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REPORT OF THE

Joint SGRST-SGECA sub-group on

"Further improvements of the EIAA model including long term perspective and effect of recovery plans"

Brussels, 14 – 16, June 2004

This report has been evaluated and endorsed by the STECF at its 19th Plenary Meeting of November 2004

This report does not necessarily reflect the view of the European Commission and in no way anticipates the Commission's future policy in this area.

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1. Summary and recommendations

The economic model EIAA (Economic Interpretation of ACFM Advice) has been developed as part of the concerted action Economic Assessment of European Fisheries (EAEF). It pursues the aim to assess economic repercussions of the proposed TACs by ICES' Advisory Committee of Fisheries Management (ACFM). The EIAA model is 'institutionally' based on the EAEF that ends in 2004. The EIAA model has been constructed to use TAC/quota proposals and fish stock biomasses respectively as variables given from outside to calculate economic indicators for future periods. The design of the EIAA allows for very quick use of the newest biological and economic information provided at the end of October and the STECF meeting in the beginning of November.

The identified **observations and limitations of the model** could be summarized in the following

1) It is assumed that each species is caught separately and not in fixed proportions
2) Prices are calculated with a lag of 2 years
3) It is assumed that each fleet segment catches a constant share of the TAC/quota
4) The model accounts for differences in gross revenue from accountants and gross revenue calculated from landings but does not take discards into account explicitly
5) The model is dependant on data across Member States in terms of time series and the most recent data
6) The model implicitly computes aggregated effort as a best effort approximation of fleets harvesting a portfolio of TAC restricted species using elasticities with uniform values over a range of species and fleet segments
7) The model is enhanced to estimate 'overcapacity' and the impact of 'remuneration' of the fish stocks i.e. resource rent
8) The results are not validated in terms of confidence intervals around the projected results or sensitivity analyses and no comparison between historic projections and the actual economic performance is available
9) In general the model uses the same economic indicators as proposed in the Data Regulation 1639/2001 but different fleet segments
10) The model's long term projections are unrealistic not least because of the assumption of a constant fleet structure.

With reference to the above list of observations the group **recommends** that

1) Inclusion of fixed species proportions in the catches be considered in the model
2) Inclusion of more recent prices be considered
3) Fleet dynamics in terms of changes in fleet segments shares be considered
4) Discard problems be addressed
5) The data provisions and time conditions specified in the Data Collection Regulation (1639/2001) be addressed by the Commission as this may impede the use of the model
6) The use of elasticities be elaborated also with reference item 7
7) 'Over capacity' calculations should be considered to be implemented although not being used currently
8) Sensitivity and stochastic simulations be carried out as well as comparisons of actual performance and projected results
9) The model use of economic indicators and fleet segmentation be brought in line with the Data Collection Regulation which will ensure that the included segments also represent a significant part of the fisheries
10) Development with respect to medium and long run projections have to take fleet dynamics into account as well as improved use of information from market analyses.

The use of the EIAA to assess biological advice under the umbrella of the STECF and actually carried out through its working groups has proved an important element of the necessary framework for economists and biologists to work together in running and developing models to assess not only the socio-economic impact of changes in TACs but also of other management measures. Further improvement will require a carefully constructed programme which has significant resource implications. The programme would be best developed by DG Fisheries on the advice of the STECF and should reflect the breadth of activities in fisheries economics. It is imperative that the institutional framework for the development of economic assessment models does not exclude key participants and institutes.

2. Background

The economic model EIAA (Economic Interpretation of ACFM Advice) has been developed as part of the Concerted Action: Economic Assessment of European Fisheries (EAEF) (QLRT-2000-01502). This concerted action comprised two objectives: to collect costs and earnings data and to use these data in combination with biological information presented by ICES' Advisory Committee of Fisheries Management (ACFM).

The costs and earnings data, however, collected by EAEF and form basis for the EIAA is by nature one year delayed at the time it is collected, processed and disseminated. It was considered in the project how the costs and earnings data could be of used in combination with the TAC and quota proposals for the coming year forwarded by ACFM in such a way that economic consequences of the TAC/quota proposals could be assessed and thereby form basis for final decisions about determination of the quotas.

Therefore, the EIAA model is constructed to make joint use of the costs and earnings data and the information forwarded by ACFM and the Commission services about quotas for the coming year.

In the working group meeting about "Way forward to provide economic advice in fisheries", 8-10 March 2004, the Sub-Group on Economic Assessment (SGECA) of the Scientific, Technical and Economic Committee for Fisheries recommended that economic models for the Northern EU regions and the Southern EU regions be assessed. This recommendation was endorsed by the STECF at its plenary meeting in March/April 2004.

The EIAA model is 'institutionally' based on the Concerted Action project: Economic Assessment of European Fisheries (EAEF - QLRT-2000-01502) that ends at the end of 2004 according to the project plan. Therefore, the EIAA model has no immediate institutional base as well as no database once EAEF ends.

The EIAA model has been used to contribute to or to prepare the following documents:

- The Potential Economic Impact on Selected Fishing Fleet Segments of TACs Proposed by ACFM for 2004 (EIAA-model calculations), Report from SGECA an STECF Ad Hoc Working Group, Brussels 29-31 October 2003. EU Commission Staff Working Paper 20.01.2004 SEC(2004) 61. Commission of the European Communities, Brussels.
- Investigating the Scientific Basis for a follow up to the fourth generation of Multi-annual Guidance Programme (MAGP IV). Report of the SGBRE-STECF Expert working group. Commission Staff Working Paper 20.1.2003 SEC(2003) 74. Commission of the European Communities, Brussels.
- Fleet Dynamics. Report of the SGBRE-STECF Expert working group. Commission Staff Working Paper 17.1.2003 SEC(2003) 73. Commission of the European Communities, Brussels.
- EAFE-AC Report, The Potential Economic Impact on Selected Fishing Fleet Segments of TAC's Proposed by ACFM for 2002 (EIAA-model calculations), European Association of Fisheries Economists Advisory Committee. http://www.eafe-fish.org/notices/notices.htm
- Economic Interpretation of ACFM Advice. Specimen Report No. 3. Application of Extended Methodology. Promotion of Common Methods for Economic Assessment of EU Fisheries Concerted Action (FAIR CT97-3541).

3. Participants

STECF members
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4. Terms of reference

1. Review the objective: To assess economic consequences of TAC/quotas for selected fleet segments in the fishing fleet of the European Communities, the methodology and the type of model that is used for the Economic Interpretation of the ACFM Advice

2. Consider in general short run and long run differences, and in particular with respect to rebuilding of stocks

3. Review the functional form of the model and the approach (output driven)

4. Review the endogenous and the exogenous variables of the model and the parameters

5. Review the data requirements and the uncertainty associated herewith, and assess the possible use of data collected in the Data Collection Regulation N° 1639/2001. Special attention should be given to the report provided by the ECODATA Workshop (Paris, 10-14 May), in particular on economic indicators definitions, fleet segmentation and the use of a threshold by some Member States in respect of some segments (e.g. small-scale fisheries)

6. Review the transparency and the operationality of the model, the interface and the institutional foundation

7. Evaluate advantages and limitations of the model with respect to the model objective and other possible applications

8. Recommend improvements with respect to model structure and software

9. Considerations about institutional foundation of an economic assessment model

10. Identify, examine and comment briefly on other possible operational models delivering economic assessment of biological advice.

11. Other matters

5. Description of the present implementation of the EIAA

5.1. Objective and application

The EIAA model is constructed to pursue the objective: to assess the economic consequences of the TAC proposals formulated by ACFM by making use of the data collected and disseminated in the annual economic reports (AER) produced by the Concerted Action EAEF.

The first versions of the model were developed in the concerted action: Economic Interpretation of ACFM Advice that came into existence under FAIR CT97-3541, 1998-2000. The model was gradually improved when experience was gained and the lay out was changed in 1999 with the aim to make the model more transparent. It was further developed in the subsequent concerted action: 'Economic Assessment of European Fisheries' (QLRT - 2000 – 01502) 2002 – 2004 where the EIAA model reached the format it has now. During this period the data collection improved and expanded to include 20 countries i.e. 17 EU Member States and Iceland, Norway and The Faroe Islands.

Certain time restrictions are imposed as to the use of the model. Ideally, the model should be used *before* next years quotas are agreed, i.e. before the Council of Ministers meets in December and *after* the quota proposals have been forwarded. This time restriction leaves very little time in late October and early November to carry out calculations. Therefore the model set-up takes into account that it should be very easy and quick to use.

By use of base-line information the model projects the economic results for the current year, the coming year, and for a long run case i.e. after stocks have been recovered.

At the time the quotas for the coming year are proposed the available cost information, however, relates to the year before. Therefore, costs and prices are projected two years ahead to compare to the quotas. Further, as calculations take place in October/November the economic result for the current year is unknown. Therefore the model also calculates economic results for the current years. The process as it is viewed in October/November is shown in table 1:

Table 1. Projections and data availability for projections

Data type	**Baseline** (3 years average)	**Current year (October/November)**	**Coming year**	**Long run**
Economic	Costs and earnings Landings of species in volume and value	Not known i.e. calculated by the model	Not known i.e. calculated by the model	Not known i.e calculated by the model
TAC/quota	Known	Known	Known	Estimated
Stock abundance	Estimated for certain stocks	Estimated for certain stocks	Estimated for certain stocks	Estimated for certain stocks

The results of the model calculations are presented for fleet segments – and not 'fisheries' or species as the economic performance of the fishing vessel is the main interest of the fisherman and the industry.

The procedure in time for the use of the EIAA-model in 2003 was as follows:

- Costs and earnings data and preliminary calculations carried out by economist at a working group meeting in Salerno (I) 14-18. October 2003, cf. AER.
- Joint meeting between two STECF sub-groups in Brussels 27-31. October:
    - SGRST (subgroup on Reviews on Stocks)
    - SGECA (subgroup of Economic Assessment)
    - Results submitted to the STECF
- During the STECF meeting in Brussels 3-7. November
    - Interactive model calculations with additional quota input.
    - Results reviewed and summary included in the STECF report

5.2. The use of biological information in the model in terms of TAC and stock abundance

Fleet activity

The EIAA model is output driven contrary to most bio-economic models that are input driven[1]. It uses biological information, TAC proposals and spawning stock biomasses respectively, as exogenous variables to calculate a number of economic indicators for future periods per fleet segment.

The EIAA model does not operate with fishing effort as such but with a fleet activity variable. The model operates with variable costs as a function of estimated fish prices, landings and fish stock abundance so that variable costs in future years are calculated from the variable costs in the base years. Because no strong capacity (input) restrictions prevail currently, and because higher stock abundance (for demersal species in particular) implies higher catch rates it is reasonable to assume that there is sufficient current excess capacity and, therefore, no direct impact on fixed costs.

Changes are considered only within fleet segments, not between segments, i.e. a constant fleet structure is assumed. The calculation of the fleet activity variable consists of three steps. First an

[1] FAO (2004) Measuring and assessing capacity in fisheries. 1. Basic concepts and management options. FAO Fisheries Technical Papers, T 433/1. In this report output driven models are named 'input-based', and input driven models are named 'output-based'.

index is constructed by use of the landings of each species of the fleet segment in the base period multiplied with the predicted future price of each species set relative to the total landings value in the base period (Laspeyres index). The future prices are calculated by use of an inverse demand function including a flexibility exponent (inverse price elasticity). This procedure redistributes the fleet activity on species in accordance with the price estimated for the future period. The rationale behind this is that the fisherman is allowed to react to price changes. The second step calculates an index for the future period taking future landings per species in volume and relates that to current landings per species in volume. The proposed TAC/quotas determine future landings. The third step calculates an index of spawning stock biomasses per species in the future period related to spawning stock biomass per species in the current period. The coefficients of each step are multiplied with each other per species. Finally, this index is aggregated over species and the coefficient is multiplied onto the variable cost of the baseline, see Annex table 1 for an example.

The rationale behind this procedure is an inverse Cobb-Douglas type production function, see Annex 1 for details, which for a single species is:

$$\mathrm{A} = a * \frac{p(TL)L^{\chi}}{X^{\beta}}$$

where

A: fleet activity (effort)
a: coefficient
p: price as a function of aggregate landings TL on EU level
L: landings per segment
X: spawning stock biomass
chi and beta are parameters (flexibilities)

The fleet activity calculation is based on the following values of the flexibilities:

- Price-activity flexibility rates to adjust allocation of activity on species as a function of prices is currently –0.2 in the model (default value)
- Landing-activity flexibility rate to adjust activity as a function landing volume chi (χ) is currently 1 in the model (default value)
- Stock-catch flexibility rate to adjust activity as a function of stock abundance beta (β) is currently 0.1 for pelagic species and 0.6 for demersale species in the model (default values).

Costs

The fishing costs are included in the model in an aggregate fashion that identifies and emphasize short term and long term differences as well the employment aspect. In the short run, variable costs are important, while in the long run fixed costs also have to be covered to keep the vessel in business. Therefore three main cost components are distinguished:

- Variable costs
- Crew share
- Fixed costs

The running (variable) costs of a fleet segment in future years are calculated by adjusting the running cost in the base years by the fleet segment activity variable as calculated in the model.

The crew share is calculated in the model for the base period by taking the costs of the crew relative to the gross revenue.

Fixed costs are divided between fixed operational costs on one-hand and depreciation and interest payments on the other. These are maintained constant throughout time.

5.3. Summarized aspects of the EIAA model

- Developed in an Excel workbook for maximum transparency
- Designed to calculate economic consequences for fleet segments of:
  - Proposed quota scenarios for the current year
  - Proposed quota scenarios for next year
  - Long run situation i.e. long-term TAC (only indicative)
- Uses data input from:
  - The annual Economic Report (AER)
  - Quota proposals for the European Union
  - Information about sustainable biomasses SSB and long-term TAC (ACFM, ICES WG-reports, and other sources e.g. the MTAC model output)
- Requires that
  - The fleet segments examined need to be subject to quotas (or target landings)
  - Knowledge of the catch composition for the national fleet and for each fleet segment
  - Non-quota species are assumed constant in the model
  - The costs and earnings information is from the Annual Economic Report (AER) or in a similar format.
- Model features are partly dynamic by use of elasticities
- Fixed fleet structure i.e. constant fixed costs and number of vessels
- Prices changes of species according to changes in aggregate EU-quotas
- Changes in catch compositions of the fleets according to the proposed TAC/quotas
- Changes in variable costs (fishing effort) according to
  - Changes in species prices
  - Changes in allocated quotas (catch composition)
  - Changes in stock abundances SSB (catch rates)
- Results presented by
  - A classification based on the ratio between net profit (NP) and total (gross) revenue (TR) (the operating profit margin) the classification is as follows:
    - Profitable: NP/TR > 5%.
    - Stable: -5% < NP/TR < 5%
    - Unprofitable: NP/TR < -5%. In this situation fishing cannot continue in the long run
  - And economic indicators:
    - Value of landings
    - Variable costs e.g. fuel, provision, repair
    - Crew share e.g. payment to the crew including skipper
    - Gross cash flow e. g. the value of landings minus variable costs and minus crew share

- Fixed costs e.g. interest payments and depreciation, insurance, administration etc.
- Net result e.g. value of landings minus all costs
- Gross value added (socio-economic indicator) e.g. remuneration of labour and capital (contribution to gross domestic product).

6. Limitations of the present implementation of the EIAA

6.1. EIAA Model Output

The model assumes separate outputs (non-joint production) implying that all species are caught independently of one another. If all or some species are caught in fixed proportions (joint output) information (or assumptions) about fishing activity of the fleet segments are required.

6.2. Information on prices

The model calculates prices per fleet segment of each species subject to quota management in the base case. Price formation should include more extensive market information, since results may be highly sensitive to assumptions regarding price flexibilities in the model. In the short run predictions the input to the price module calculation for the projected year (assessment year +1) is based on a year average of prices, where the most recent year is two years before the projected year (assessment year –1). Possibilities of using more recent prices in the model should be investigated. The availability of annual prices by segment (gear) and species varies by member state, but this may be overcome by using for instance preliminary estimates for the year of assessment together with some historical keys for price variation by segment, species and area.

6.3. Constant fleet segment share

The model uses constant shares of quota species of each segment for the projections into the future. Quota changes will change the catch composition of the segment. However, fleet behaviour between segments in terms of changes in shares cannot be dealt with inside the model in the current version but have to be controlled outside the model by use of exogenous variables that specifies each segments future shares of the quota. Reallocation procedures of less profitable segments' landings to more profitable segments should be considered.

6.4. Misreported landings

The information about earnings (gross revenue) collected from accountants do not always equal gross revenue calculated from information about landings in volume and value. This is explained partly by 'other income' to the vessels (not fishery related) and to misreporting of landings (this being the most important). In the model this problem is dealt with by calculating an adjustment coefficient in the base period taking the proportion of gross revenue (from the accounts) to the values of landing (calculated from the landing composition), which is then used for future period projections. The model does not take discards into account.

6.5. Practical Problems with the data

There is a need for clarification on the timing of the provision of data by member states to the Commission Services under the Data Collection Regulations and its availability to researchers. The Data Collection Regulation (1639/2001 art. 10) limits the time that the Commission may hold data, which has been provided to it, to only 20 days. This restricts the time that researchers have to spend each year on running and developing any models using the data unless permission has been obtained from member states to use the data.

The logistics of the requirement to obtain the permission of all individual Member States to retain the data and use it outside the 20-day window are likely to restrict access and hinder model development and analyses.

Clarification is urgently needed as to when Member States must provide data and for what year. The prospect exists that a number of member states may provide data for one year, while the remainder provide data for the previous or next year, all for use in the 20-day window. If this materialises it could make modelling impossible.

It is obvious that this will have to be corrected if it serves to prevent running and development of economic assessment models.

Because of delay in obtaining appropriate data and the way the EIAA is set up, the base-line economic reference period available in the current year y, is based on a three year average for years y-3 to y-1, and in some cases, y-4 to y-2. This means that to evaluate the likely impact of the TAC in year y+1, we also have to predict the outcome for year y. The best possible case in the future would appear to be that all data are available for years y-3 to y-1. In order to maximise the utility of the EIAA as a predictive tool for fishery economics, The Commission is urged to ensure that Member States make their annual data available by the autumn of the subsequent year.

6.6. Estimating costs and assumptions about fishing effort

A comparison is made between methods that relate effort to fishing mortality (and compute effort per fleet in TAC-based managed fleets) and the method used in the EIAA model to compute effort (activity). For bio-economic models where effort is computed from estimates of fishing mortality, the assumed function between effort and fishing mortality can be used to estimate effort if F is provided. The latter is based on estimating catchability coefficients per species. This approach does not assume constant CPUE across species, or that cost per unit of effort is constant for each species. If this operation is undertaken on a species by species basis then the species dependent effort estimates can be computed. For a fleet targeting several species in an output-based management (TAC) the fleet effort has to be estimated across the species.

The possibilities for effort per fleet that can be calculated are[2]:

- The minimum effort that is the effort to catch one of the species; that is the minimum effort of species dependent effort estimates

[2] Sparre, P. J *et. al.*: TEMAS project, Danish Institute for Fisheries Research; http://www.dfu.min.dk/dk/side4.asp?id=48

- The maximum effort that is the effort to catch one of the species; that is the maximum effort of species dependent effort estimates.

- An average effort across the species; that is sum species dependent effort for all species and divide by number of species. This value for effort should be between the minimum and maximum.

- A computed value between the minimum and maximum constrained by data on observed effort.

The problem is, that none of the above are able to estimate the effort across a fleet exactly, taking into account explicitly the technical interactions that exist. The method above, as a best approximation, either estimates an average or some minimum or maximum. For a particular scenario where the TAC of one species is reduced by a significant magnitude, the use of an average fleet effort or maximum can have far reaching consequences for the species as well as the fishing operation leading, for example, to the potential discarding of the species concerned (with the costs of discarding impacting on the profitability of the fishing trips) and therefore the actual total effort will not be the maximum. These effects will not be included unless they are explicitly modelled.

In the EIAA model, the function for the calculation of effort (an index of effort that assumes every species is taken independently), assumes that there is a constant fleet segment share of each species over time but different catch of each species per unit of effort, and a constant cost per unit of effort for each species if prices and SSBs are constant. In effect, this approach is distributing fleet effort across species as it calculates a catchability index, which assumes the contribution of each species in the base period is equal to the value share of the species in the catch composition. For future periods this catchability index is adjusted as a function of future prices, SSBs and TACs. Thus, as an approximation it is similar in principal to the calculation of fleet effort when using the method, outlined above, which is based on relating effort to fishing mortality.

In the method based on estimating catchabilities, the species dependent effort estimates are weighted by the estimated catchabilities and these will differ for each species. The method is used in the EIAA. A vector for stock abundances is included in the EIAA approach to account for the differences in catchability between the species, see Annex table 1. However, significant changes to the catch compositions will impact on both methods and errors will arise from using the method after these changes in catch composition have occurred. Essentially testing for ‘jointness’ of production means that the elasticity of substitution between the ‘outputs’ (different species catches) needs to be estimated, and taken into account in the model (if data for such an analysis exist).

In summary, both methods are computing aggregated effort as a best approximation of fleet effort for a fleet harvesting a portfolio of species with TAC-based restrictions. The EIAA method is less data intensive as the catchability coefficients are not estimated but obtained by a distribution of variable costs (effort) on species in the same shares as the value share of the species. In comparison, the method of relating effort to fishing mortality is data intensive in that the catchability coefficients need to be estimated.

7. Proposed enhancements to the EIAA and its evaluation

7.1. Overcapacity and resource rent

The EIAA model includes an estimation over-capacity and the impact of remuneration of the fish stocks i.e. resource rent, see Annex 1 for details.

Traditionally, capacity of fishing fleets has been summarised in terms of physical characteristics such as total fleet gross tonnage (e.g. see MAGP requirements). However, in the economic literature, estimation of capacity is considered through the evaluation of how input characteristics (e.g. fixed inputs such as gross tonnage and variable inputs such as days at sea) are used in production of outputs (e.g. catch (value) of specific species). Such a technique has been proposed by the FAO[3] for the measurement of over-capacity in world fisheries.

In the EIAA model, a proxy is included to consider the question of over-capacity[4]. The assumption used is that the gross cash flow required to cover fixed costs represents capacity. Therefore, if this is exceeded then it is assumed that some over-capacity exists.

By use of the break-even concept, defined as the profit (i.e. the gross revenue less variable costs including crew share) required to cover exactly the fixed costs, an estimate of the break-even revenue given the fixed costs is obtained. When the estimated break-even revenue is put relative to the current gross revenue an estimate is obtained for the over capacity and the under capacity respectively. The obtained estimate provides an indication of how much the fixed costs should be changed to comply with the break-even condition i.e. in an over capacity situation the current gross revenue is lower than the break-even revenue and hence current fixed cost are too high.

The inclusion of resource rent is based on the break-even concept and the concept of fixed costs. The model contains information about fish stock abundance in volume that makes it possible to calculate an estimate of the value of the fish stocks if a price on the fish stocks is known. Assuming that fish stocks are remunerated parallel to invested capital in fishing vessels, the payment to the fish stocks could be included in the fleet segments' fixed costs equal to the fixed costs of vessel capital in terms of interest payment and depreciation. Inclusion of such additional costs obviously entails higher fixed costs for the fleet segments and therefore higher over capacity relative to the case where these cost are not included.

Information about over capacity and resource rent is part of the results from the EIAA model, but they are preliminary because further development and theoretical foundation as to how the value of the fish stocks should be estimated is necessary.

7.2. Validating the Results

[3] FAO (2004) Measuring and assessing capacity in fisheries. 1. Basic concepts and management options. FAO Fisheries Technical Papers, T 433/1.

[4] SEC (2003) 74 "Report of the SGBRE-STECF Expert working group on Investigating the Scientific Basis for a follow up to the fourth generation of Multi-annual Guidance Programme (MAGP IV)". Commission Staff Working Paper, Brussels, 20.1.2003. Chapter 5.

To provide confidence intervals around the forecasts the model could be run using multiple stochastic simulations. This would involve changing the value of the control variable – the vector of changes in TACs and would need the use of an Add-In to the existing Excel spreadsheet on which the model is based.

This is a complex operation to set up but not difficult once in place and needs only be carried out when any of the parameters of the model are changed since it validates the parameters.

A similar process of testing the sensitivity of the results to the parameter values can be performed varying the parameter values to identify their individual importance.

Validation of model results could also be carried out via retrospective analysis, i.e. confronting simulation results to the results actually observed, as has been carried out in the past e.g. for the Danish fleet.

7.3. Use of in-year data

The present implementation uses baseline averages for economic performance, spawning stock biomass and landings, based on the average of the most recent three years. The forecast performance of the fleets is then compared to the baseline economic performance using the assumed TACs for the prediction year. For the short-term forecast, it would be useful to make the comparison with the most recent annual estimates.

8. Data requirements

8.1. Utility of data collected under Commission Regulation (EC) 1639/2001 and the EIAA.

The group reviewed the inputs required by the EIAA model, and the description of economic information required by EC regulation 1639/2001 (appendix XVII), as well as the proposed revised heading, definitions and specifications adopted during the Paris workshop (Report of the workshop 'Economic Indicators' Paris 10-14 May 2004, IFREMER). The various variables and indictors are summarised in Table 2. With the exception of the financial information provided for under the minimum program, which does not include interest payments, the list of variables included under the regulation, and their proposed specification provide adequate input for running the EIAA simulations. Harmonisation of the terminology used under the data collection regulation and the EIAA model would be useful. The group recommends that the terminology used in the EIAA output be amended in the future according to the definitions used in the data regulations.

Table 2. Economic variables and indicators used in the EIAA compared to the EC data regulation and the revisions proposed by the Paris workshop

Cost and earnings input to the EIAA from the AER	Review of economic indicators (Paris workshop)	
	Indicator required by EC 1639/2001	**Proposed revised heading by the workshop**
Gross revenue/value of landings	Income – Turnover	Gross revenue (of which gross value of landings)
Fuel costs	Fuel costs	
Vessel costs	Repair and maintenance	
Crew share	Crew (incl. Social costs)	
Other running costs	Other running costs	Other costs
Depreciation	Fixed costs	Capital costs
Interest	n.a. under the minimum program	
Invested capital	Investment (asset)	The value of capital
Prices/species	Prices/species	

Source: Commission Regulation (EC) no 1639/2001, appendix XVII (section j) and Report of the workshop ‘Economic Indicators’ Paris 10-14 May 2004, IFREMER.

Enhancement of economic indicators for the future as proposed by the Workshop "Economic Indicators” could slightly change the model. E.g. taking into account of gross revenue from non-fishing activities and accepting the proposed definitions of employment, labour costs, prices, capital costs and the division between fuel and oil costs.

Implementation of improvements of the model as suggested by the group, e.g. modelling changes in segment share and ‘jointness’ in output will require collection of data that is not currently provided by the data collection regulation.

8.2. Segmentation

As stated in the model description, the objective of the EIAA approach is to analyse the potential effects of an imposed quota on a particular fleet segment as a whole. Therefore, fleet segment definition has clear implications, both in terms of consistently using data collected and for the interpretation of results. It should be noted that, for the most part, fleet segmentation is not the same across member states. In some cases it is gross tonnage that classifies vessels, in others it may be engine power, length of vessel and/or area fished. However, this does not necessarily impact on the use of the EIAA approach for specific fleet segments.

The foremost assumption of a fleet segment, as used in EIAA, is homogeneity. That is, vessels incorporated into a segment must have similar operating characteristics, not only with respect to how and where they fish, but also, and more importantly in EIAA, through unit (variable) costs experienced. A main result of EIAA is to indicate the expected change in average variable costs. For example, a 20 metre trawler fishing for cod in the North Sea may not have the same production costs as a similar vessel fishing for cod in the Baltic. Hence, a less homogeneous fleet segment will impact on the confidence of the results obtained.

It is also noted that a fleet segment may not be wholly consistent over time, as vessels may change strategy in a given year. For homogeneous fleet segments, this is not generally a problem. However, where vessels have a number of alternative fishing strategies, and as a result move around fleet segments, this may need to be qualified with respect to fleet structure in terms of the average effects of TAC on that segment for the forthcoming year.

In the design of long-term data collection strategies, it would be advantageous for the analysis undertaken by EIAA to collect biological and economic data using, as far as possible, common fleet segment definitions. Further, for the best use of advice produced, such definitions should correspond to segments that can be managed as separate units. The group notes that the homogeneity of fleet segments may not be satisfactory under the minimum programme of the data collection regulation (1639/2001). The extended programme as shown in table 3 may overcome part of this issue because of the more detailed categorization with respect to length of the vessels. This will not, however, fully overcome the differences in homogeneity caused by fishing areas and 'fisheries' in terms of species composition.

Table 3. Detailed disaggregation of vessels for capacities (Extended Programme)

Vessel length (level 1)			< 10 m	10 - < 12 m	12 - < 18 m	18 - < 24 m	24 - < 40 m	≥ 40 m
Type of fishing technique								
Level 2	**Level 3**	**Level 4**						
Mobile gears	Beam trawl	North Sea < 221 kW						
		North Sea ≥ 221 kW						
		Outside North Sea						
	Demersal trawl and demersal seine	Bottom trawl						
		Danish and Scottish seiners						
		Polyvalent						
	Pelagic trawl and seiners	Pelagic trawl						
		Pelagic seiner and purse						
		Polyvalent						
	Dredges							
	Polyvalent mobile gears							
Passive gears	Gears using hooks	Longlines						
		Other gears using hooks						
	Drift nets and fixed nets							
	Pots and traps							
	Polyvalent passive gears							
Polyvalent gears								

Source: Commission Regulation (EC) no 1639/2001 Appendix IV (section C)

8.3. Thresholds for data collection

The notion of thresholds relates to the objective that adequate coverage of fleet segments be obtained for the required economic indicators e.g. as listed in the ‘Economic indicators’ workshop (Paris 10-14 May 2004, page 4). Hence, in the context of EIAA where selected fleet segments are utilised, it needs to be ensured that collectively, those fleet segments analysed represent a significant part of the fisheries.

Firstly, the measurement of a threshold will differ depending on the criteria used. For example, fleet segments considered may account for 80% of a member states’ total landings but say 90% of total value. The number of vessels could also be used. However, in this latter case coverage of small vessels may not be as complete as larger vessels. Therefore, the criterion used on one variable as a threshold can still result in partial coverage of another variable (which itself will not reach its threshold based on another criterion).

In other words, for various reasons, including the use of thresholds for the identification of segments may result in an analysis that will in some cases cover only part of the fleet concerned with a particular TAC regulation. In such cases the results from the EIAA may not be representative and as a result, give an erroneous picture. The appropriate threshold will vary between member states depending on the characteristics of their fleets and the appropriate segmentation.

9. Transparency and operationality

The EIAA model is constructed in an Excel workbook distributed on 17 sheets. The model uses cell references, 'array names', and 'if-sentences' but no macros or visual basic. Basically, the structure of the cell references is somewhat difficult to trace in the workbook and in that respect transparency is compromised. An extensive description of the model in terms of equations is required to understand the structure and the theoretical foundation of the model. An overview of the model is given in Annex I and II.

The advantage in terms of *transparency* is associated with the widespread use of excel spreadsheets which means that *operating* the model is easy. Programme accessibility is good and no barriers with respect to operating the model exist. Further, once data has been put into the model the results appear instantly in predetermined tables and figures. The model is designed with the aim to be operated by a diverse group including researchers, civil servants and others.

Despite its ease of use, the danger of easy accessibility lies in the fact that the results produced from the model require certain skills to interpret in the sense that the assumptions behind the calculations are not clear to the user, and that the possibilities to change model parameters may lead to unjustified results. The model contains no restrictions as to the interval of the parameters and variables.

The *institutional* platform of the current EIAA model is the concerted action: Economic Assessment of European Fisheries' (QLRT - 2000 – 01502). A number of participants in this concerted action are skilled users, and enjoy the benefit a continuing development of the model and a continuing discussion of the results. This benefit does not apply to users outside the concerted action.

10. EIAA and a model for recovery options in the medium to long run

EIAA is designed as an evaluation tool in order to perform a short run analysis whereby it accounts for changes in TAC/quota. The model computes the economic effect of a given TAC/quota on a specified "current" fleet segment in the short-run. Accordingly, the model is founded on strict assumptions and uses data that is relevant only in the short run. The strongest of these assumptions are that the fleet remains constant (i.e. the same physical characteristics and homogeneous) between time periods, and that the species are caught separately (i.e. no joint production). Market effects (i.e. price changes), technology effects, and stock effects are included but need further empirical foundation, and the magnitude of the 'elasticity' parameters relevant in the short run are not necessarily valid for the medium and long run. As the fleet remains constant between time periods fixed costs are kept constant. Therefore, with such requirements, short term stability is a key condition of EIAA.

In the medium and long run, the assumption of a constant fleet (i.e. an unchanging fleet segment) cannot be made. For reasons such as the mobility of fleets and changing tactics regarding gear used and areas fished, and accordingly species targeted, fleets are (and can be expected to be) naturally varying over time. In a stock recovery scenario, this changing nature of fleets is likely to be even more pronounced as vessels react to increased management restrictions. Furthermore, in a stock recovery scenario catch composition of fleets will also change differently from the TAC composition as vessels modify their tactics. Some of these changes will be in response to the economic pressures and incentives created by the presence of a more abundant stock and may be dependent on the management regime within which the fleet is operating. Therefore, it is reasonable to expect that fleet dynamics and stock dynamics are key features of a model designed to consider medium and long run recovery scenarios. Fundamentally, the EIAA is not designed to tackle the analysis of the long run, particularly with respect to stock recovery, as it includes no fleet dynamics or stock dynamics.

The EIAA is driven by changes in output. Specifically, future TACs are used as the basis of the analysis in order to project how the profitability of a fleet segment is likely to change in light of the imposed TAC/quota. To model fleet dynamics, effort becomes an endogenous variable. Effort in terms of days at sea is included on an annual basis in the EIAA. However, the fleet capacity component of effort, e.g. number of vessels, GT or kW, is not an endogenous variable in the EIAA. Development of the EIAA model to improve the applicability with respect to medium and long term projections would benefit from making effort an endogenous variable. With fleet dynamics included and with long run TACs and stock biomasses modelled, a model could project economic performance of changed fleet segments.

With respect to further development of the EIAA model in terms of developing a new model to better accommodate medium term and long term projections it is recommended that the model be developed to include fleet dynamics and stock dynamics. In addition, medium and long term projections would benefit from market analyses (price formation), which could be included in a new model.

Ideally, a model that is input driven (e.g. effort driven) enables that, after changes in effort applied by a fleet to given stocks have occurred, the consequences on the stocks and in turn on the different fleet segments can be evaluated (thus capturing the feedback that is required). TACs can still be imposed in such a system, and the effects of the TACs on discarding also be considered. This approach is different from the EIAA as the input driven model works with effort as the control variable whereas EIAA works with TAC as the control variable.

Such a model framework would have to model the biology of each stock concerned explicitly (i.e. the biological component); and model the economic aspects of the fleets and their behaviour (i.e. the fleet and economic components) as well as prices and other exogenous and endogenous economic variables. Both components would be fully integrated in a bio-economic model to account for the myriad of feedbacks to the extent that a recovery programme could be evaluated. Such a model framework could be simulation-based or optimisation-based and may possibly include multiple objectives to evaluate some wider effects of TAC policy (e.g. social / community issues). Such a model is, however, much more data demanding than the EIAA approach.

It is a recommendation of this STECF sub-group that a specific programme of model development be established to assist directly in the development of medium and long run recovery scenarios. Two currently funded sixth framework projects that may be relevant to this are EFIMAS and COMMIT, which intend to tackle the question of modelling medium and long run recovery, and may in part deal with some or all of the issues discussed here.

11. Institutional foundation of economic model

The current institutional arrangement is that the EIAA model is run as part of the work of the Concerted Action. However, the last opportunity to run the model within that framework will occur in the autumn of 2004 when the Concerted Action ends. A chance to run the model in 2005 will be secure if the Concerted Action is extended for a further year. The Commission has indicated to the STECF that this is its intention. Beyond that there are no plans for an institutional framework and the associated funding that would enable the model to be run or further developed.

Provision of an institutional framework for using and analysing the data available under the Data Collection Regulations will be essential if indeed it is to be used for economic evaluations. This will be in line with the intention of the new Common Fisheries Policy to include more socio-economic advice in deliberations relating to the management of EU fisheries.

It is assumed that, as this work relates to the development of Commission proposals on the management of the EU fisheries, it will come under the umbrella of the STECF and actually be carried out through its working groups. This would provide the necessary framework for economists and biologists to work together in running and developing models to assess the socio-economic impact of changes, not only in TACs, but also in other management measures.

Running and developing these models is time consuming and therefore will require a carefully constructed programme which has significant resource implications. The programme would be best developed by DG Fisheries on the advice of the STECF and should reflect the breadth of activities in fisheries economics. It is imperative that the institutional framework for the development of economic assessment models does not exclude key participants and institutes.

12. General comments on operational models for economic evaluation of advice based on biological criteria

The STECF at its plenary meeting in March/April 2004 endorsed the recommendation of The Sub-Group on Economic Assessment (SGECA) about "Way forward to provide economic advice in fisheries", 8-10 March 2004[5] that economic models for the Northern regions and the Southern regions of the EU be assessed and that a third meeting in Spring 2005 about general modelling concepts included a broader review of known models.

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[5] SEC (2004) 1024 "18th Report of the Scientific, Technical and Economic Committee for Fisheries" 29 March – 2 April 2004. Commission Staff working paper, Brussels, 27.7.2004. See Chapter 5 and in particular Annex II "Organisation of the future economic advice". Report of the SGECA meeting, Brussels 8-10 March. 2004 for a more comprehensive description of economic models.

Certain general concepts about modelling are described in the SGECA report "Way forward to provide economic advice in fisheries" from March 8-10 to which the reader is referred. All these models are numerical models contrary to analytical model with no data input.

The basic goal for the economic management of the fishery aims to achieve a balanced economic use of resources including production factors while maintaining fish stocks at sustainable levels. This means that biological limitations on fish stocks yield are taken into consideration. The EU fisheries are characterised by multi-species and multi-fleet fisheries (multi-output and multi-input fisheries). The inclusion of several output and input make the models very complex and the intention with such models *is not to analyse the behaviour of the fishermen* i.e. estimating parameters such as coefficients and elasticities but to *analyze the consequences of fishermen's behaviour* given certain restrictions. The analytical advantages are embodied in the possibility of making calculations for large systems of the consequences if some or several of the exogenous variables and/or the parameters of the model change.

An important question in this respect is the question about long run and short run. In economics the distinction between short and long run is often defined by the time period required for the fixed capital to change. An important question in that respect is how long the parameter values could be considered constant.

The numerical analyses could involve both simulation and/or optimization. Simulation is referred to as *'what-if'* analyses while optimization is referred to as *'what's-best'* analyses. While simulation is forward iteration based on a specified set of parameters, optimization is not only forward iteration but also the optimal combination of variable values subject to some predetermined goal. In that respect it could be argued that the simulation model is a subset of the optimization model. However, if the optimal solution of large systems is aimed at the problem could be extremely difficult to solve, if any solution exists at all. Therefore, the two approaches are rather complimentary in the sense that the optimization model is applied in a comparative static way implying that the endogenous variables are determined at two different points in time and then compared. What is happening in between these two points in time is considered outside the model e.g. by use of a simulation *('what-if')* model.

In practical fisheries management it is necessary to specify the starting point numerically be it in terms of fish stock abundances, TAC, quota, capacity, effort (e.g. fishing days) and economic performance. From this starting point the allocation could commence either by direct allocation or by market forces subject to the use of management tools. In terms of direct allocations of individually allocated quotas, fishing days or, on member state level, the size of capacity, the overall value of a numerical calculation also depends of the value at the end point at least in *what's best* analyses.

The main limitation of many of the current economic models is data limitations. A large amount of parameter values need be specified either by non-numerical methods e.g. by use of account statistics or by use of econometric methods. Further, if the models are used for long run prediction a number of exogenous variables have to be specified, which requires estimations outside of these models. By nature, data shortness is not a problem in analytical models.

13. ANNEX I: Overview of the EIAA model.

The EIAA model computes future landings value and costs by use of recorded baseline information, which is a three years average, and future TACs as proposed by the EU Commission, ICES et. al.

1. Landings of quota species in future periods:

The landing of quota species in future periods per fleet segment is calculated by taking the quota share of the country of the total EU-TAC and distribute that by use of the fleet segments share of the national share in the baseline period. The degree to which the quota is exhausted is taken into account by use of an up-take-ratio:

1.1 $$L_{t,i,j,m} = \left(\sum_a Q_{t,i,a} \cdot ns_{i,a,m} \right) \cdot nu_{i,m} \cdot \left(\frac{L_{0,i,j,m}}{L_{0,i,m}} \right)$$

where $nu_{i,m}$ can be changed and is defined as:

1.2 $$nu_{i,m} = \frac{\sum_j L_{0,i,j,m}}{\sum_a Q_{0,i,a,m}}$$

$L_{0,\,i,\,m,\,j}$	Member State *m* landings at base years of species *i* by fleet segment *j* (exogenous variable)
$L_{t,\,i,\,j,\,m}$	Member State *m* landings at year *t* of species *i* by fleet segment *j* (endogenous variable)
$Q_{t,\,i,\,a}$	Quota at year *t* of species *i* in area *a* (exogenous variable)
$ns_{i,\,a,\,m}$	Relative stability i.e. Member State *m* share of species *i* in area *a* (parameter)
$nu_{i,\,m}$	Member State *m* quota uptake ratio of species *i* (parameter, calculated by the model). Can be changed for future years
$Q_{0,\,i,\,a,\,m}$	Member State *m* quota in base years of species *i* (exogenous variable)

The following is described on Member State level. Therefore *m* is omitted.

2. Prices in future periods

After the calculations of future landings prices are calculated. First the baseline prices are calculated from the landings value and the landings volume. Then, assuming that the price of each species in the future is a function of the total EU-TACs, future prices are calculated. The function includes a price flexibility rate which is fixed at –0.2 as a default rate:

2.1 $$P_{0,i,j} = \frac{TR_{0,i,j}}{L_{0,i,j}}$$

2.2 $$P_{t,i,j} = P_{0,i,j} \cdot \frac{\sum_a Q_{t,i,a}^{\alpha_i}}{\sum_a Q_{0,i,a}^{\alpha_i}}$$

$\alpha_i \leq 0$

$P_{0,i,j}$	Fish prices in base years of species *i* by fleet segment *j* (endogenous variable)
$L_{0,i,j}$	Landings of quota species *i* in base years by fleet segment *j* (exogenous variable)
$TR_{0,i,j}$	total revenue of quota species in base years of species *i* by fleet segment *j* (exogenous variable)
$P_{t,i,j}$	Fish prices year *t* of species *i* by fleet segment *j* (endogenous variable)
α_i	Price flexibility of quota species *i*. Can be changed

3. Gross revenue in future periods

Gross revenue (total revenue) in future periods is calculated by the computed landings and prices for the future period. The value of non-quota species are calculated from baseline information and added to the computed future value of quota species. Finally the computed gross revenue for the future period is adjusted with a coefficient to account for income outside fisheries etc.:

3.1 $$TR_{t,j} = (\sum_i P_{t,i,j} \cdot L_{t,i,j} + K_{t,j}) \cdot \frac{GR_{0,j}}{\sum_i P_{0,i,j} \cdot L_{0,i,j} + K_{0,j}}$$

where $K_{t,j}$ is defined as:

3.2 $$K_{t,j} = TR_{0,j} - \sum_i P_{0,i,j} \cdot L_{0,i,j}$$

and $GR_{0,j}$ is defined as:

3.3 $$GR_{0,j} = TR_{0,j} + O_{0,j}$$

$TR_{t,j}$	Total revenue at year *t* by segment *j*
$K_{t,j}$	Landings value at year *t* of other species than quota species of segment *j*
$GR_{0,j}$	Gross revenue including non-fisheries specific income of segment *j*
$O_{0,j}$	Income from non-fisheries specific activities of fleet segment *j*

4. Variable costs in future periods

A fleet activity variable *A* is calculated and used in the model to adjust variable costs. Changes are considered only within fleet segments, not between segments. The calculation of the fleet activity variable consists of three steps. The rationale behind this procedure is the (well known) Cobb-Douglas type production function where an explicit functional form a fleet segment and a single species is:

4.1 $$\mathrm{A} = a * \frac{p(TL)L^{\chi}}{SSB^{\beta}}$$

where

A: fleet activity
a: coefficient
p: price as a function of aggregate landings TL on EU level
L: landings per segment
SSB: spawning stock biomass
chi and beta are parameters (flexibilities)

Expanding this expression in terms of time, species and fleet segment one gets the expression that is applied in the model:

4.2 $$A_{t,j} = \sum_i \left(\frac{L_{0,i,j} \cdot P_{t,i,j}}{\sum_i L_{0,i,j} \cdot P_{0,i,j}} \cdot \left(\frac{L_{t,i,j}}{L_{0,i,j}} \right)^{(\chi_{i,j})} \cdot \left(\frac{SSB_{t,i}}{SSB_{0,i}} \right)^{(-\beta_i)} \right)$$

$\chi \geq 0$; and $\beta \geq 0$

4.3 $$RC_{t,j} = RC_{0,j} \cdot A_{t,j}$$ function of quota species only, or

4.4 $$RC_{t,j} = RC_{0,j} \cdot AA_{t,j}$$ function of all species

where

4.5 $$AA_{t,j} = A_{t,j} \cdot \frac{\sum_i P_{t,i,j} \cdot L_{t,i,j}}{TR_{t,j}} + \frac{TR_{t,j} - \sum_i P_{t,i,j} \cdot L_{t,i,j}}{TR_{t,j}}$$

$A_{t,j}$	'Activity coefficient' as a function of quota species at year *t* of fleet segment *j;* $A_{0,j} = 1$ (endogenous variable) calculated for the baseline
$L_{t,i,j}$	Landings in volume in baseline period 0, and TAC in period *t* of species *i* by fleet segment *j*
$P_{t,i,j}$	Prices in period *t* of species *i* by fleet segment *j*
$SSB_{t,i}$	Spawning stock biomass at year *t* of species *i* (exogenous variable)

$AA_{t,j}$ ‘Activity coefficient’ as a function of quota and non quota species at year t of fleet segment j; (endogenous variable)
$\chi_{i,j}$ ‘Technology flexibility rate’ of quota species i by fleet segment j
β_i ‘Stock – effort’ flexibility rate of quota species i
$RC_{t,j}$ Running costs at year t of fleet segment j, includes fuel and other fishing days dependent costs (endogenous variable)
$RC_{0,j}$ Running costs at base years of fleet segment j, includes fuel and other fishing days dependent costs (exogenous variable)

The *‘P-element’* account for incentives to reallocate effort as a function of changes in relative prices. Note that future prices depend on the price flexibility rates, see equation 2.1 and 2.2.

The *‘L-element’* accounts for technological accessibility. If χ is zero the fish is easily accessible, and when χ increases if accessibility becomes harder. The default value in the model is $\chi = 1$. The inclusion of the element makes it possible to distinguish between different accessibilities in particular for demersal and pelagic species and different fishing technologies.

The *SSB-element* accounts for accessibility caused by stock abundance. $\beta = 0$ implies there is no stock abundance effect on activity. With full effect $\beta = 1$. Default values are between 0.6 and 0.8 for demersal species and between 0.1 and 0.2 for pelagic species

When the A-variable is calculated for each fleet segment the recorded variable costs $RC_{0,j}$ for the baseline period is multiplied with A to obtain variable cost for the future period. A numerical example in annex table 1 shows the calculation of A_t in the lower right hand cell.

The model contain to options for calculating A. One option takes into account only the effect of changes in the quota species. The second options denoted AA is adjusted for the share of the value of the quota species relative to the total landings value.

By use of that procedure it is assumed that each species in the landings composition could be caught separately which makes it possible to add the cost share oh each species. However in many fisheries joint production prevails entailing that species are caught in fixed proportions. These fixed proportions are however changed in future periods by change of the quota compositions.

Further to the variable costs the crew share is calculated in the model for the baseline period by taking the costs of the crew relative to the gross revenue.

4.6 $$CC_{t,j} = cc_{0,j}\, TR_{t,j}$$

where $cc_{0,j}$ is defined as:

4.7 $$cc_{0,j} = \cdot \frac{CS_{0,j}}{GR_{0,j}}$$

$CC_{t,j}$ Crew share at year t of fleet segment j (endogenous variable)

$CC_{0,j}$	Crew share coefficient in base years of fleet segment *j* (endogenous variable)
$CS_{0,j}$	Crew share in base years of fleet segment *j* (exogenous variable)

5. Fixed costs

Fixed costs are assumed constant i.e. transferred from the baseline period to the future period. The model distinguish between fixed costs related to the operation of the vessel and fixed capital costs

5.1 $$FC_{t,j} = FC_{0,j}$$

5.2 $$DC_{t,j} = DC_{0,j}$$

FC_j	Fixed costs, fleet segment *j,* other than *DC* and *RC*
DC_j	Depreciation and interest costs, fleet segment *j*

6. Indicators of economic performance:

A number of economic indicators are calculated as shown by the subsequent expressions.

Cash Flow:

6.1 $$GF_{t,j} = TR_{t,j} - (RC_{t,j} + CC_{t,j} + FC_{t,j})$$

Net profit:

6.2 $$NP_{t,j} = TR_{t,j} - (RC_{t,j} + CC_{t,j} + FC_{t,j} + DC_{t,j})$$

Operating profit margin:

6.3 $$OPM_{t,j} = \frac{TR_{t,j} - (RC_{t,j} + CC_{t,j} + FC_{t,j} + DC_{t,j})}{TR_{t,j}}$$

Gross value added:

6.4 $$GV_{t,j} = NP_{t,j} + CC_{t,j} + DC_{t,j}$$

$GF_{t,j}$	Gross cash flow at year *t* of fleet segment *j*
$NP_{t,j}$	Net profit at year *t* of fleet segment *j*
$OPM_{t,j}$	Operating profit margin at year *t* of fleet segment *j*

7. Break even and 'over capacity'

The EIAA model contains information that makes it possible to calculate the gross revenue that is required to cover fixed costs exactly with the given variable costs. That is denoted the Break-even revenue. With salary to the owner/skipper of the vessel included in the variable cost the Break-even revenue is the revenue that equals net profit at zero.

Break-even Revenue = (Depreciation + Interest) * Revenue / (Revenue - (Fuel C. + Running Costs + Vessels Costs + Crew Share)) or BeR = Fixed costs * Revenue / Gross Cash Flow if vessels costs are included in fixed costs.

If Break-even revenue and the actual revenue is compared an indication of the change of the fixed costs in order to comply with break-even is obtained. Assuming that fixed costs are a proxy for capacity an indication of over and under capacity is provided. The result does not indicate whether a required change in fixed cost actually is possible, only that it is necessary.

Further it is possible with the information in the model to estimated remuneration of the fish stocks i.e. include resource rent. Required resource rent is include in the fixed costs of a fleet segment, and the obtained result indicates the level of capacity if the 'capital' fish resources is remunerated in the same way as the capital invested in fishing vessels.

7.1 $$BR_{t,j} = \frac{(DC_{t,j} + [FC_{t,j}]) \cdot TR_{t,j}}{GF_{t,j}}$$

Note: Inclusion of $FC_{t,j}$ is subject to consideration; therefore in bracket

Definition: Over-capacity = 1- Revenue / Break-even Revenue

7.2 $$OC_{t,j} = 1 - \frac{TR_{t,j}}{BR_{t,j}}$$

The value share of the fish stocks subject to quotas of each fleet segment and Member State is calculated:

7.3 $$SSBLC_{t,i,j,m} = rl \cdot P_{t,i,j,m} \cdot \left(\sum_a SSB_{t,i,a} \cdot ns_{i,a,m} \right) \cdot nu_{i,m} \left(\frac{L_{t,i,j,m}}{L_{0,i,m}} \right)$$

Break-even with quota fish stock value included (subsequently Member State i.e. *m* is omitted):

7.4 $$BRLS_{t,j} = \frac{(DC_{t,j} + \sum_i SSBLC_{t,i,j} + [FC_{t,j}]) \cdot TR_{t,j}}{GF_{t,j}}$$

7.5 $$OCLS_{t,j} = 1 - \frac{TR_{t,j}}{BRLS_{t,j}}$$

Calculation of other species excl. quota species are calculated:

7.6 $$SSBNC_{t,i,j} = rn \cdot SSBLC_{t,i,j} \frac{TR_{0,j} - \sum_i P_{0,i,j} \cdot L_{0,i,j}}{\sum_i P_{0,i,j} \cdot L_{0,i,j}}$$

7.7 $$BRTS_{t,j} = \frac{(DC_{t,j} + \sum_i SSBLC_{t,i,j} + \sum_i SSBNC_{t,i,j} + [FC_{t,j}]) \cdot TR_{t,j}}{GF_{t,j}}$$

Note: Inclusion of $FC_{t,j}$ is subject to consideration; therefore in bracket

7.8 $$OCTS_{t,j} = 1 - \frac{TR_{t,j}}{BRTS_{t,j}}$$

$BR_{t,j}$	Break-even at year *t* of fleet segment *j*. It is optional to include *FC*
$OC_{t,j}$	Over capacity at year *t* of fleet segment *j*
$SSBLC_{t,i,j}$	Spawning stock biomass costs of quota species at year *t* of species *i* by fleet segment *j*
rl	Remuneration percentage of the quota fish stocks
$BRLS_{t,j}$	Break-even at year t of fleet segment *j* including remuneration of quota species
$OCLS_{t,j}$	Over capacity at year *t* of fleet segment *j* taking stock remuneration (resource rent) of quota species into account
rn	Remuneration percentage of the non quota fish stocks
$SSBNC_{t,i,j}$	Stock biomass costs of non quota species at year *t* of species *i* by fleet segment *j*
$BRTS_{t,j}$	Break-even at year t of fleet segment j including remuneration of quota species
$OCTS_{t,j}$	Over capacity at year *t* of fleet segment *j* taking stock remuneration (resource rent) of quota and non quota species into account.

Fixed costs are divided between fixed operational costs on one-hand and depreciation and interest payments on the other. These are maintained constant throughout time.

Annex table 1. Numerical example of the calculation of fleet activity A

	Landings and quotas												**Stock abundance SSB**				**Total**
	Base year			Year t									Base	Year t			Year t
Species	Landings/ quotas	Price	Revenue	Quota	Price flexibility	Price	Revenue	'Price effect'	Chi	'Volume effect'	Total effect		SSB	SSB	beta	'SSB effect'	Total effect
1	50	12.0	600	50	-0.2	12	600	0.308	1	1	0.308		200	200	1	1.000	0.308
2	40	10.0	400	30	-0.2	10.5	420	0.215	1	0.75	0.162		150	100	1	1.500	0.242
3	30	5.0	150	45	-0.2	4.5	135	0.069	1	1.5	0.104		100	200	1	0.500	0.052
4	10	70.0	700	15	-0.2	63	630	0.323	1	1.5	0.485		50	75	1	0.667	0.323
5	5	20.0	100	7.5	-0.2	18	90	0.046	1	1.5	0.069		50	75	1	0.667	0.046
Total	135		**1950**	147.5			1875	0.962			1.12692						0.971

The activity variable A for period t is in this example 0.971.

14. ANNEX II: The Excel Workbook

The model is constructed in an Excel workbook. A workbook contains all the formulas of the model. The model is constructed by use of cell-references named arrays and if-sentences. No macros or virtual basic is used.

All the data information of EU quota-management areas and fish stocks is included in every workbook. The quota-management areas and the stock information are updated every year and the reason for the inclusion of that information in all workbooks is to avoid mistakes with respect to these two variables.

A workbook is *country specific* i.e. costs and earnings information is included in separate workbooks for each country. The country workbook comprises currently up to four fleet segments. More fleet segments can be handled by using several workbooks for one country.

When a workbook is used for one particular country, a country code specified in every workbook must be invoked to extract the quota and the fish stock information from the data sheets for that particular country.

A workbook is organised in 17 sheets:

1. Guidelines that explain what is included in the workbook
2. AER Input that included cost and earning information copied from the AER. Catch compositions in volume and value on national level and on fleet segment level are included here as well.
3. Selected economic indicators and result figures in € on fleet segments
4. Detailed result tables on fleet segments
5. Selected economic indicators and result figures in national currency on fleet segments where that apply
6. Figures showing 'overcapacity' base on the 'break-even principle'
7. Allocation of shares of spawning stock biomass on fleet segment in terms of value
8. Catch-effort and stock-catch flexibility rates. Parameters that can be changed
9. Calculated up-take-ratios. Can be changed
10. Price flexibility rates and calculated prices
11. Fleet segment shares of national quota. Can be changed
12. Spawning stock biomass information on quota management areas
13. Long term TAC on quota management areas
14. EU TAC for the base years and the coming year on quota management areas
15. Relative stability matrix i.e. Member State share of TAC per area
16. Calculation of fleet activity changes
17. Auxiliary information such as exchange rates, deflator indices and interest rates

Compared to above, the latest version (October 2004) includes to more sheets (19 in total): one with capacity data from the AER and one with capacity adjustment calculations (adjustment of number of vessels and fixed costs) in the long run assuming use of maximum number of fishing days per year.

15. ANNEX III: Participants and contact details.

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