



**DEPARTMENT OF THE ARMY**  
U.S. Army Corps of Engineers  
WASHINGTON, D.C. 20314-1000

REPLY TO  
ATTENTION OF:

CECW-CP

27 November 2007

MEMORANDUM FOR PLANNING COMMUNITY OF PRACTICE

SUBJECT: Economics Guidance Memorandum, 08-04, Deep-Draft Vessel Operating Costs FY 2008

1. Deep-draft vessel operating costs (DDVOCs) have been published by the Institute for Water Resources (IWR) and are provided for use by analysts of the U.S. Army Corps of Engineers (USACE) for assessment of potential economic benefits associated with waterway improvement projects. Vessel operating cost (VOC) estimates are not posted or distributed for public access as some or much of the information integral to the estimates is considered sensitive or proprietary by commercial sources and protected from open or public disclosure under Section 4 of the Freedom of Information Act (or FOIA; current and/or as amended). Accordingly, costs are hereby designated for limited release and distribution to USACE analysts as required and as non-disclosure protections allow, for development and review of waterway project analysis.
2. USACE analysts should contact Ian Mathis, CEIWR-GI at [ian.a.mathis@usace.army.mil](mailto:ian.a.mathis@usace.army.mil) or the Deep Draft Navigation Planning Center of Expertise to obtain FY 2008 DDVOC estimates. Questions related to this memorandum should be addressed to Bruce Carlson, CECW-PC at [bruce.d.carlson@usace.army.mil](mailto:bruce.d.carlson@usace.army.mil) or by telephone at (202) 761-4703.

A handwritten signature in cursive script that reads "Harry E. Kitch".

Harry E. Kitch, P.E.  
Deputy, Planning Community of Practice  
Directorate of Civil Works

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Harry E. Kitch, P.E.  
Deputy, Planning Community of Practice  
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## **Deep-Draft Vessel Operating Costs FY 2008 – General Technical Support Document**

1. The EGM documentation herein will only provide an update of information concerning the general trends in costs and any notable technical changes concerning the structure, method(s) or basis for development, and compilation of supporting data or information applied for derivation of deep-draft vessel operating costs (DDVOC) estimates. USACE analysts should contact the Institute for Water Resources or the Deep Draft Navigation Planning Center of Expertise (points of contact as identified in the cover memo) to obtain information or instructions for access to DDVOC estimates or for technical issues regarding applicability of the estimates particular to study needs.
2. DDVOC estimates associated with this EGM are generally limited to consideration of ocean-going self-propelled hulls and are not considered directly applicable for other vessel types or classifications of service relative to general configuration of propulsion (i.e., barge units, etc.). The current release of vessel costs as compiled is the latest in a series of estimated vessel operating costs (VOCs) which have been typically distributed to USACE analysts every one to two years since the 1960's. This release of VOCs is provided as an update to costs released in fiscal year (FY) 2005 and supercedes all prior editions of estimated vessel costs with regard to currency of price level, available information for tabulation of costs by vessel type or class of service, flag or registry, and applicable interest or discount rate (for capital asset amortization and life-cycle cost evaluation).
3. DDVOC tables list estimates of various cost components including capital costs of hull replacement (based on a multi-year moving average of newbuild costs brought to current price levels) as well as other categories of costs which are included in total operating costs. Other such costs include crew labor compensation and subsistence, administration, and other expenditures for ongoing life-cycle vessel operation and maintenance. Also listed for general information purposes are estimates of vessel size (as measured by metric deadweight tonnage or DWT) and approximate dimensions or specifications for length overall (LOA), beam or breadth and maximum summer loadline draught (SLLD) and immersion.
4. It should be noted that the estimates for physical dimensions are provided primarily for general information and overall perspective of vessel size relative to costs and were derived from general linear regression relationships from statistics of the world fleet. Accordingly, due to the variability of dimensions across the world fleet relative to deadweight tonnage and vessel cargo capacity, the specific estimates of dimensions as given (length, breadth, draught, etc.) may or may not reflect the physical characteristics of fleet service regime particular to a given port, harbor, or region and are therefore not intended to serve as a basis for fleet forecasts typically required for detailed studies. The compilation of physical dimensions for vessel service and related forecasts for a given harbor or region of study is an endeavor and realm of investigation that should be

undertaken and verified according to individual study requirements with relevance to waterway engineering, design, and plan formulation.

5. A general description of changes or revisions to methods or procedures for estimation of vessel operating costs is provided in the following paragraphs. These revisions have been undertaken to further improve the Corps' capability to develop credible and defensible estimates of economic benefits for public investment decisions in support of waterway system development. Improvements in the estimation of VOCs also reflect efforts to better capture economic resource costs more consistent with the Principles and Guidelines for estimating reductions or savings in transportation costs as National Economic Development (NED) benefits.

a. Review of recent maritime industry literature combined with ongoing efforts to improve quality and credibility of technical analysis conducted by the Corps indicated that deep-draft vessel operating costs and the procedures by which they are estimated periodically warrant a general procedural or technical review. The general review resulted in a determination that sources of data and methods for estimation of costs should be reevaluated and updated as prudent for changes in availability of data and information without losing consistency with the concept(s) of National Economic Development (NED) procedures.

b. One of the most significant determinations for estimation of vessel operating costs is that estimates should reflect economic resource costs as opposed to merely financial or accounting costs. As such, costs ideally should allow for the estimation of value for the productive or marketable life of the hull asset from laydown of the keel until the hull is permanently withdrawn from applicable vessel service or is broken for salvage. As a result of continuing initiatives to migrate vessel operating cost estimates toward a resource cost basis, changes governing the calculations of costs have been undertaken to better reflect life-cycle economic resource costs.

c. Most of the foreseeable changes to prior practice have been implemented for the current release of costs and concern the estimation of average annual equivalent (AAEQ) hull costs and bunkering, and will be discussed for each general constituent or component of costs where applicable. It should be noted that the additive impact of all applicable adjustments is significant for many larger carriers with particular reference to containerized cargo carriers. The most significant influence on costs has been the increase in bunkering prices and steel used in the fabrication of hulls, and the period(s) for moving averages applied thereto. Due to efforts to improve estimates of vessel operating costs combined with concern for recent changes in various VOC components, considerable efforts have been undertaken to improve and increase sampling for cost information which has resulted in an increase in total sample size of approximately 90 to 105 vessels (varying somewhat from year to year) across four vessel types to over 750 vessels across four vessel types with particular emphasis on containerized cargo carriers which often drive plan formulation for many in-process or pending harbor studies.

d. Vessel Capital Newbuild or Replacement Costs - The interest or discount rate applicable to estimates of average annual equivalent (AAEQ) hull replacement costs for FY 2008 is 4 7/8 percent which provides for a reduction from 5 6/8 percent since the prior compilation of vessel costs. Compared to an increase in costs that would otherwise generally be expected with an upward movement in interest or discount rate this change by itself results in a reduction in costs of approximately one to two percent to as much as approximately six percent depending on the vessel type and DWT class and whether from the view of hull capital costs or total operating costs per unit of time (assuming comparable or constant price levels). Other changes to hull replacement or investment costs concern a.) the span of time for assessment of the applied moving average of replacement or base investment hull cost, b.) the period of time for amortization of costs, and c.) consideration of economic return for proceeds from withdrawal from service and subsequent sale or breakage and salvage.

e. Prior editions of vessel costs have generally employed a moving average of cost data to limit volatility or price fluctuation and to better reflect long-term average costs. The moving average for vessel hull capital costs prior to the previous edition of costs was based on a ten-year period. Review of industry literature and sources for quotation for newbuild prices indicates prices have declined considerably in recent years, largely due to changes in shipbuilding technology (and related reductions shipyard manpower requirements) and aggressive development of shipbuilding capability in various cost-competitive locales, notably China. In many ways however this has been offset by rising labor costs and significant increase material resource inputs such as steel and other materials employed in the construction of hulls. Each of these considerations are expected to be long-term influences in the pricing structure of future shipbuilding markets. Correspondingly, the estimation of costs based on a ten-year historical average did not allow hull cost estimates to maintain a viable pace or be sufficiently responsive to recent changes in some material and competitive cost factors, and resulted in hull capital costs that arguably were either understated or overstated for some vessel types.

f. While review of available information combined with recent and foreseeable trends in hull costs basically affirms that a ten-year average extending historically to periods before 2000 is no longer technically viable, it is difficult to assess precisely the best interval universally applicable to all types and class(es) of self-propelled vessels. Alternatively, inherent market volatility in the short-to-interim term combined with requirements for class and related thresholds over time for owner\operator decision(s) concerning asset management and turnover indicates a period of less than five years is probably too limited. It was therefore decided that for the previous release of costs that a period of seven years would be applied for the general basis of moving averages corresponding to the approximate average age of hulls (in the world fleet) for which the other constituents of costs (crew, administration, etc.) are benchmarked. With further review for the current release of costs the applied period of time has been revised to allow for a five-year moving average of costs (brought to current price levels) and this duration of period is considered to represent the best balance for accommodation of allowances regarding sufficient stability in VOC estimates, price or cost changes of vessel construction and operation, and business cycles typically impacting demand for shipping

services and construction of new hulls for replacement tonnage and net growth in fleet capacity. Nonetheless, ongoing review of the applied moving average period costs will continue with any subsequent recommendations for proposed adjustment applied as deemed appropriate.

g. The adjustment in moving average duration from seven years (as employed in the prior release of costs) to five years has resulted in significant changes in average annual equivalent capital hull costs. Changes have been realized across many deadweight tonnage (DWT) categories and vessel types, with adjustments to larger classes and containerized cargo carriers generally being the most notable. Across the four vessel types, changes in the moving average period have resulted in capital hull costs for some smaller classes requiring slight downward or upward adjustments with significant upward adjustment for many larger classes where shipyard availability and associated competition is less.

h. The amortization of hull costs represents another area of vessel cost estimation which by definition of economic resource cost continues to mandates revision and clarification. As stated previously, economic resource costs for hull assets involves the assessment of life-cycle economic value of vessel hulls and fleet composition over the applicable service life of hull assets from laydown to terminal withdrawal from service (and any related economic returns or consequences pertaining thereto). Prior to the FY 2005 release of costs, practices for cost estimation incorporated a general application of a twenty-year period of amortization for capital recovery across all vessel types and DWT classes subject to the applied interest or discount rate. Originally, this period for amortization of costs when first selected was intended to reflect approximate duration of functional service life (with nearly equal or secondary consideration of a maximum period for financial or accounting cost recovery). The estimated twenty-year period was based on then-current knowledge and limited availability of information concerning vessel service lives and applicable shipbuilding technology during the initial years when USACE vessel costs were first devised. Over time, the twenty-year period has become somewhat arbitrary compared to actual service lives and consideration of economic resource costs.

i. The Institute for Water Resources (CEIWR) continues to review the service life for self-propelled hulls and has determined that in the full context of service life for economic resource cost estimation, the period of twenty years is too limited and should be adjusted upward or increased in duration. General review of service lives indicate the overall period of service can vary considerably with purpose of vessel or nature of service; capacity; related alternatives for redeployment or utilization; owner/operator management; practices for maintenance and technological development of shipbuilding design or fabrication. The review of applicable service life according to type and DWT class of carrier is ongoing but currently available information indicates that an average *minimum* adjustment upward from twenty to twenty-five years is appropriate for many vessel types and more current information for revisions to costs indicate appropriate amortization periods of thirty years or more may be applicable. In addition, information for the current release of costs indicates that service lives and amortization periods often

vary considerably according to vessel size based on alternatives for use or employment toward the end of primary service life. Accordingly, differing periods of amortization across DWT class(es) are now reflected in the VOC estimates for some carrier types, such as tankers and bulk carriers. Further adjustment to service life and amortization may be applied to future releases of VOCs until the assessment(s) of service life according to carrier type and DWT are considered reasonably complete or if related information warrants change over time.

j. This extended duration of service life and its relationship to amortization of costs generally results in a reduction of average annual equivalent (AAEQ) hull replacement costs (assuming comparable or constant price levels and interest or discount rate). The adjustment to the period of amortization more reflective of overall service life combined with changes in interest rate(s) and the reduction in the span of time for moving averages results in relative downward pressure on vessel costs compared to previous estimates. Subject adjustments however better (re)align cost estimates with requirements for estimation of VOCs relative to an economic resource cost basis.

k. A final consideration for adjustment of capital investment costs for hulls concerns allowances for breakage or scrap value of hull assets at the terminal year of applicable service life. Consistent with estimation of economic resource costs, values for return on breakage or scrap have been estimated according to current price levels. Applied price levels are based on value of breakage for light displacement tonnage (LDT) given its market standard to relationships for recoverable materials such as steel and salvageable vessel components. The value for return is then discounted according to the number of years applied for overall asset service life (i.e., 25 or more years) and subtracted from newbuild or initial acquisition costs to determine net capital costs applicable for allocation over the functional service life of the vessel. Due to the discounting process, this adjustment proves to be relatively minor even with current levels for associated scrap and steel prices. Adjustment for this release of costs includes more current information for breakage values adding to the development of moving averages which will eventually be equal to the moving average period for hull acquisition costs. It was not deemed critical to additionally research and incorporate historical values for scrap given the relatively minor impact of this adjustment combined with the general procedure for adjustment to annualized costs.

6. Operations and Maintenance Costs (excluding bunkering) - Primary constituents of related costs display notable upward trends with increases in such costs resulting from general influences of inflation and changes in the moving average for such costs (from seven to five years) for reconciliation with the revised moving average for hull costs. Available information indicates that insurance costs continue to be somewhat moderated from otherwise higher levels in general based on perceptions or realization of reduced risk for asset liability and potential loss due to trends for increased safety (or demonstrated reductions in loss). Other contributing factors include limited consolidation of underlying management of various P&I (protection and indemnity) financial pools and survey process administration.

7. Bunkerage Consumption and Costs – Among the most significant adjustments to bunkerage costs for the current release of VOCs is adjustment in the moving average from five years to three years. This adjustment more heavily weights current and recent price levels. Review of trends in bunkerage prices indicates that a five year average was not sufficiently responsive to changes in related costs but less than two years still results in excessive volatility in regard to planning considerations and applicability of estimates to waterway project analysis. IWR will continue to review the moving average period for bunkerage costs and adjust estimations as availability of information warrants. In addition, bunkerage cost estimates beginning with this release of VOCs are now based on a composite of approximately sixty port locales (as opposed to only ten locales for previous estimates) worldwide. With the current listing of locales, the data applied for estimates comprises approximately eighty-five to ninety percent of the worldwide bunkerage market for seafaring trade. Further, estimates now and in the future will be based on relative weights for volumes actually sold or brokered as opposed to only mid-point estimates of maximum and minimum price levels.

The physical relationships for fuel consumption remain largely the same for the accompanying release of vessel operating costs. Retention of the previous consumption relationships for bunkerage consumption was applied even though available information concerning technological developments for self-propelled hulls are immediately pending or in-process for application to vessel engine construction. Large-scale reciprocating engine and propeller technology currently being developed for both newbuilds and refit applications indicates increased fuel efficiencies will probably be applicable to revisions of costs in the FY 2006-2008 period and beyond (as application of new technology finds its way into ranks of the world fleet with asset turnover or replacement and refit). However, investigation of related trends and relationships is not complete and therefore related adjustments will be not significantly implemented into revisions to costs until late FY 2008. Also of note for future revisions to costs is an increasing emphasis on the variable duty-sized generator set for in-port use to reduce both costs and emissions while in port. Separable estimates for such equipment will be provided as information becomes available over the next three to four years. Further, sufficient information was not available to assess impact or change of described developments for the current release of costs due to uncertainty of possible mitigating impacts due to evolving or more stringent emission(s) requirements that may limit net efficiencies and the limited deployment of such technology to the existing fleet. Of particular note however has been the significant increase in bunkerage unit prices (i.e., per metric tonne) for all general classes of fuel (HVO, IFO, MDO, and MGO) with price levels in many port markets reaching new or record highs. Bunkerage costs like hull costs however are based on moving averages to account for volatility versus interim to long-term costs and therefore the impact of recent surges in bunkerage prices over the past few years is correspondingly realized in aggregate estimates. With the adjustment to the moving average period and elapse of time the increase is significant with the moving average prices of HVO and MDO reaching \$285 and \$558 per metric tonne, respectively. It is anticipated that fuel prices will moderate from levels of the current year but review of some industry sources indicates that prices will not decline (even over the long-term) to relatively low levels of two to four year previous or more.

8. Stratification of Vessel Operating Costs by Vessel Size Class - When DDVOCs were first distributed in the general form and deadweight tonnage (DWT) stratifications (many of which are still largely evident in the current VOC tabulations), the structure of the world fleet from which general specifications for capacity and dimensions were derived reflected a significantly different period for naval architecture, prime mover and generator set efficiency, hull asset employment, and market pressures for unit cost efficiencies. Correspondingly, the existence and employment of some DWT classes as listed in the VOC tables has declined considerably and in some circumstances certain classes simply no longer represent a significant portion of the world fleet. Certain classes of carrier have simply been displaced by larger or alternative configurations and scale for handling of some cargo and it is anticipated certain DWT classes will be replenished with replacement tonnage as time progresses. Nonetheless, subject classes are still listed in the tabulations or tables as sometime comparative reviews, updates, and revisions are required for prior studies.

A note of caution is that generally obsolescent carrier classes are not in many cases viable for forecasts of future fleet service and economic analysis of waterway improvements. Costs for these classes will however continue to be listed in the DDVOC tables for historical perspective but will remain the responsibility of project analysts to determine applicability for a given project analysis. Of particular note is the continuing increase in size of fully cellular containerized cargo vessels. In the previous edition of vessel operating costs, the deployment of second generation Post-Panamax hulls (6,000 TEU or greater) was limited to relatively few operators and not much information was available for hulls in exceeding 5,500 TEUs. Post-Panamax designs continue to become more common and the current cost tables now include VOC estimates up to approximately 8,000 TEUs (for foreign-flagged hulls). Additional review of information available for hull pricing affirms that cost efficiencies often do not increase along the same trend as the general composition of the world container fleet for preceding vessel classes due in part to limited facilities, dry docks and labor in selected countries to support construction. Further, newer vessels are not increasing in summer loadline draft in proportion to ratings for TEU capacity. Available information does indicate that operators are realizing other efficiencies associated with larger hulls such as the realignment or repositioning of empty containers and this appears to correlate with the recent change in relationship for homogeneous DWT rating per TEU traditionally viewed as an industry standard for construction. With the foreseeable developments of containerized carrier size it is anticipated the revisions to cost tables in the latter part of FY 08 will include tabulations for carriers of up to 10,000 TEUs to as much as 12,500 TEUs (depending on availability of information over time).

The view and objective of aggregate vessel cost formulation continues to be to develop costs considered reasonably representative of long-term trends for construction and operation and it is anticipated that costs for newly-established DWT or TEU classes of vessel will normalize relative to smaller classes as more newbuild orders are placed with shipyards and countries which continue to have the most significant representation of cost structures within the universe of the world fleet. Correspondingly, capital costs for the

largest containerized carrier classes (the realm of 2<sup>nd</sup> to 3<sup>rd</sup> generation or super to ultra Post-Panamax classes) have been adjusted or normalized based on trends in cost reduction as generally discerned for establishment of first-generation hulls.