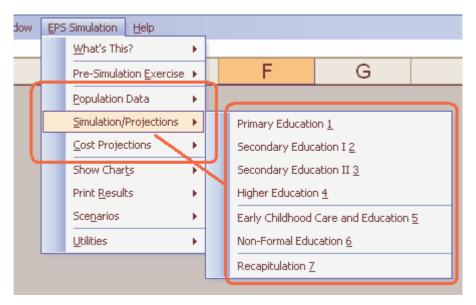
Once you have entered all the data and policy information, review the projected

results, paying particular attention to Rows 118 to 127 (Budget Framework), in order to appraise whether your policy is realistic and feasible within the stipulated sector-wide and macro-economic frameworks. If you find that the financing gap (Gap Simulation Costs vs. Budget), placed in Row 126, is too big, then change some policy options in order to reduce this gap. For instance, instead of the GER Goal of 20% in Cells B28 and B33, enter 10% (See Figure 3.3).

**Note**: Ideally, this pre-simulation exercise should be done by at least two people at the same time, each with his/her own PC, in order for them to compare and discuss the results of each simulation made with the same data and policy information.

#### Projections for simulation

This component is the most important part of EPSSim 2.1. This is where you can enter, by level or type of education, the baseline data and policy options of your education sector after having adjusted EPSSim according to the actual structure of your country's education system (Figure 3.4). Making such adjustments is explained later in this chapter in the section dealing with *Utilities*.



#### Figure 3.4 Core components of EPSSim

The **first step** is to enter your population data. The projected population data are usually obtained from the national department dealing with demographic data and projections. In case you don't have the officially derived population projections, you can apply the formula of growth rate as explained in Chapter 2, Section on *Major formulae for computer simulation*.

**Tip**: If your population data are in the form of aggregates by age-group, you can disaggregate them by age-specific data, using a Utility on Sprague Multipliers (EPS Simulation | Utilities | Sprague Multipliers).

The **second step** is to enter your education data and policy options by level and type of education. This implies that you have collected in advance all the necessary major baseline data required as well as the information on future policy orientations.

**Note**: In EPSSim, baseline data are to be entered in the cells under Column E and policy options in those under Columns B, C and occasionally D, across all education levels.

In case you are missing some critical data and/or policy options for EPSSim, you can either interrupt the data entry after saving your work or skip the concerned cell(s) and continue entering other data. However, you will need to enter the required data at a later stage into the relevant cells of EPSSim. For data entry, you can use the four option buttons as explained in the previous section on *Pre-simulation exercise*. Figure 3.5 displays the worksheet on primary education. All the other worksheets have been designed in a similar format.

1	<u>E</u> ile <u>E</u> dit	⊻iew	Insert	F <u>o</u> rmat <u>T</u> o	ols <u>D</u> ata	a <u>W</u> indo	w EPS Sin	nulation <u>H</u> e	elp
	D60	•	<i>f</i> x =	F(AND(\$B	60=0;E60	D=0);0;(E	360/E60)^(	1/C60)-1)	
		A		B	C	D	E	F	G
1	PRIMARY	EDUC/	ATION						
2	🔿 Data Col	umn Onl	У						
3	🔿 Нуро Со	umns Oi	nly		Target	Annual	Baseline		
4	🔿 Data & H	ypo Col	umns Only	Hypothese	9 number	increase	2001	2002	2003
5	Show All	Columns		(Decision	) of years	rate	2002	2003	2004
56	Flow rates								
57	Public								
58	Prome	otion rat	e						
59	Mal	e		0	<= If this t	raget is to b	e implemented	immediately,	put 0, otherwise
60	Gra	de 1		99%	13	1,1%	86%	87%	88%
61	-			99%	13	1,1%	i 86%	87%	88%
	Gra	de 2		33.70	1 10	1 101.00		01.70	
62		de 2 de 3		99%	13	1,1%		87%	88%
	Gra					· · ·	86%		88% 87%

#### Figure 3.5 Example of simulation worksheet: Primary education

**Note:** In EPSSim 2.1, it is possible to simulate a particular level or type of education, independently of the other levels or types of education (e.g. formal basic education, ECCE, non formal education, etc.). However, the simulation will be incomplete since all levels and types of education are intrinsically interlinked. Therefore, appraisal of the realism and feasibility of the projected results in any one level or type of education needs to be made in light of the array of policy options taken <u>across</u> the whole education sector. Furthermore, within the formal education setting, one should start the simulation from primary education and

proceed to secondary and higher education, as it occurs in reality, in order to make the necessary appraisals at each level consecutively.

**Tip**: Each level of education is "physically" placed in one worksheet. For instance, the simulation of the 2<sup>nd</sup> cycle of secondary education, together with the types and streams of education equivalent to this cycle, is done on the same worksheet, called SEC2, which can be accessed through EPS Simulation | Simulation/Projections | Secondary Education 2.

For the terms and indicators used in the worksheets of EPSSim, go to the Glossary (EPS Simulation | What's This? | Show the Glossary), or to the *Annex* of this guide. To understand the formulae of the annual increase rate and the annual increments of projection, refer to the section on the *Major formulae for computer simulation* of the previous chapter.

The **third step** is for entering unit costs and other expenditure-related data in order to make the cost projections and thus to complete the simulation. The unit costs to enter in this part of EPSSim 2.1 are the multiples of GDP per capita for staff salaries, while for all other items, they are the costs of each unit (for example, the average price of textbooks, the cost of classroom construction, etc.) Some of the expenditure-related data will need to be obtained from other ministries, those in charge of finance, economic planning and development.

3		Unit	Propor	Annual	Baseline		
4		Cost/	tion/	incre-	2001	2002	2003
5	Hype	othesis	Target	ment	2002	2003	2004
10	1. Primary education (public)						
11	Recurrent costs						
12	1.1 Teachers (Wage, etc.)				112.400.000	127.362.717	142.396.740
13	Teachers Category 1	2.00			24,000,000	27,733,948	31,681,442
14	Teachers Category 2	2.50			T 10,000,000	11,719,021	13,576,113
15	Teachers Category 3	2.80			22,400,000	23,595,383 🗖	24,569,643
16	Teachers Category 4	7.00			56,000,000	64,314,366 🗖	72,569,543
17	1.2 Other Staff and Administrativ	e Costs			10.420.000 <b>*</b>	12.079.537	<u>13.863.060</u>
18	Administration		5%		5,620,000	6,368,136 🗖	7,119,837
19	Supervisory staff	3.00	3%		2,880,000	3,255,234 🗖	3,637,180
20	Clerical and others	1.50			1,920,000	2,456,167	3,106,043
21	1.3 Teaching/learning material				<u>200.000</u>	10.996.054 🗖	359,316
22	Textbooks	\$2.0			100,000	10,810,064 🗖	342,412
23	Teaching guides	\$2.0			100,000	185,991	16,904
24	1.4 Other running costs				<u>1.985.000</u>	2.141.964	2.302.695
25	Maintenance	\$10.0			397,000	428,393	460,539
26	Water & electricity	\$20.0			794,000	856,786	921,078
27	Miscellaneous	\$20.0			794,000	856,786	921,078
28	S/Total				125.005.000	152,580,273	<u>158.921.812</u>
29	Construction & other inve	stments			<u>37.386.652</u>	38,838,282	<u>39.385.531</u>

#### Figure 3.6 Unit costs for simulation

Note: For more details on the unit costs, you can refer to the descriptions

given in the Descriptor column of Figure 3.2.

3		Unit	Propor	Annual	Baseline		
4		Costl	tion/	incre-	2001	2002	2003
5	Hype	othesis	Target	ment	2002	2003	2004
303	BUDGET FRAMEVORK						
304	GDP ('000)	\$0.80	ke GDPi	5.6%	14.112.017	14.902.290	<u>15.736.818</u>
305	Total government expendi	20%	13	0.3%	15.8%	16%	16%
306	Value ('000)				2.229.699	2.402.708	<u>2.588.101</u>
307	Public expenditure on edu	25%	13	0.4%	20.0%	20%	21%
308	Value ('000)				445.940	<u>489.783</u> 🗖	<u>537,529</u>
309	Formal Education	85%	13	-0.5%	92%	91%	91%
310	Value ('000)				410.265	447.963	<u>488.738</u>
311	Of which Primary	37%	13	0.2%	34%	34%	34%
312	Value ('000)				<u>151.620</u>	<u>167.656</u> 🗖	185.241
313	Of which Secondary 1	20%	13	0.4%	15%	15%	16%
314	Value ('000)				66.891	75.351	84.764
315	Of which Secondary 2	15%	13	-0.6%	23%	22%	22%
316	Value ('000)				102.566	<u>109.636</u> 🗖	117.016
317	Of which Higher	13%			20%	19%	19%
318	Value ('000)				<u>89.188</u>	<u>95.319</u>	101.717
319	ECCE	8%	13	0.2%	5%	5%	5%
320	Value ('000)				22.297	<u>25.619</u> 🗖	<u>29.357</u>
321	NFE Budget	7%	13	0.3%	3%	3%	4%
1000							

#### Figure 3.7 Expenditure-related data

These cost data enable the projection of the resource implications and financial requirements for achieving the government's policy options within the specified macroeconomic and budgetary frameworks. Different policy options and their resultant resource implications are tested by exploring alternative scenarios, examining their technical and financial feasibility.

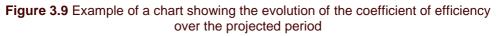
#### Further utilization

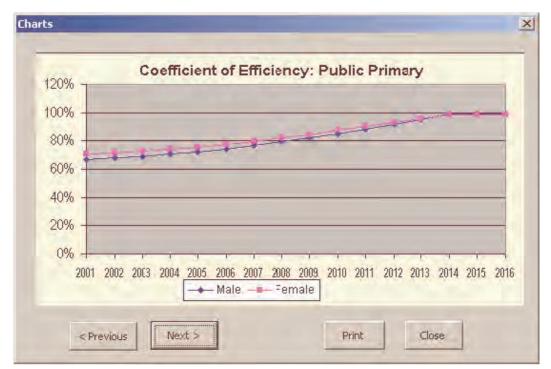
Once you have obtained the projections in terms of enrolments and resource requirements for achieving the enrolment targets, you can display the projected results in the form of charts or hard copies, either entirely or for only a specific part of the simulation (see Figure 3.8).

In order to consult the projected results in the form of charts (e.g., enrolments, teachers and facilities, etc.), choose EPS Simulation | Show Charts, then select the relevant submenu items. Figure 3.9 presents an example of a built-in chart of EPSSim 2.1: Choose EPS Simulation | Show Charts | Efficiency in Primary Education, then select **Next** until you obtain the chart entitled *Coefficient of Efficiency: Primary Education*.



#### Figure 3.8 Consultation of projected results in different formats





Tip: You can modify the content of the charts according to your actual

presentational needs. In order, for example, to replace the chart on the survival rates with the one on the wastage rates, choose Format | Sheet | Unhide, then select Charts5 from the **Unhide** Box. The worksheet Charts5 contains, under the columns D and E, the information on the survival rates, which cells refer to the worksheet COH!, Rows 158 for Male and 181 for Female. You then open this worksheet (choose Format | Sheet | Unhide, then select COH). Rows 158 and 181 contain the information on survival rates, while Rows 160 and 183, the information on wastage rates. This means that from the worksheet Charts5, you can relate the corresponding cells to the cells of Rows 160 and 183 (instead of Rows 158 and 181) of the worksheet COH in order to replace the information of the chart on the survival rates with the one on the wastage rates.

Another possibility for consultation is printing out the specific information by education level or type of information (EPS Simulation | Print Results, then select the relevant category you are interested in).

You can also generate a number of scenarios (see Figure 3.8). A scenario description box (Figure 3.10) is displayed when you choose EPS Simulation | Scenarios | Generate Scenario. You can briefly describe the main features of your scenario and click **Finish**.

**Note**: Please refer to Chapter 2, Section on *Simulation scenarios through extrapolation, exploration and forecasting*, which describes the three-stage method of producing development scenarios (i.e. extrapolation, exploration and forecasting).



#### Figure 3.10 Scenario Description Box

Once you have generated the first scenario, you can create other alternative scenarios

after changing the relevant policy options. In order to create the second scenario, enter some new policy options (for example, change the pupil/teacher ratio at primary education), then repeat the process you followed to create the first scenario (EPS Simulation | Scenarios | Generate Scenario). You can repeat this operation in order to create several scenarios. Figure 3.11 displays an example of three different scenarios generated by EPSSim 2.1.

:2	<u>File E</u> dit <u>V</u> iew	Insert	Format	<u>T</u> ools <u>D</u> at	a <u>W</u> indow	EPS Simulat	ion <u>H</u> elp					
	A1 👻	fx	Scenarios									
	A		В	C D	E	F (	Э Н	I	J	K L	M	N
1	Scenarios											
2				Scenari	o 1		Scenario 2			Scenario 3		
				Same tr	ends as befo	ore	Reduce pu well as the	pils/teachei class size	ratio as		jross intake luced gross	
										enrolment	ratios	
3												
4			200				2006	2010	2015	2006	2010	2015
5	Primary education		200	2 20	07 2011	2016	2007	2011	2016	2007	2011	2016
			000	. 96	% 95%	101%	<b>%3</b> 8	95%	101%	94%	91%	93%
7	Gross enrolment ratio Gross intake rate	D	<b>90</b> % 98%				96% 99%	95% 99%	101% 100%	94% 96%	91% 94%	93% 92%
7	Gross enrolment ratio Gross intake rate Promotion rate		90% 98% 84%	6 99 6 89	% 99% % 94%	100% 99%	99% 89%	99% 94%	100% 99%	96% 89%	94% 94%	92% 99%
7 8 9 10	Gross enrolment ratio Gross intake rate Promotion rate Students/teacher ratio		98% 84% 5	6 99 6 89 6	1% 99% 1% 94% 49 44	100% 99% 40	99% 89% 36	99% 94% 26	100% 99% 20	96% 89% 36	94% 94% 26	92% 99% 20
7 8 9 10 11	Gross enrolment ratio Gross intake rate Promotion rate Students/teacher ratio Student enrolments		989 849 5 2 262 40	6 99 6 89 6 0 25998	% 99% % 94% 49 44 74 2826339	100% 99% 40 3 326 314	99% 89% 36 2 599 874	99% 94% 2 826 339	100% 99% 20 3 326 314	96% 89% 36 2 553 999	94% 94% 2 706 165	92% 99% 20 3 080 181
7 8 9 10 11 12	Gross enrolment ratio Gross intake rate Promotion rate Students/teacher ratio Student enrolments No of teaching posts		98% 84% 50 2 262 40 40 46	6 99 6 89 6 2 599 8 3 53 5	% 99% % 94% 49 44 74 2826339 55 65050	100% 99% 40 3 326 314 83 158	99% 89% 36 2 599 874 70 907	99% 94% 26 2 826 339 107 653	<b>100%</b> <b>99%</b> <b>20</b> 3 326 314 162 231	96% 89% 2 553 999 69 726	94% 94% 26 2 706 165 103 631	92% 99% 20 3 080 181 152 251
7 8 9 10 11 12 13	Gross enrolment ratio Gross intake rate Promotion rate Students/teacher ratio Student enrolments		989 849 5 2 262 40	6 99 6 89 6 2 599 8 3 53 5	% 99% % 94% 49 44 74 2826339 55 65050	100% 99% 40 3 326 314 83 158	99% 89% 36 2 599 874	99% 94% 2 826 339	100% 99% 20 3 326 314	96% 89% 36 2 553 999	94% 94% 2 706 165	92% 99% 20 3 080 181
7 8 9 10 11 12 13 14	Gross enrolment ratio Gross intake rate Promotion rate Students/teacher ratio Student enrolments No of teaching posts No of classrooms	)	98% 84% 50 2 262 40 40 46	6 99 6 89 6 2 599 8 3 53 5	% 99% % 94% 49 44 74 2826339 55 65050	100% 99% 40 3 326 314 83 158	99% 89% 36 2 599 874 70 907	99% 94% 26 2 826 339 107 653	<b>100%</b> <b>99%</b> <b>20</b> 3 326 314 162 231	96% 89% 2 553 999 69 726	94% 94% 26 2 706 165 103 631	92% 99% 20 3 080 181 152 251
7 8 9 10 11 12 13 14	Gross enrolment ratio Gross intake rate Promotion rate Students/teacher ratio Student enrolments No of teaching posts	)	98% 84% 50 2 262 40 40 46	6 99 6 89 6 2 599 8 3 53 5 0 49 7	% <b>99%</b> % <b>94%</b> <b>49 44</b> 74 2 826 339 55 65 050 89 64 113	100% 99% 3326314 83158 85405	99% 89% 36 2 599 874 70 907	99% 94% 26 2 826 339 107 653	<b>100%</b> <b>99%</b> <b>20</b> 3 326 314 162 231	96% 89% 2 553 999 69 726	94% 94% 26 2 706 165 103 631	92% 99% 20 3 080 181 152 251
7 8 9 10 11 12 13 14 15	Gross enrolment ratio Gross intake rate Promotion rate Students.keacher ratio Student enrolments No of teaching posts No of classrooms Secondary education	)	989 849 5 2 262 40 40 46 35 50	6 99 6 89 0 25998 3 535 0 497 6 86	% 99% % 94% 49 44 74 2 826 339 55 65 050 89 64 113 % <b>82</b> %	100% 99% 40 3 326 314 83 158 85 405 82% 95%	99% 89% 36 2 599 874 70 907 58 308	99% 94% 2 826 339 107 653 85 130	100% 99% 20 3 326 314 162 231 124 386	96% 89% 36 2 553 999 69 726 57 272	94% 94% 2 706 165 103 631 81 730	92% 99% 20 3 080 181 152 251 116 180

#### Figure 3.11 A synoptic table of scenarios

**Note**: Technically, you can generate as many scenarios as possible. However, in EPSSim 2.1, the number of scenarios that can be created was intentionally limited to four. In order to create and display more scenarios, go to Visual Basic Editor and look for the macro called Scenario\_view, which contains the necessary information.

**Tip**: You can improve or modify the categories of information to be displayed in this scenario component. In order to do this, choose ViewScenario worksheet (either through EPS Simulation | Scenarios | View All Scenario Charts or choosing Format | Sheet | Unhide | ViewScenario). Then bring the necessary modifications in the range of AA6 to AF59 of the worksheet ViewScenario.

Once you have generated scenarios, you can display them in the form of charts or make hard copies of the scenarios.

## Chapter 4. Additional adaptation of EPSSim 2.1

This part of the guide explains the additional functions of EPSSim as well as the macros, which can facilitate its use and enable further adaptation of the simulation model.

#### **Utilities**

Figure 4.1 displays the different utilities that you can use to further customize EPSSim 2.1 according to your educational context and to obtain additional necessary data and indicators.

<u>W</u> indow	EPS	Simulation <u>H</u> elp				
		What's This?	×			
		Pre-Simulation <u>E</u> xercise	F	F	G	
		Population Data	F			
		Simulation/Projections	×			
		<u>C</u> ost Projections	F			
		Show Char <u>t</u> s	F			
		Print <u>R</u> esults	×			
		Sce <u>n</u> arios	×.			
		<u>U</u> tilities	F	Structure of an I	Education System <u>1</u>	
				Flow Rates 2		
				Cohort Analysis	3	
				Sprague Multiplie	er <u>4</u>	
				HIV/AIDs 5		
				Show Menu She	et <u>6</u>	

#### Figure 4.1 Utilities submenu items

Structure of an Education System: Choose EPS Simulation | Utilities | Structure of

an Education System. You will be prompted to a worksheet containing Figure 4.2. In this part, you can enter the duration of each level and type of your education system, and specify whether a particular level or type of education is relevant or not in your simulation. For example, if your education system is 5-3-4 (5 years of primary education, 3 years of 1<sup>st</sup> cycle of secondary education and 4 years of 2<sup>nd</sup> cycle of secondary education), specify "5" in the cell C2, "3" in the cell C3 and "4" in the cell C6. If vocational education doesn't exist at the level of the 1<sup>st</sup> cycle of secondary education, put "0" in Cell C5. Then click "**Click here for restructuring according to the above information**". EPSSim 2.1 will be restructured according to the information that you have specified (Figure 4.2).

2         Secondary I: General         6         min=2;           3         Secondary I: Technical         6         min=2;	and the second se
1     Primary Education     9     min=4; i       2     Secondary I: General     6     min=2; i	
	max=9
	max=6
	max=6
4 Secondary I: Vocational 6 min=2; r	max=6
5 Secondary II: General 6 min=2;	max=6
5         Secondary II: General         6         min=2; n           6         Secondary II: Technical         6         min=2; n           7         Secondary II: Vocational         6         min=2; n	max=6
3 7 Secondary II: Vocational 6 min=2; r	max=6
	max=6
0	

Figure 4.2 Structuring the model according to your education system

**Note**: The restructuring of EPSSim 2.1 is done by hiding the unnecessary rows (grades of each level or type of education) in the corresponding worksheets. For example, according to the above instructions, if you open PRIM, the simulation part (the worksheet) for primary education (EPS Simulation | Simulation/Projections | Primary Education), you will notice that the rows 65-68 (as well as other concerned rows) have been hidden. In order to physically delete these unnecessary rows, select the whole worksheet (clicking the upper left-hand corner as in Figure 4.3), then unhide all the rows (Format | Row | Unhide). The next step is to select the unnecessary rows (for example rows 65-68), click the right button of your mouse and choose Delete. You can repeat this operation as many times as necessary.

**Flow rates**: This utility enables you to calculate the flow rates (promotion, repetition and dropout rates). To this end, enter the enrolment data of two consecutive years and the number of repeaters in the second year in the blue-coloured cells. The flow rates of your education systems will be displayed in columns L through Q (see Figure 4.4).

#### Figure 4.3 Selecting the whole worksheet

:	Eile	Edit	⊻iew	Insert	Format	Tools	Data	<u>W</u> indow	EPS Simula
	A1		•	fx	PRIMAR <sup>®</sup>	( EDUC	ATION		
			A		В	С	D	E	F
	PRIM/	ARY E	DUCAT	ION				15	
2	Ob	ta Colur	nn Only						
3	⊖ H∎	no colu	mns Only			Target	Annual	Baseline	
4	1 Y Y		-		Hypotheses	number	increace	2001	2002
	LCC Da	ita îv Hile	o Colum	ns Onlu	riypoureses	number	Increase	2001	2002
5		ita & Hỹp Sw. All Ci	lo Colum olumns	ns Only	(Decision)			2001	2002
				ns Only					
5		ou All C	olumns	ns Only				2002	2003
5 50 51 52	<u>íð Shr</u>	Male	olumns	ns Only				<b>2002</b> 1 120 000	<b>2003</b> 1 170 296
5 50 51	<u>íð Shr</u>	Male Female	olumns	ns Only				<b>2002</b> 1 120 000 1 120 000	<b>2003</b> 1 170 296 1 158 935
5 50 51 52	<u>íð Shr</u>	Male Female ivate	olumos	ns Only				<b>2002</b> 1 120 000 1 120 000 22 400	2003 1 170 296 1 158 935 31 477

#### Figure 4.4 Calculating the flow rates

	A1 🔹	∱ STUDENT	FLOWS												
1	A	BC	D	E	F	G	H	1	J	K L	M	N	0	P	Q
1	STUDENT FLOWS	2001													
2															
3															
4	and the second second						1.1								
5	Level 1	Humbers	: Enrolme			Repetition		Promotio	n	Flow Rates			2001		
6		2001		2002		2002		2001	1.0	Promotion		Repetition		Dropout	
7		M	F	M	F	M	F	M	F	M	F	М	F	M	F
8	Grade 1	20 1 94	19 052	21 894	20 920	1 357	1 344	17 448	16 345	86,4%	85,8%	6,7%	7,1%	6,9%	7,2%
9	Grade 2	18 770	17 671	18 779	17 677	1 331	1 332	16 097	15 044	85,8%	85,1%	7,1%	7,5%	7,1%	7,3%
10	Grade 3	17 436	16 357	17 424	16 363	1 327	1 319	14 926	13 914	85,6%	85,1%	7,6%	8,1%	6,8%	6,9%
11	Grade 4	16 243	15 226	16 250	15 232	1 324	1 318	13 798	12 821	84,9%	84,2%	8,2%	8,7%	6,9%	7,1%
12	Grade 5	15104	14 129	15113	14133	1 315	1 312	11 237	10 358	74,4%	73,3%	8,7%	9,3%	16,9%	17,4%
13	Grade 6							0	0	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
14	Grade 7							0	0	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
15	Grade 8							0.	0	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
16	Grade 9							0	0	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
17		11 237	10 358												

**Cohort Analysis**<sup>2</sup>: This utility (Figure 4.5) enables you to calculate a number of indicators showing the efficiency of your education system by means of the technique of the reconstituted cohort analysis. To this end, specify the required information in the yellow-coloured cells (A3 to A5), click **Start/Restart**, then fill in the blue-coloured cells. This operation will compute and display several efficiency-related indicators.

<sup>&</sup>lt;sup>2</sup> Cohort analysis using flow diagrams is useful to calculate indicators of internal efficiency. A school cohort is a group of pupils who join the first grade of a given cycle or level of education in the same year and subsequently experience the events of promotion, repetition or dropout. Cohort analysis traces the flow of such group of pupils who enter the first grade in the same year as they progress through the given cycle or level of education. In particular, it can help calculate wastages rates due to dropout or repetition, survival rates and the coefficient of efficiency.

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	A1 🔻	r <i>f</i> ∡ Internal Efficie	ency according t	o the Student C	ohort Analysis			
	A	В	C	D	E	F	Ĺ	М
1	Internal Ef	ficiency according	to the Stude	nt Cohort Ai	nalysis			
2	Sta	art/Restart	<= Click here	e when the y	ellow cells (	A3 to A5) a	re comple	ted
3	2003	<= Please specify the start year	r					
4		<= Please specify the number of		( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( )				
5	3	<= Please specify the number of	of repetitions allowed	1				
6		4	1 000					
7								
8	Үеаг		Grade 1	Grade 2	Grade 3	Grade 4	Graduates	Total
9								2.
10	2003	Enrolments						0
11	2004	Enrolments						0
12		Repeters						0
13	2003	Promotion rate	0,0%	0,0%	0,0%	0,0%		
14	(Flow rates)	Repetition rate	0,0%	0,0%	0,0%	0,0%		
15		Dropout rate	0,0%	0,0%	0,0%	0,0%		
16								
17	Male / Female	Promoted	0	0	0	0	0	
18		Repeaters	0	0	0	0		
19		Dropouts	0	0	0	0		
20								
21		Internal efficiency	100					
22			6					
23		(Assumption: if 1000 stude	nts enrolled in Gra	ide 1)				
24		Total output	0					
25		Total pupil-year	0					
26		Total drop-outs	0					

#### Figure 4.5 Worksheet on student cohort analysis

#### Figure 4.6 Sprague multipliers

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		A		B	Age-y	С		D		E		F
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						spra	gue N	Iultiplier	<u>'S</u>			
		9	Star	t		:	Prin	t			Clea	ır
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3												
4	0-4											
5	5-9											
6	10-1											
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8	20-2	4										
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12	0										-	
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14	2											
15	3											
16	4											
17	5											
18	6											
19 20	78											
20	9											
21	10											

- **Sprague Multipliers**: This utility (Figure 4.6) uses Sprague Multipliers to calculate age-specific populations when the population data are only available by age-group (most frequently by 5-year groupings). To this end, click **Start**, enter age-group population data, then click **OK** in order to obtain age-specific population data.
- **HIV/AIDS**: This is an example of how to calculate the impact of HIV/AIDS in the education system. This methodology is not exclusive. Many other methodologies are applied in different countries. However, this utility demonstrates that if there are pupil- and/or staff-related data on HIV/AIDS, one can calculate the financial impact of this pandemic on the education system. To enter this utility, choose EPS Simulation | Utilities | HIV/AIDS.

:2)	Eile	Edit	<u>V</u> iew	Insert	F <u>o</u> rmat	<u>T</u> ools	<u>D</u> ata	<u>W</u> indow	EPS Simulation	Help
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1	Level	Cap	otion					Po	sition/Macro	Divider
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7	2	Pre-	Simula	ation &E	Exercise					TRUE
8	3	Pro	blem S	tatemei	nt &1				EXERO	
9	3	Pop	ulation	Data 8	2				DataEXER	
10	3	Sim	ulation	8.3				F	ResultEXER	
11				on Data						TRUE
12	3	Pop	ulation	Project	tions &1			[	Obase_Pop	

#### Figure 4.7 Customizing menu items

**Show Menu Sheet**: This utility, displayed in Figure 4.7, enables you to customize the drop-down menu of **EPS Simulation** according to the specific terminology used in your education system (for example, 'Elementary Education' instead of 'Primary Education'). To open it, choose EPS Simulation | Utilities | Show Menu Sheet. Under the column A (Level), the numbers mean (in the drop-down menu) the main menu for 1, menu item for 2 and submenu item for 3. Under the column B (Caption), the texts are the captions (headings) that actually appear on the **EPS Simulation** menu. Column C contains the macros, while Column D states whether there is a divider (True) or not (blank) between the submenu items.

#### <u>Macros</u>

A number of macros have been designed to improve the user-friendliness of EPSSim and to automate the consultation of the projected results. The macros are made possible by means of Visual Basic for Applications (VBA)<sup>3</sup>, scripted on the Visual Basic Editor, which is accessed by choosing Tools | Macro | Visual Basic Editor. The three typical elements of Excel Visual Basic Editor are (i) Microsoft Excel Objects, (ii) Forms, and (iii) Modules. Figure 4.8 is the typical presentation of the Visual Basic Editor.

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Figure 4.8 Screen of the Visual Basic Editor

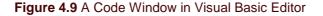
**Note**: A macro is a set of codified instructions that are scripted, saved, and typically assigned to a short key. In other words, it is a short programme written to automate several and/or repetitive steps. Macros can be found in many types of software, such as spreadsheets and word processing. They consist of a list of several operations saved in a file which can be called up from within e.g. the Excel programme. When called up by a single word or even a single letter, the entire list of specified operations is executed.

Tip: If you want to change some of the macros, first you have to identify the name of the concerned macro programme by opening the worksheet entitled

<sup>&</sup>lt;sup>3</sup> VBA stands for Visual Basic for Applications, the official name of which is *Visual Basic, Applications Edition.* VBA is Microsoft's common application programming (macro) language for Access, Excel, and the Visual Basic programming environment.

MenuSheet (EPS Simulation | Utilities | Show Menu Sheet). Then, look for the names of the macros under Column C against the captions (menu items) listed under Column B. For example, the name of the macro for generating a scenario is StartScen located in Cell C47. Once you have identified the name of the particular macro, access the Visual Basic Editor (Tools | Macro | Visual Basic Editor) and click Modules. Look for the name of the macro which usually starts with "Sub MacroName()" and ends by "End Sub". For example, with regard to the macro StartScen, it is a programme batch starting with Sub StartScen() ... and ending with Sub End, as shown below:

```
Sub StartScen()
Set D13 = ThisWorkbook.DialogSheets("D13")
'Set up the defaults (values used if user clicks Finish
early)
D13.EditBoxes("EditName").Text = ""
D13.EditBoxes("Edit Box 13").Text = ""
ShowDialog3
End Sub
```



(General) Scenario_View
' Show DialogBox and calculate Macro
Sub ShowDialog()
DialogSheets("Dialog1").EditBoxes(1).Text = Null
DialogSheets("Dialog1").EditBoxes(2).Text = Null
DialogSheets("Dialog1").EditBoxes(3).Text = Null
DialogSheets("Dialog1").EditBoxes(4).Text = Null
DialogSheets("Dialog1").EditBoxes(5).Text = Null
If DialogSheets("Dialog1").Show Then
Sheets("Sprague").Cells(4, 28) = DialogSheets("Dialog1").EditBoxes(1).Text
Sheets("Sprague").Cells(5, 28) = DialogSheets("Dialog1").EditBoxes(2).Text
Sheets("Sprague").Cells(6, 28) = DialogSheets("Dialog1").EditBoxes(3).Text
Sheets("Sprague").Cells(7, 28) = DialogSheets("Dialog1").EditBoxes(4).Text
Sheets("Sprague").Cells(8, 28) = DialogSheets("Dialog1").EditBoxes(5).Text
End If
Range ("A1").Select
Calculate
Call Scenario View
End Sub

Those who wish to learn more about VBA should refer to <u>www.microsoft.com</u> or the many other available sources (website, documents or tutorials) dealing with VBA. Figure 4.9 is an example of a macro, used to facilitate data entry using Sprague Multipliers.

## Frequently asked questions (FAQs)

#### The menu EPS Simulation disappeared ...

It happens when there has been a mistake (though benign) on your part. In order to make the menu appear again, go to "Start" worksheet, scroll down to Cell A40, then click "Create Menu". You can make it disappear by clicking "Delete Menu".

#### View all or part hidden worksheets...

If you would like to display part or most of the worksheets of EPSSim 2.1, go to "Start" worksheet, scroll down to Row 40, then click "All visible". You can hide all the open worksheets again by clicking "All invisible". Another possibility is to use the Excel built-in macro (Format | Sheet | Hide or Unhide...)

#### Change the menu items or titles...

It's pretty easy. Choose EPS Simulation | Utilities | Show Menu Sheet. Under Column B, change the captions as you like, then click "Create Menu" in the Cell A40 of the "Start" worksheet. For example, in order to change the heading of the main menu "EPS Simulation" to "EFA Simulation", go to the cell B2 of "MenuSheet", change "&EPS Simulation" to "&EFA Simulation" (& means an underlined character (shortcut) in a menu item), click "Create Menu" in the Cell A40 of the "Start" worksheet. A new name "<u>E</u>FA Simulation" will appear on the Menu Bar.

#### Create/delete menu...

See above "The menu EPS Simulation disappeared ..."

## EPSSim has been opened, but no EPS Simulation menu was created on the Bar Menu...

If EPSSim opens without prompting the Security Warning, it means that the security level of the Excel programme is not defined as "Medium" and that the model was opened without enabling the necessary macros. In order to activate macros, choose, on the Menu Bar of the Excel programme, Tools | Macro | Security... The Security Level to be selected is Medium. You need to reopen the Excel programme and the simulation model as well, in order to use EPSSim properly. When you open the model, you choose "Enable Macros".

## Annex

# Most frequently used indicators in education simulation models: definitions and formulae

#### **ENROLMENT RATIOS**

**Gross enrolment ratio:** Total enrolment in a specific level of education, regardless of age, expressed as a percentage of the eligible official school-age population corresponding to the same level of education in a given school-year. The ratio is calculated by dividing the number of pupils (or students) enrolled in a given level of education regardless of age by the population of the age-group which officially corresponds to the given level of education.

Formula:

$$GER_h^{t} = \frac{E_h^{t}}{P_{h,a}^{t}}$$

Where:

 $GER_{h}^{t}$  = Gross Enrolment Ratio at level of education *h* in school-year *t* 

 $E_{h}^{t}$  = Enrolment at the level of education *h* in school-year *t* 

 $P_{h,a}^{t}$  = Population in age-group *a* which officially corresponds to the level of education *h* in school-year *t* 

**Net enrolment ratio:** Enrolment of the official age-group for a given level of education expressed as a percentage of the corresponding population. It is computed by dividing the number of pupils enrolled who are of the official age-group for a given level of education by the population for the same age-group.

Formula:

$$NER_{h}^{t} = \frac{E_{h,a}^{t}}{P_{h,a}^{t}}$$

Where:

 $NER_{h}^{t}$  = Net Enrolment Ratio at level of education *h* in school-year *t* 

 $E_{h,a}^{t}$  = Enrolment of the population of age-group a at level of education *h* in schoolyear *t* 

 $P_{h,a}^{t}$  = Population in age-group *a*, which officially corresponds to level of education *h* in school-year *t* 

Age specific enrolment ratio: Percentage of the population of a specific age enrolled, irrespective of the level of education. To calculate this ratio, divide the number of pupils (or students) of a specific age enrolled in educational institutions at all levels of education by the

population of the same age.

Formula:

$$ASER_a^{\ t} = \frac{E_a^{\ t}}{P_a^{\ t}}$$

Where:

 $ASER_a^t$  = Age Specific Enrolment Ratio of the population of age *a* in school-year *t* 

 $E_a^{t}$  = Enrolment of the population of age *a* in school-year *t*.

 $P_a^t$  = Population of age *a* in school-year *t* 

#### **INTAKE (ADMISSION) RATES**

**Apparent (gross) intake rate:** Total number of new entrants in the first grade of primary education, regardless of age, expressed as a percentage of the population at the official primary school-entrance age. The rate is calculated by dividing the number of new entrants in grade 1, irrespective of age, by the population of official school-entrance age.

Formula:

$$GIR^{t} = \frac{N^{t}}{P_{a}^{t}}$$

Where:

 $GIR^{t}$  = Gross (Apparent) Intake Rate in school-year t

 $N^{t}$  = Number of new entrants in the first grade of primary education, in school-year *t* 

 $P_a^{t}$  = Population of official primary school entrance-age *a*, in school-year *t*.

**Net intake rate:** New entrants in the first grade of primary education who are of the official primary school-entrance age, expressed as a percentage of the population of the same age. It is calculated by dividing the number of children of official primary school-entrance age who enter the first grade of primary education by the population of the same age.

Formula:

$$NIR^{t} = \frac{N_a^{t}}{P_a^{t}}$$

Where:

 $NIR^{t}$  = Net Intake Rate in school-year *t*.

 $N_a^{t}$  = Number of children of official primary school-entrance age *a* who enter the first grade of primary education, in school-year *t*.

 $P_a^{t}$  = Population of official primary school-entrance age a, in school-year *t*.

#### FLOW AND TRANSITION RATES

**Promotion rate:** The proportion of pupils enrolled in a given grade at a given school-year who will at the beginning of the following school-year, be enrolled in the next higher grade. There are two possible ways of calculating this indicator, depending on the availability of data on the number of promotees by grade. If such data are available, "Formula 1" can be used, in which case, the number of promotees by grade in school-year *t*+1 is divided by the number of pupils enrolled in the corresponding grade in school-year *t*. Otherwise, "Formula 2" is used when data on the number of promotees by grade are not available; the number of repeaters by grade in school-year *t*+1 are deducted from the number of pupils enrolled in the corresponding school-year and the difference is then divided by the number of pupils enrolled in corresponding grade in school-year *t*.

Formulas:

$$p_{i}^{t} = \frac{p_{i+1}^{t+1}}{E_{i}^{t}}$$
  
or  
$$p_{i}^{t} = \frac{E_{i+1}^{t+1} - R_{i+1}^{t+1}}{E_{i}^{t}}$$

Where:

 $p_i^{t} = \text{Promotion Rate at grade } i \text{ in school-year } t$   $p_{i+1}^{t+1} = \text{number of pupils promoted to grade } i+1 \text{ in school-year } t+1$   $E_{i+1}^{t+1} = \text{number of pupils enrolled in grade } i+1 \text{ in school-year } t+1$   $R_{i+1}^{t} = \text{number of pupils repeating grade } i+1 \text{ in school-year } t+1$  $E_i^{t} = \text{number of pupils enrolled in grade } i, \text{ in school-year } t.$ 

**Repetition rate:** Proportion of pupils from a cohort enrolled in a given grade at a given schoolyear who study in the same grade in the following school-year. To calculate it, divide the number of repeaters in a given grade in school-year t+1 by the number of pupils from the same cohort enrolled in the same grade in the previous school-year t.

Formula:

$$r_i^t = \frac{R_i^{t+1}}{E_i^t}$$

Where:

 $r_i^{t}$  = Repetition Rate at grade *i* in school-year *t*  $R_i^{t+i}$  = number of pupils repeating grade *i*, in school-year *t*+1  $E_i^{t}$  = number of pupils enrolled in grade *i*, in school-year *t*.

Dropout rate: It is the proportion of pupils leaving school without completing a given grade in a

given school-year expressed as a percentage of those who were enrolled at the same grade in the beginning of the same grade in the beginning of the same school-year. There are two possible ways of calculating this indicator, depending on the availability of data on the number of drop-outs by grade. If such data are available, "Formula 1" can be used, in which case, number of drop-outs by grade in school-year *t* is divided by the number of pupils enrolled in the corresponding grade in school-year *t*. Otherwise, "Formula 2" is used when data on the number of dropouts are not available; the number of repeaters and promotees by grade in school-year *t*+1 are deducted from the number of pupils enrolled in the corresponding grade in school-year *t*.

Formula (2):

$$d_{i}^{t} = \frac{E_{i}^{t} - (R_{i}^{t+1} + P_{i+1}^{t+1})}{E_{i}^{t}}$$

Where:

 $d_i^{t}$  = Dropout Rate at grade *i* in school-year *t*  $E_i^{t} - (R_i^{t+1} + P_{i+1}^{t+1})$  = number of pupils dropping out from grade *i* in school-year *t* 

**Transition rates:** The number of pupils (or students) admitted to the first grade of a higher level of education in a given year, expressed as a percentage of the number of pupils (or students) enrolled in the final grade of the lower level of education in the previous year. To calculate this rate, divide the number of new entrants in the first grade of the specified higher cycle or level of education by the number of pupils who were enrolled in the final grade of the preceding cycle or level of education in the previous school year.

Formula:

$$TR_{h,h+1}^{t} = \frac{E_{h+1,1}^{t+1} - R_{h+1,1}^{t+1}}{E_{h,n}^{t}}$$

Where:

 $TR_{h,h+1}^{t}$  =Transition rate (from cycle or level of education *h* to *h*+1 in school year *t*)

 $E_{h+1,1}^{t+1}$  = number of pupils enrolled in the first grade at level of education *h*+1 in school-year *t*+1

 $R_{h+1,1}^{t+1}$  = number of pupils repeating the first grade at level of education *h*+1 in school-year *t*+1

 $E_{h,n}^{t}$  = number of pupils enrolled in final grade *n* at level of education *h* in school year *t*.

#### **OUTPUTS AND EFFICIENCY OF THE SYSTEM**

**Gross completion rate:** The total number of students completing (or graduating from) the final year of primary or secondary education, regardless of age, expressed as a percentage of the population of the official primary or secondary graduation age. It can be calculated by dividing the number of students completing (or graduating from) the final year of primary or secondary

education by the population at the official graduation age.

Formula:

$$GCR_h^{t} = \frac{C_h^{t}}{P_{h,a}^{t}}$$

Where:

 $GCR_{h}^{t}$  = Gross Completion Rate at level of education *h* in school-year *t* 

 $C_h^t$  = number of students completing (or graduating from) the final year of primary or secondary education *h* in school-year *t* 

 $P_{h,a}^{t}$  = Population at the official graduation age *a* which officially corresponds to the level of primary or secondary education *h* in school-year *t* 

In fact, in the absence of information on graduates, the completion rate is often proxied by the following formula (here applied to the primary case):

**Survival rates by grade:** Percentage of a cohort of pupils (or students) enrolled in the first grade of a given level or cycle of education in a given school-year who are expected to reach successive grades. Calculate it by dividing the total number of pupils belonging to a school-cohort who reached each successive grade of the specified level of education by the number of pupils in the school-cohort i.e. those originally enrolled in the first grade of primary education.

Formula:

$$SR_{g,i}^{\ \ k} = \frac{\sum_{t=1}^{m} P_{g,i}^{t}}{E_{g}^{k}}$$

Where:

 $P_{g,i}^{\ t} = E_{g,i+1}^{\ t+1} - R_{g,i+1}^{\ t+1}$ 

i = grade (1, 2, 3, ..., n) t = year (1, 2, 3, ..., m) g = pupil-cohort.

 $SR_{g,i}^{k}$  = Survival Rate of pupil-cohort g at grade *i* for a reference year k  $E_{\sigma}^{k}$  = Total number of pupils belonging to a cohort g at a reference year k

 $P_{g,i}^{t}$  = Promotees from  $E_g^k$  who would join successive grades *i* throughout successive years *t*.

 $R_i^t$  = Number of pupils repeating grade *i* in school-year *t*.

**Coefficient of efficiency:** The ideal (optimal) number of pupil-years required (i.e. in the absence of repetition and drop-out) to produce a number of graduates from a given school-cohort for a cycle or level of education expressed as a percentage of the actual number of pupil-

years spent to produce the same number of graduates. Input-output ratio, which is the reciprocal of the coefficient of efficiency, is often used as an alternative. *N*.B. One school-year spent in a grade by a pupil is counted as one pupil-year. This indicator can be calculated by dividing the ideal number of pupil-years required to produce a number of graduates from a given school-cohort for the specified level of education, by the actual number of pupil-years spent to produce the same number of graduates.

Formula:

$$CE_{g} = \frac{\sum_{j=n}^{n+k} G_{g,j}^{t} * n}{\left\{\sum_{j=n}^{n+k} G_{g,j}^{t} * j\right\} + \left\{\sum_{j=1}^{n+k} D_{g,j}^{t} * j\right\}}$$

Where:

 $CE_{\sigma}$  = Coefficient of Efficiency for a pupil-cohort g

 $G_{g,n}$  = the number of pupils graduating from cohort g in final grade *n* after *n* years of study (without repetition)

 $G_{g,j}$  = the number of pupils graduating from cohort g in final grade *n* after *j* years of study

 $D_{{\rm g},j}\,$  = the number of pupils (of the cohort g) dropping out after j years of study

k denotes the number of repetitions allowed;

n the prescribed normal duration of study for a cycle or level of education;

g the pupil-cohort; and

*j* the number of years of study.

**Years-input per graduate:** The estimated average number of pupil-years spent by pupils (or students) from a given cohort who graduate from a given cycle or level of education, taking into account the pupil-years wasted due to drop-out and repetition. *N*.B. One school-year spent in a grade by a pupil is equal to one pupil-year. To calculate this indicator, divide the total number of pupil-years spent by a pupil-cohort (graduates plus drop-outs) in the specified level of education by the sum of successive batch of graduates belonging to the same cohort.

Formula:

$$YIG_{g} = \frac{\left\{\sum_{j=n}^{n+k} G_{g,j} * j\right\} + \left\{\sum_{j=1}^{n+k} D_{g,j} * j\right\}}{\sum_{j=n}^{n+k} G_{g,j}}$$

Where:

 $YIG_{g}$  = Years input per graduate (for graduates belonging to cohort g)

 $G_{g,i}$  = Graduates from cohort g after *j* years of study

 $D_{g,j}$  = drop-outs from cohort g after *j* years of study

k denotes the number of repetitions allowed; *n* the prescribed normal duration of study for a cycle or level of education; g the pupil-cohort; and *j* the number of years of study.

**Average duration of studies per graduate:** The estimated average number of years taken by graduates to graduate from a given school cohort in a cycle or level of education. The calculation can be done by dividing the sum of the products of the number of graduates by number of *n* years spent in a given school cohort in a cycle or level of education by the number of graduates in the corresponding school cohort and cycle or level of education and express the result in number of years. *N*.B. one year spent in a grade by a pupil is equal to one pupil-year.

Formula:

$$ADSG = \frac{\sum_{i=n}^{n+k} G_i * i}{\sum_{i=n}^{n+k} G_i}$$

Where:

 $G_n$  = Graduates after *n* years of study

 $G_{n+1}$  = Graduates after *n*+1 years of study

 $G_{n+k}$  = Graduates after *n+k* years of study

$$G = \sum_{i=n}^{n+k} G_i^{-}$$
 = Total number of graduates

**Average duration of studies per dropout:** The estimated average number of years dropouts from a given school cohort in a level of education, stayed at school before dropping out. To calculate this indicator, divide the total number of years (pupil-years) during which drop-outs from a given school cohort and in a level or cycle of education stayed in a school before leaving by the number of drop-outs in corresponding school cohort and level or cycle of education and express the result in numbers of years. *N*.B. one year spent in a grade by a pupil is equal to one pupil-year.

Formula:

$$ADSD = \frac{\sum_{i=n}^{n+k} D_i * i}{\sum_{i=n}^{n+k} D_i}$$

Where:

 $D_i$  = Dropouts after *i* years of study

$$D_{n+k}$$
 = Dropouts after *n+k* years of study

$$D = \sum_{i=n}^{n+\kappa} D_i$$
 = Total number of dropouts

Average duration of studies for the cohort: The estimated average number of years required to graduate a pupil/student from a given school cohort in a cycle or level of education. This can be calculated by dividing the sum of the total number of pupil-years taken by pupils from a given school cohort and in a level or cycle of education to graduate and the total pupil-years during which drop-outs stayed in school before leaving by the sum of the number of graduates and drop-outs in corresponding school cohort and level or cycle of education and express the result in numbers of years. N.B. one year spent in a grade by a pupil is equal to one pupil-year.

Formula:

 $ADSC = \frac{ADSG * G + ADSD * D}{1000}$ 

Where:

ADSG= Average duration of studies per graduate ADSD= Average duration of studies per dropout See above.

**Proportion of total wastage spent on dropout:** The proportion of total number of pupil/years wasted due to drop out of school from a given cohort in cycle or level of education. This proportion is calculated by dividing the total number of pupil-years wasted by pupils who drop out from a given school cohort and in a level or cycle by the sum of the total number of pupil-years wasted by both the former and the pupils who repeat grades in the corresponding school and level or cycle of education (i.e. the excess of pupil-years wasted on the repetition and dropouts) and multiply the result by 100.*N*.B. one year spent in a grade by a pupil is equal to one pupil-year.

Formula:

$$PTWSD = \frac{\sum_{i=1}^{n} D_i * i}{PYEG} * 100\%$$

Where:

PYEG= the excess of pupil-years wasted on the repetition and drop-outs.

**Proportion of total wastage spent on repetition:** The proportion of total number of pupil/years wasted due to repetition of school within a given cohort in a level of education. It is calculated by deducting the PTWSD from 100 and expresses the result as a percentage. *N*.B. one year spent in a grade by a pupil is equal to one pupil-year. The formula below calculates this indicator by deducting PTWSD from 100%.

Formula: PTWSR = (100 - PTWSD)%

Where:

$$PTWSD = \frac{\sum_{i=1}^{n} D_i * i}{PYEG} * 100\%$$

See above.

Adult literacy or illiteracy rates: Adult literacy rate is defined as the percentage of population aged 15 years and over who can both read and write with understanding a short simple statement on his/her everyday life. Adult illiteracy is defined as the percentage of the population aged 15 years and over who cannot both read and write with understanding a short simple statement on his/her everyday life. The adult literacy rate is calculated by dividing the number of literates by the corresponding age-group population. Alternatively, apply the same method using the number of illiterates to derive the illiteracy rate; or by subtracting literacy rate from 100%.

Formula:

$$LIT_{15+}{}^{t} = \frac{L_{15+}{}^{t}}{P_{15+}{}^{t}}$$

or

$$ILL_{15+}^{t} = \frac{I_{15+}^{t}}{P_{15+}^{t}}$$

Where:

 $LIT_{15+}^{t} = \text{Adult Literacy Rate (15+) in year } t$   $ILL_{15+}^{t} = \text{Adult Illiteracy Rate (15+) in year } t$   $L_{15+}^{t} = \text{Adult Literate Population (15+) in year } t$   $I_{15+}^{t} = \text{Adult Illiterate Population (15+) in year } t$   $P_{15+}^{t} = \text{Adult Population (15+) in year } t$ 

$$LIT_{15+}^{t} + ILL_{15+}^{t} = 100\%$$

**Number of adult illiterates:** The population aged 15 years and above who cannot both read and write with understanding a short simple statement on their every day life. To calculate it, either use data on the number of adult illiterates collected during population census or survey or subtract the number of adult literates from the total population aged 15 years and above.

#### TEACHER-RELATED INDICATORS

**Pupil-teacher ratio:** Average number of pupils (students) per teacher at a specific level of education in a given school-year. Teachers are defined as persons whose professional activity involves the transmitting of knowledge, attitudes and skills that are stipulated in a formal curriculum programme to students enrolled in a formal educational institution. The ratio is computed by dividing the total number of pupils enrolled at the specified level of education by the number of teachers at the same level.

Formula:

$$PTR_h^t = \frac{E_h^t}{T_h^t}$$

Where:  $PTR_{h}^{t}$  = Pupil-teacher ratio at level of education *h* in school-year *t*   $E_h^t$  = Total number of pupils or (students) at level of education *h* in school-year *t*  $T_h^t$  = Total number of teachers at level of education *h* in school-year *t*.

**Teachers' emoluments as percentage of public current expenditure on education:** Public expenditure devoted to teachers' emoluments expressed as a percentage of total public current expenditure on education. This is calculated by dividing public current expenditure devoted to teachers' emoluments in a given financial year by the total public current expenditure on education for the same financial year.

Formula:

$$\%TX_t = \frac{TX_t}{PCXE_t}$$

Where:

 $\sqrt[9]{TX_t}$  = Percentage of public current expenditure on education devoted to teachers' emoluments in financial year *t*.

 $TX_t$  = Total public current expenditure on teachers' emoluments in financial year t.

 $PCXE_t$  = Total public current expenditure on education in financial year *t*.

**Teacher requirements** (full-time equivalent): There are two methods : the first is based on the pupil-teacher ratio and the second on the number of teaching hours per week):

• <u>Method based on the pupil-teacher ratio</u> (used most frequently for primary education and to some extent for preschool education and literacy programmes)

Formula:

$$TR^{t} = \frac{E^{t}}{R^{t}}$$

$$R^{t} = R^{0} + t * cr$$

$$NT^{t+1} = (TR^{t+1} - AT^{t+1}) * \delta_{t}$$

Where:

 $TR^{t}$  = number of full-time equivalent teachers required

 $E^{t}$  = total projected number of students

 $R^{t}$  = pupil-teacher ratio

 $R^0$  = initial pupil-teacher ratio

cr = constant annual rate change of pupil-teacher ratio

 $NT^{t+1}$  = number of new teachers required at year *t*+1

 $AT^{t+1}$  = Available teachers by category at year *t*+1

 $\delta_i$  = proportion of new teachers appointed to the category *j* 

• <u>Method based on the number of pupils by class and hours taught by teachers</u> (most frequently used for the levels and cycles of education other than primary education)

Formula:

$$TR^{t} = \frac{E^{t} * H^{t}}{C^{t} * L^{t}}$$
$$C^{t} = C^{0} + t * cc$$

where:

 $TR^{t}$  and  $E^{t}$  are defined above.

 $H^{t}$  = average number of weekly hours per student

 $C^{t}$  = average number of students per class

 $L^{t}$  = average number of weekly hours per full-time teacher

cc = constant annual rate change of average number of students per class

#### **INFRASTRUCTURE-RELATED INDICATORS**

**Pupil-classroom ratio:** The ratio of the number of pupils (students) to the number of classrooms. The ratio is calculated by dividing the number of pupils (students) at a level or cycle of education by the number of classrooms in the corresponding level or cycle of education.

Formula:

$$PCR_h^t = \frac{E_h^t}{C_h^t}$$

Where:

 $PCR_{h}^{t}$  = Pupil-classroom ratio at level of education *h* in school-year *t* 

 $E_{h}^{t}$  = Total number of pupils or (students) at level of education *h* in school-year *t* 

 $C_{h}^{t}$  = Total number of classrooms at level of education *h* in school-year *t*.

**Classroom space utilisation rate:** Percentage of the area of the standard floor space occupied by pupils/students in a classroom. The rate is calculated by dividing the area of floor space of a classroom actually used by pupils/students at a level or cycle of education by the standard floor space which is planned for utilisation by pupils/students in the corresponding level or cycle of education.

Formula:

$$CSUR_{h}^{t} = \frac{A_{h}^{t}}{S_{h}^{t}}$$

Where:

 $CSUR_{h}^{t}$  = Classroom space utilisation rate

 $A_h^t$  = Area of classroom's floor space actually used at *h* level or cycle of education

 $S_h^t$ =Area of the standard classroom's floor space that is planned for utilisation at *h* level or cycle of education

Data required: 1) Number of classrooms 2) Standard and actual area of floor space classrooms are respectively utilized or planned to be utilized.

**Classroom time utilisation rate:** Proportion of hours classrooms are used or occupied for teaching/learning purposes within the total number of standard hours of utilisation. To calculate the rate, divide the number of hours during which classrooms are actually utilised for teaching and learning at a level or cycle of education by the standard numbers of hours classrooms are planned to be used in the corresponding level or cycle of education.

Formula:

$$CTUR_h^t = \frac{H_h^t}{S_h^t}$$

Where:

 $CTUR_{h}^{t}$  = Classroom time utilisation rate

 $H_h^t$  = Number of actual hours classrooms used at *h* level or cycle of education

 $S_h^t$  = Number of standard hours of utilisation of classrooms at *h* level or cycle of education

Data required: 1) Number of classrooms 2) Standard and actual number of hours classrooms are respectively utilised or planned to be utilised.

**Classroom utilisation rate:** The product of the classroom's space and time utilisation rates. Multiply the CTUR (Classroom Space Utilisation Rate) by the CSUR (Classroom Time Utilisation Rate) to calculate this rate.

Formula:  $CUR_{h}^{t} = CSUR_{h}^{t} * CTUR_{h}^{t}$ 

Where:  $CUR_{h}^{t}$  = Classroom utilisation rate

Data required: 1) Number of classrooms 2) Standard and actual number of hours classrooms are respectively utilised or planned to be utilised. 3) Standard and actual area of floor space classrooms are respectively utilized or planned to be utilised.

**Classroom requirements:** Based on the analyses of the projected enrolments and classroom utilization standards, it is possible to calculate future requirements for new constructions by level or cycle of education. This indicator is indispensable when preparing sector plans or programmes/projects related to classroom constructions. It is calculated, especially for primary education level, by dividing the total number of students by the average number of students per classroom. As for the secondary and higher levels of education, classroom requirements are calculated by taking into account the number of (weekly or monthly) learning hours and laboratory-usage hours as well.

Formula:

$$TCR_{d}^{t} = \frac{E_{d}^{t}}{ASC_{d}^{t}}$$
$$NC_{d}^{t} = \frac{\left[E_{d}^{t} - (1 - a) * E_{d}^{t-1}\right]}{ASC_{d}^{t}}$$
$$ASC_{d}^{t} = ASC_{d}^{o} + t * cc$$

Where:

 $E_d^t$  = Total projected number of students, at year *t* and level of education d

 $TCR_d^t$  = total classrooms required, at year *t* and level of education d

 $ASC_{d}^{t}$  = Average number of students per classrooms at year *t*, level of education d

 $NC_d^t$  = new classrooms required, at year *t*, level of education d

a = replacement rate of buildings cc = constant annual rate of change of average of students per classroom 0 = initial year

#### MACRO-ECONOMIC INDICATORS

**Public expenditure on education as percentage of gross national product:** Total public expenditure on education (current and capital) expressed as a percentage of the Gross National Product (GNP) in a given financial year. It can be calculated by dividing total public expenditure on education in a given financial year by the GNP of the country for the corresponding year.

Formula:

$$\%GNP_t = \frac{PXE_t}{GNP_t}$$

Where:

 $\% GNP_t$  = Percentage public expenditure on education in financial year t.

 $PXE_t$  = Total Public expenditure on Education in financial year t.

 $GNP_t$  = Gross National Product in financial year *t*.

Interpretation: In principle a high percentage of GNP devoted to public expenditure on education denotes a high level of attention given to investment in education by the government; and vice versa.

**Public expenditure on education as percentage of total Government expenditure:** Total public expenditure on education (current and capital) expressed as a percentage of total government expenditure in a given financial year. It can be calculated by dividing total public expenditure on education incurred by all government agencies/departments in a given financial year by the total government expenditure for the same financial year.

Formula:

$$\% PXE_t = \frac{PXE_t}{TPX_t}$$

Where:

 $\% PXE_t$  = Public expenditure on education as a percentage of total government expenditure in financial year *t*.

 $PXE_t$  = Total public expenditure on education in financial year t.

 $TPX_{t}$  = Total government expenditure in financial year t.

**Percentage distribution of public current expenditure on education by level:** Public current expenditure for each level of education, expressed as a percentage of total public current expenditure on education. It can be calculated by dividing public current expenditure devoted to each level of education by the total public current expenditure on education.

Formula:

$$\%PCXE_{h}^{t} = \frac{PCXE_{h}^{t}}{\sum_{h=1}^{n} PCXE_{h}^{t}}$$

Where:

 $\% PCXE_h^t$  = Percentage public current expenditures on level of education *h* in financial year *t*.

 $PCXE_{h}^{t}$  = Total public current expenditures on level of education *h* in financial year *t*.

**Public current expenditure per pupil (student) as % of GNP per capita**: Public current expenditure per pupil (or student) at each level of education, expressed as a percentage of GNP per capita in a given financial year. It can be calculated by dividing per pupil public current expenditure on each level of education in a given year by the GNP per capita for the same year.

Formula:

$$%PCXE_{h,GNPc}^{t} = \frac{PCXE_{h}^{t}}{E_{h}^{t}} / \frac{GNP^{t}}{P^{t}}$$

Where:

 $^{0}\!\!/PCXE_{h,GNPc}^{t}$  = Public current expenditure per pupil of education level *h* as percentage of GNP per capita in financial year *t* 

 $PCXE_{h}^{t}$  = Public current expenditure on education level *h* in financial year *t* 

 $GNP^{t}$  = Gross National Product in financial year *t* 

 $E_{h}^{t}$  = Total enrolment in education level *h* in school-year *t* 

 $P^{t}$  = Total national population in year *t*.

Public current expenditure on education as percentage of total public expenditure on education: Public current expenditure on education expressed as a percentage of total public expenditure on education (current and capital) in a given financial year. It can be calculated by dividing public current expenditure on education in a given financial year by the total public expenditure on education for the same financial year.

Formula:

$$\% PCXE_t = \frac{PCXE_t}{TPXE_t}$$

Where:

 $\% PCXE_t$  = Percentage public current expenditure on education in financial year t

 $PCXE_t$  = Total public current expenditure on education in financial year t

 $TPXE_{t}$  = Total public expenditure in financial year t.

#### Total costs (recurrent and capital)

Formula:  

$$C_d^t = RC_d^t + I_d^t$$
  
Where:  
 $t = year$   
 $d = level of education$   
 $C_d^t = Total costs$   
 $RC_d^t = Total recurrent costs$   
 $I_d^t = lnvestment$ 

#### **Recurrent costs**

Formula:  $RC_d^t = CT_d^t + CM_d^t + CA_d^t + CO_d^t$ 

$$CT_{d}^{t} = \sum_{i=1}^{n} \sum_{j=1}^{k} T_{dij}^{t} w_{dij}$$
$$CM_{d}^{t} = E_{d}^{t} * CMPS_{d}$$
$$CA_{d}^{t} = E_{d}^{t} * CAPS_{d}$$
$$CO_{d}^{t} = E_{d}^{t} * COPS_{d}$$

Where:

$$CT_d^t$$
 = Teacher costs  
 $CM_d^t$  = Costs of materials  
 $CA_d^t$  = Administrative costs  
 $CO_d^t$  = Other costs  
 $T_{dij}^t$  = Teachers by category *i* and step *j*  
 $w_{dij}^t$  = salaries by category and step  
 $CMPS_d$  = per pupil cost for materials  
 $CAPS_d$  = per pupil administrative cost  
 $COPS_d$  = per pupil other costs

### **Building (capital) costs**

Formula:  $I_d^t = CBPS * \left[ E_d^t - (1-a) * E_d^{t-1} \right]$ Where:

 $CBPS_d$  = per pupil building cost  $E_d^t$  = Enrolment a = replacement rate of buildings