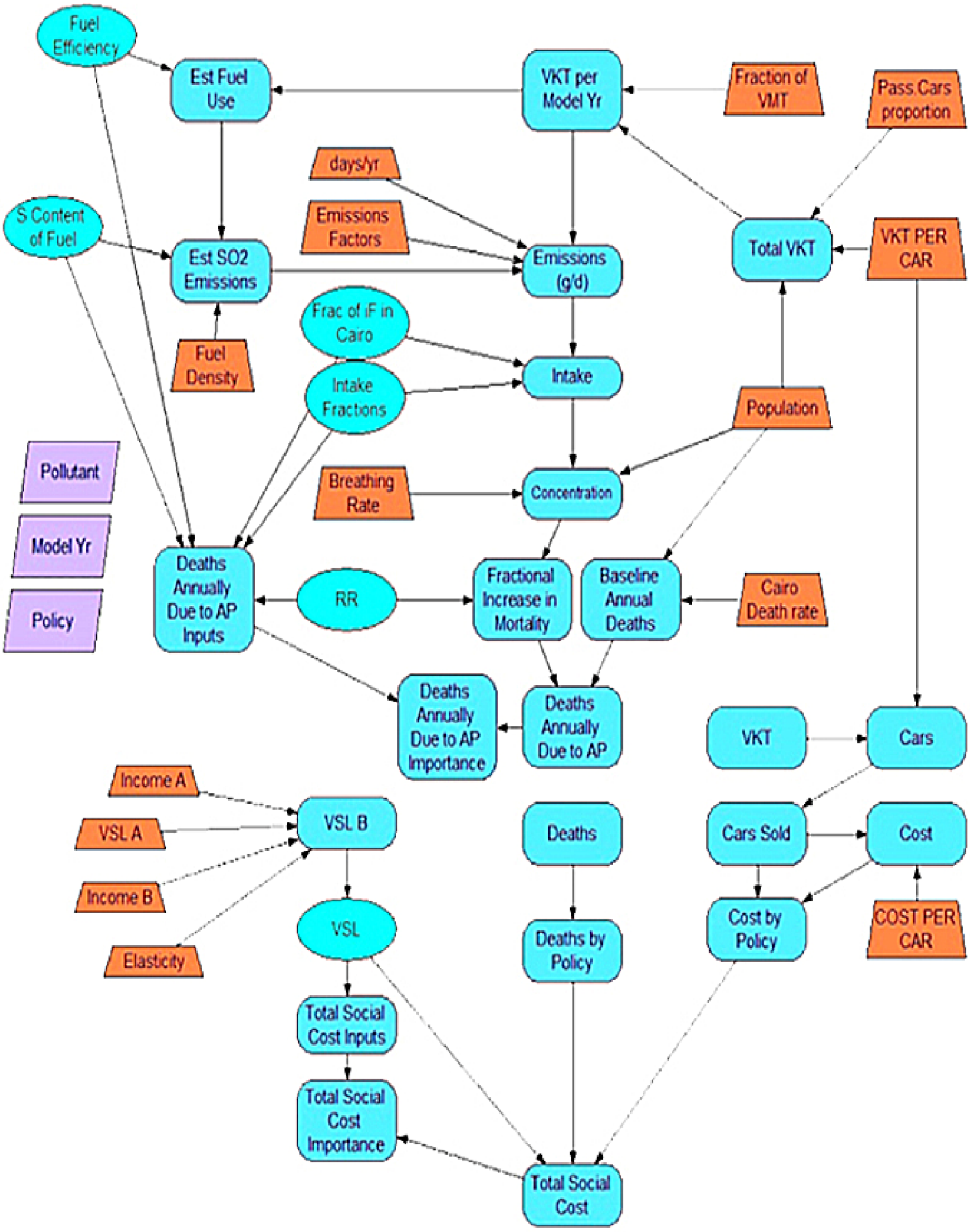
Case-scenarios

In these two upcoming demonstrative risk assessment papers below, we will try to put most of what have been already covered in this session into practice. We will go through simplified examples of a full risk assessment process about environmental problems in certain location. The purpose of these examples as it has just been mentioned is painting a global picture of how to use risk assessment rather than giving definite results on the actual situation in the locations under investigation. In both case-scenarios modeling has been done using Analytica Software (a visual modeling software package). Note that the main objective here is to put an emphasis on the skeleton upon which the two models have been built.

Case scenario one: Effects of Disposal of Outdated Passenger Cars in Cairo

Cairo has always been known to be one of the most densely populated capitals in the world and has weather conditions that make the dispersion factor twice as bad as it is in Los Angles. Traffic is a major source of Particulate Matter emissions. Different model year cars have different emission rates. Exposure to Primary PM2.5, Secondary Sulfur Dioxide and Secondary Nitrogen Oxides has been modeled in this risk assessment process. Valuation of health impacts has been conducted using VSL approach. Results show positive relationship between cars' model year and increased mortality in Cairo.

The flow chart below shows in details every input in the model that has been used. And to best understand it; keep in mind that it follows risk assessment steps. Hazard identification process is not shown in the model as it does not have numerical values, nevertheless; it mainly focuses on the physical and chemical properties of particulate matter. Exposure assessment process starts with calculating the total vehicle kilometers traveled in the area of study and based on the average emission rate for each kilometer traveled by all vehicles the total emitted pollution could be. Does response analysis prime objective in this model is assessing mortality due to exposure to vehicles' exhausts based on their relative risk and intake fraction. Note that in take fraction is "the fraction of a pollutant (or its precursor) emitted from a source that is inhaled by a specified population during a given time (Bennett et al., 2002)". The next step is to introduce different scenarios to the model to reduce emissions in what is known by Control Options which in this case is investigating the cost of scrapping old model-year vehicles and replacing them with newer ones based on the argument that newer vehicles have fewer emissions. The fourth step is to valuing health impacts which is in this case mortality using Value per Statistical Life approach. Last step is risk characterization and decision analysis which is the result of integrating all the parts of the model into one last piece that shows numerically and visually the total social costs of each control option and the best recommended solution.

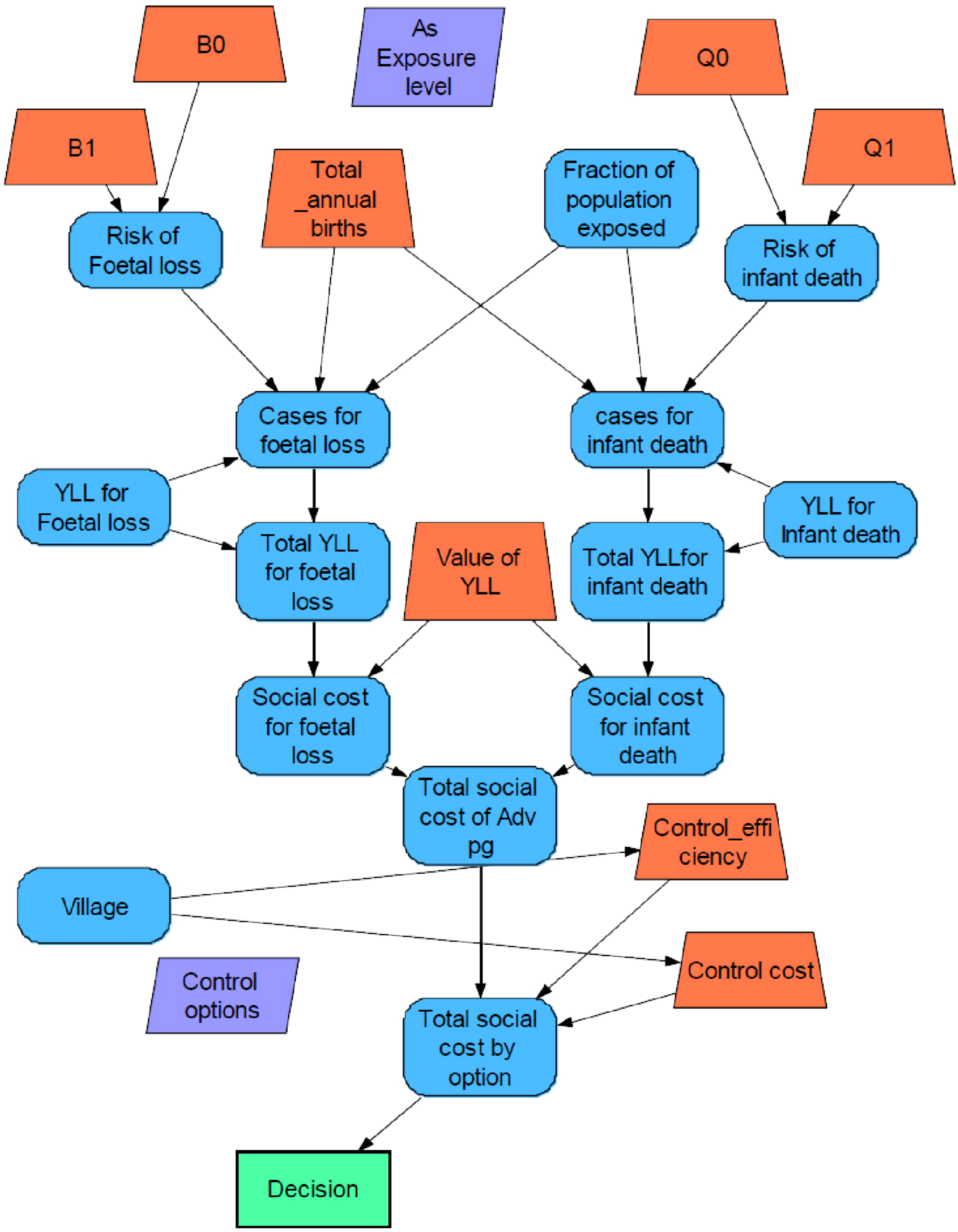


Fuel Efficiency
Est Fuel Use
VKT per Model Yr
Fraction of VMT
Pass.Cars proportion
days/yr
Emissions Factors
S Content of Fuel
Est SO2 Emissions
Emissions (g/d)
Total VKT
VKT PER CAR
Frac of iF in Cairo
Fuel Density
Intake
Intake Fractions
Population
Pollutant
Breathing Rate
Concentration
Model Yr
Deaths Annually Due to AP Inputs
RR
Fractional Increase in Mortality
Baseline Annual Deaths
Cairo Death rate
Policy
Deaths Annually Due to AP Importance
Deaths Annually Due to AP
VKT
Cars
Income A
VSL B
VSL A
Deaths
Cars Sold
Cost
Income B
VSL
Deaths by Policy
Cost by Policy
COST PER CAR
Elasticity
Total Social Cost Inputs
Total Social Cost Importance
Total Social Cost

Case scenario two: Valuing risk of adverse pregnancy outcome through drinking arsenic Contaminated water and control options to reduce the social cost inthe context of Bangladesh

Arsenic is a wide spread environmental contaminant associated with various adverse health effects including adverse pregnancy outcome. The arsenic problem in Bangladesh is more devastating than any other affected countries in the world. For 2000 year's arsenic has been recognized as a human toxicant. This ubiquitous environmental element is associated with variety of adverse health effects. Chronic arsenic exposure is associated with skin lesions, neurological effects, hypertension, peripheral vascular disease, cardiovascular disease, respiratory disease, diabetes mellitus and cancers of internal organs and skin (Ahsan et al., 2006, Chen, 1988, Chen and Ahsan, 2004, Rahman et al., 1998, Rahman et al., 1999, Rahman et al., 2006, Rahman et al., 2005, Wu, 1989). It has been reported that arsenic crosses the placental barrier (Concha G, 1998) and may be associated with negative reproductive outcomes such as spontaneous abortion, still birth, preterm birth, low birth weight, fetal loss and Infant death (Ahmad et al., 2001a, Borzsonyi MB, 1992, Hopenhayn et al., 2003, Hopenhayn-Rich et al., 2000a, Milton et al., 2005a, von Ehrenstein et al., 2006b, Yang et al., 2003a, Aschengrau et al., 1989, Cherry et al., 2008, Mukherjee et al., 2005, Myers et al., 2010, Rahman et al., 2007, Rahman et al., 2009a, Rudnai et al., 2006, Sen and Chaudhuri, 2008, Huyck et al., 2007, Kwok RK, 2006 Jun). Epidemiological studies so far conducted are indicative of negative effects of arsenic on pregnancy outcome and infant survival but there is lack of strong evidence to support these findings conclusively. Qualitative reviews have managed to concentrate pertinent epidemiologic studies on adverse pregnancy outcomes and Arsenic exposures (Vahter, 2008, Vahter, 2009, Rahman et al., 2009c, Smith and Steinmaus, 2009) and showed mixed findings. Carcinogenicity of As is well known and it is classified as a group '1' carcinogen (IARC, 2004). Studies showed causal association between As exposure and cancer of skin and internal organs (IPCS, 2001).

Hazard characterization in this study has been done on two steps. First, the chemical nature and sources of arsenic has been defined. Second, a thorough review of then-available epidemiological studies has been made in order to primarily investigate the non-carcinogenic adverse health effects of arsenic such as reproductive and developmental toxicity. Exposure assessment data that has been used as inputs in the shown below model of this study has been that of BGS survey of tube-wells in Bangladesh (Kinniburgh DG, 2001, Kamalini M. Lokuge, August 2004). In order to make dose-response evaluation, arsenic dose-response relationship for adverse pregnancy outcome from exposure to arsenic through drinking water has been obtained relevant studies in Bangladesh focusing mainly on fetal loss and infant death.The next step was to define the control options and their relative cost and efficiency which revolved around either treatment of arsenic contaminated water or alternative arsenic-free sources, or both. YLL (Years Life Lost) was used as a measure of DALY (Disability adjusted life years) which is an approach widely used in valuing health impacts. Risk characterization and decision analysis were the final stepss in the model and the study in which an integration of all the previous steps has been done in order to reach an estimation of the magnitude of the problem.



B0
As Exposure level
Q0
B1
Total _annual births
Fraction of population exposed
Q1
Risk of Foetal loss
Risk of infant death
Cases for foetal loss
cases for infant death
YLL for Foetal loss
YLL for Infant death
Total YLL for foetal loss
Value of YLL
Total YLLfor infant death
Social cost for foetal loss
Social cost for infant death
Total social cost of Adv pg
Control_effi ciency
Village
Control cost
Control options
Total social cost by option
Decision