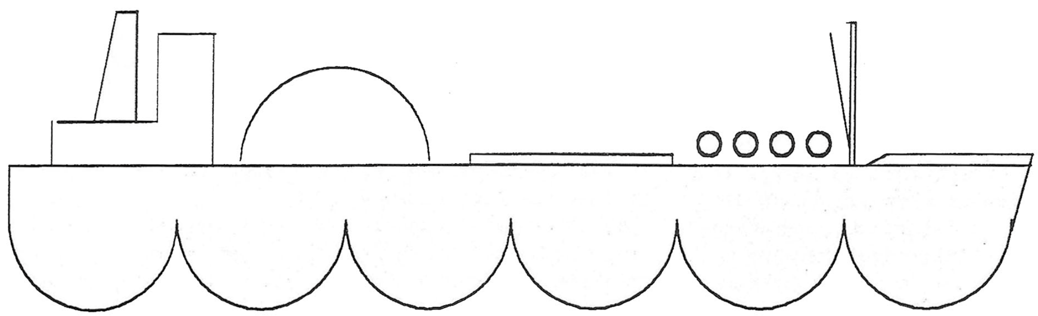
BULK SHIPPING DEVELOPMENT SYSTEM

Design Optimization & Project Economic Analysis

for

Tanker, Dry Bulk and Liquified Gas Marine Transport Systems



"Superior Tools for Better Solutions!"

Est. 1979

TransTech Marine Co.

TransTech Marine Co. Background

- Founded 1979
- Shipping Research / Design / Financial Advisory
- *"Superior Tools for Better Solutions"*
  - Trade Research
  - Preliminary Design
  - Project Financial Planning

BSDS -Inspiration

- Economy of **<u>Scope</u>** **…**

  … adaptation by one industry of a successful process, technique or technology from another industry.**(1)**

- What can ship designers, builders and operators learn from the airline industry?

- *"United [Airlines] picks planes by running calculations through an extraordinarily complex economic model… Its aim is to arrive at a single figure that expresses the value of flying a particular aircraft."*(**2**)

1. Porter, Michael, <u>The Competitive Advantage</u>, Harvard University Press, 1985.
2. "*How Boeing Got a New Airliner Aloft*", Wall Street Journal, October 29, 1990.

How Boeing Got a New Airliner Aloft

Long Development Was Welded to Tough Bargaining

By RICK WARTZMAN
Staff Reporter of THE WALL STREET JOURNAL

After five days of intensive labor, Phil Condit's baby was born, weighing 506,000 pounds.

"I'm very proud," said the executive in charge of Boeing Co.'s new 777 jetliner, which UAL Corp.'s United Airlines became the first to order a fortnight ago. "We're talking about entering a market that could easily see 50 years of production."

United's call for up to 68 of the wide-body twin-engine planes assures that Boeing will build a whole different size of aircraft, a 360-seater that falls between its 767 and 747 jumbo models. At stake, as Boeing makes its long-awaited move to replace older DC-10s and L-1011s, is an estimated $250 billion in business. The market is also coveted by the European consortium Airbus Industrie and St. Louis-based McDonnell Douglas Corp., which have put the Seattle concern in an unfamiliar catch-up role by having already sold hundreds of their A-330, A-340 and MD-11 airliners.

But no one could catch Boeing a couple of weeks ago. By sealing the record $22 billion United order, which includes bookings for as many as 60 747-400s, some think the company has introduced in the 777 a juggernaut that will reshape jetliner competitions well into the next century. McDonnell's ability to compete over the long haul is questionable, though Airbus is sure to remain a contender.

Few corporations dominate their field like Boeing, which is powerful enough to tip the U.S. trade balance singlehandedly. Not that its competitors are rolling over. "We think we already have a pretty established, proven product," said John Leahy, Airbus's chief negotiator. Added Robert Hood, president of McDonnell's commercial aircraft division: "I don't think the 777 alters our strategy one bit."

Boeing's victory in the United battle wasn't easy. Arriving at the airline's suburban Chicago headquarters on a Wednesday, brokers for the aircraft producers holed up in a series of conference rooms about 50 feet apart. Representatives from competing engine-makers General Electric Co., Rolls-Royce PLC and United Technologies Corp.'s Pratt & Whitney division did likewise. The teams haggled, crunched numbers and guzzled coffee. Jack Pope, United's chief financial officer, bounded from room to room, prying concessions.

Finally, by Sunday, Mr. Condit "couldn't stand it anymore," in the words of one United official. So he raced to Chicago to answer personally some last, lingering questions about the plane's range and payload. By the time he arrived, though, the bargaining was over. After years of planning, the 777 finally had a buyer, and Boeing its first new aircraft program in 11 years.

McDonnell and Airbus knew all along they faced an uphill fight. For one thing, United leans toward "rationalizing" its fleet—operating planes made by one manufacturer. When it phases out its DC-10s in favor of the 777s in the mid-1990s, the commonality achieved by going all-Boeing will save on spare parts and training.

Design Strategy

United wasn't in a position to make or break the 777 program. Boeing had worked closely in designing the plane with two other domestic and five foreign airlines that it still considers strong candidates to become early buyers. Nonetheless, with U.S. air travel softening, it isn't certain that American or Delta will be so quick to sign up. And although British Airways, Japan Air Lines, All Nippon Airways, Qantas Airlines and Cathay Pacific are all strong carriers, "Boeing's board wanted to have at least one solid domestic customer on the 777 before it gave its okay," said an industry executive. Boeing directors, set to meet today, must still launch the plane.

Likely adding to Boeing's motivation was the failure of its last design program—the 150-seat 7J7, which was to use a new "propfan" fuel-saving engine, but was shelved in 1987 for lack of a market.

Today's 777 was originally dubbed the 767-X because it was seen as a straight derivative of the 270-passenger 767 twin-jet. Aiming to please potential buyers, however, Boeing ended up with something quite different. It toyed with various elongations of the standard nine-seat-abreast 767 fuselage. It even proposed a sort of camel back, with a second deck of seats. Eventually, after "aggressively listening" to the airlines, Mr. Condit said, Boeing settled on a whole new cabin width and 10-abreast seating. It also increased the range to 4,800 miles, and added movable galleys and lavatories for easy reconfiguring. The 777 offers folding wingtips to allow for parking at smaller gates.

Such engineering advances suggest that by waiting to launch the 777, Boeing may have outfoxed its rivals. "Airbus has always said they were superior technologically," said Howard Rubel, aerospace analyst for Cyrus J. Lawrence Inc. "The 777 takes away that claim."

Waiting Risks

There are also risks in having waited. Deliveries won't begin until 1995, putting the 777 five years behind McDonnell's MD-11 and two behind Airbus's A-330.

In the end, though, Boeing seemed driven to protect its 50%-plus world market share. The company is said to have obliged United by making only 15 of the 777 outright orders; 19 others remain subject to "reconfirmation," according to one knowledgeable person, allowing United to back away if the economy sours. Neither Boeing nor United will comment. By promising an entire "family" of 777s, filling different niches, Boeing found another edge, especially over McDonnell.

On Saturday, UAL Chairman Stephen Wolf telephoned Douglas's Mr. Hood seeking assurances that there was a firm timetable for a larger, longer-range follow-on to the MD-11, the MD-12X. Although the company hopes to launch the plane in 1991, Mr. Hood said Mr. Wolf "wanted more confidence than we could give him that we are going to go ahead."

McDonnell's debt load also probably hurt, because airlines like to use a manufacturer's creditworthiness as collateral with lenders financing purchases. "This is a rich man's game," said Mr. Hood.

By Saturday afternoon, executives were so exhausted they were falling asleep in the middle of sentences. To keep awake, GE even started a pool in which participants bet on what airframe-engine combinations United might buy.

United picks planes by running calculations through an extraordinarily complex economic model. Created by United analyst Lou Valerio—and therefore known as Valerio's Black Box—its <u>aim is to arrive at a single figure that expresses the value of flying a particular aircraft</u>. The manufacturers detest the Box because they can't tell how much credit their products are given for certain purported advantages. Losers, of course, hate it most. After GE was eliminated Sunday evening, several people say, some company officials wept.

Even the winners didn't get off easy. To Pratt & Whitney's Sel Berson, Mr. Pope snapped in jest: "I'm sick of buying Pratt & Whitney engines," before telling the stunned executive his product had won.

Boeing was summoned to Mr. Pope's office last. Mr. Condit and a colleague, Richard Albrecht, took their seats. Seconds later, Mr. Condit jumped out of his.

> "United picks planes by running calculations through an extraordinarily complex economic model...Its aim is to arrive at a single figure that expresses the value of flying a particular aircraft."

BSDS – Development

- **Define a "*single figure*" measure of merit** to readily compare alternative vessel designs, including optimized new design vs. standardized off-the-shelf designs, finance schemes and operating scenarios

- **Create a ship design tool to:**
  Parametrically design all feasible ships within a specified design space
  - For the optimum solution produce detailed technical description (principal characteristics, form coefficients, major weight groups, speed / power curve, preliminary build cost)
  - Perform trade-off studies between alternatives

- **Create a comprehensive project planning tool to:**
  - Include schedule of vessel operating and finance scheme
  - Include terminal CAPEX and OPEX
  - Incorporate port and cargo handling costs

- **Integrate all to present complete picture of proposed project**

BSDS – Inputs

Inputs to BSDS consist of detailed description of physical design constraints, build cost elements and expected economic conditions under which the shi(s) will operate.

LBSDS INPUT DATA

Linear measures in feet, Weights in tons, Prices in USD

Title Page:
Prepared for
Job code
Date
Prepared by
IDF reference
Project

Model & Output Options:
Program switch
Program switch
Program switch

Project Description: DSN
Project life
Vessel type
WS or zero
Cargo value
Cargo inflation
Freight escalator

Throughput & Finance: DSN
Req'd. throughput
Cargo stowage factor
Discount rate - ship
Discount rate - terminal
Corporate tax rate
Tax credit
Corp. structure

Route Data: DSN
One way distance
Operating days

Propulsion: DSN
HP lower limit
HP upper limit
HP increment
Nominal fuel rate
Prime mover type

Fuel Rate Calculation: DSN
Fuel rate switch
Fixed fuel rate
Variable fuel rate
Fuel rate exponent

Vessel Capacity: DSN
Max. t at load port
DWT calc. switch
Throughput limit
Max. t at disch. port

Bunker Schedule: DSN
Rotation
Price - load port
Price - disch. port
Price inflation
Vessel fuel margin

Port Time & Cost: DSN
Fixed load time
Dock & undock time
Cargo pumping rate
Pump efficiency factor
Cargo viscosity
Port costs per voyage

Vessel Lightering: DSN
Cargo lightered
Lightering pump factor
Fixed lighter time
Variable lighter time
Lightering cost

Vessel Cost: DSN
Cost calc. switch
Equity percent
Salvage value percent
Subsidy percent

Vessel Depreciation: DST
Depreciation method
Declining balance factor
Term of depreciation
Depreciable basis

Vessel Finance: DSN
Interest rate on debt
Term of loan - years
Mortgage / lease ind.

Crew Costs: DSN
Avg. cost per crew
Crew cost inflation
Annual misc. costs
Misc. cost inflation
Number of crew

M&R Costs: DSN
M.E. M&R coef.
Hull M&R Coef.
M&R inflation rate
Insurance rate
Insurance inflation

Terminal Capital Cost: DSN
Terminal fixed cost
Terminal variable cost
Equity Contribution
Salvage value

Terminal Depreciation: DSN
Depreciation method
Declining balance factor
Term of depreciation
Depreciable basis

Terminal Finance: DSN
Interest rate on debt
Term of finance
Mortgage / lease switch

Terminal Operating Costs: DSN
Fixed operating costs
Reserved data field
Reserved data field
Reserved data field
Annual escalation rate

Vessel Length Optimization: DSN
LWL lower limit
LWL upper limit
LWL increment

Block Coef. Optimization: DSN
Cb lower limit
Cb upper limit
Cb increment

Length / Beam Optimization: DSN
L/B ratio lower limit
L/B ratio upper limit
L/B ratio increment
Maximum beam limit

Length / Depth Optimization: DSN
L/D ratio lower limit
L/D ratio upper limit
L/D ratio increment
Maximum depth limit

Machinery Cost: DSN
Fixed cost of mach'y.
Mach'y variable cost
Variable cost exponent

Machinery Weight Estimate: DSN
Fixed mach'y weight
Variable mach'y weight
Var. mach'y weight exponent

Hull Cost Estimate: DSN
Steel mat'l. cost
Steel erection rate
Steel labor rate
Cb erection rate factor
Steel wastage factor

Vessel Outfit Cost Estimate: DSN
Outfit weight factor
Fixed outfit cost
Variable outfit cost
Var. outfit cost exponent

LNG & LPG Inputs: DSN
Long. strength factor
Containment weight factor
Containment fixed cost
Containment variable cost
Variable cost exponent

Shipyard Profit Rate: DSN
Reserved
Reserved
Reserved
Shipyard fixed cost per hull
Shipyard profit rate

Resistance & Propulsion: DSN
Number of screws
Midship coefficient
Appendage resistance
Service allowance
Minimum propulsive coef.
Bow bulb area percent
Wetted surface coef.

Supplemental Design Factors: DSN
Double bottom factor
Double side shell factor
Ballast requirement factor
Cargo cubic adjustment factor
Ballast adjustment factor
Steel type indicator
Forecastle indicator

Output Control: DSN
Output switch
Output switch
Output switch
Project start year

SENSITIVITY ANALYSIS

Three variables may be tested per program run.

Sensitivity Analysis Switch: DSN
First variable number
Maximum value
Minimum value
Increment

Sensitivity Analysis Switch: DSN
Second variable number
Maximum value
Minimum value
Increment

Sensitivity Analysis Switch: DSN
Third variable number
Maximum value
Minimum value
Increment

TransTech Marine Co.

BSDS – Output

Eight to twelve pages, depending on design search space, consisting of: 1. Title Page, 2. List of Inputs, 3. Vessel Design Optimization, 4. Principal Characteristics and Cost Est, 5. Speed vs. Power vs. Throuput, 6. OPEX Schedule, 7. CAPEX Schedule, 8. Summary

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 DDDDDDDD    BBBBBBBBB     SSSSSSSS  DDDDDDDD      SSSSSSSS
 DDDDDDDDD   BBBBBBBBBB  SSSSSSSSSS  DDDDDDDDD   SSSSSSSSSS
 DDD    DDD  BBB    BBB  SSS         DDD    DDD  SSS
 DDD    DDD  BBB    BBB  SSS         DDD    DDD  SSS
 DDD    DDD  BBBBBBBBB   SSSSSSSSS   DDD    DDD  SSSSSSSSS
 DDD    DDD  BBBBBBBBB     SSSSSSSSS DDD    DDD    SSSSSSSSS
 DDD    DDD  BBB    BBB          SSS DDD    DDD          SSS
 DDD    DDD  BBB    BBB          SSS DDD    DDD          SSS
 DDDDDDDDD   BBBBBBBBBB  SSSSSSSSSS  DDDDDDDDD   SSSSSSSSSS
 DDDDDDDD    BBBBBBBBB   SSSSSSSS    DDDDDDDD    SSSSSSSS

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DRY BULK SHIPPING DEVELOPMENT SYSTEM

TRANSTECH MARINE COMPANY

771 Carroll Street
Brooklyn, New York 11215 USA

Client: .

Job Code:

Date:

Prepared b

IDF Reference:

Project: .

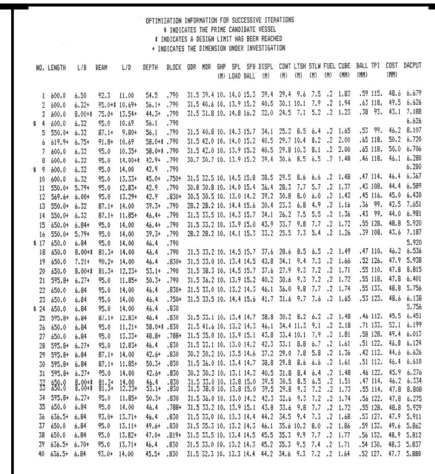
VESSEL OPTIMIZATION BASED
UPON THE FOLLOWING
PROBLEM INPUT INFORMATION

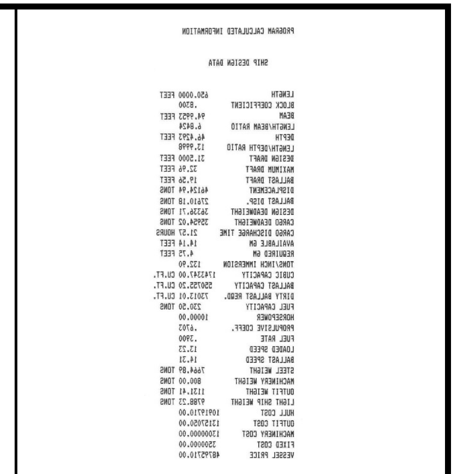
GENERAL SYSTEM INPUTS

LENGTH OF ANALYSIS	25
TYPE OF SHIP - BULK CARRIER	
THE INITIAL VALUE OF CARGO EQUALS	25.00
THE ESCALATION ON CARGO VALUE EQUALS	.050
THE CARGO DENSITY EQUALS	45.00
THE EFFECTIVE TAX RATE EQUALS	.36
NO PROFITS AVAILABLE TO COVER TAX LOSSES	
UNLIMITED THROUGHPUT ANALYSIS	
REVENUE ESCALATION RATE	.050

SHIP SYSTEM INPUTS

ONEWAY DISTANCE EQUALS	800.
OPERATING DAYS PER YEAR	350.
DEADWEIGHT COMPUTED	
CUBIC CAPACITY COMPUTED	
SLOW SPEED DIESEL PROPULSION PLANT	
NOMINAL FUEL RATE	.390
SPEED COMPUTED BY TAYLOR SERIES	
BUNKER AT LOAD PORT ONLY	
COST OF BUNKERS EQUALS,	175.00
ESCALATION RATE FOR BUNKERS	.020
FUEL MARGIN RATIO	.150
CARGO LOADING TIME - HOURS EQUALS	40.00
MISCELLANEOUS IN PORT TIME	6.00
AVERAGE PORT COSTS PER VOYAGE	25000.00
DISCHARGE TIME COMPUTED	
AVERAGE COST PER MAN EQUALS	95000.00
ESCALATION RATE FOR MANPOWER COSTS	.035
MISCELLANEOUS CREW COSTS	50000.00
ESCALATION RATE FOR MISC. CREW COSTS	.050
NUMBER OF CREW	24
FACTOR FOR ENGINE M & R	4200.00
FACTOR FOR HULL M & R	100.00
ESCALATION RATE FOR M & R	.050
INSURANCE RATE	.015
ESCALATION RATE FOR INSURANCE	.020
SALVAGE VALUE PROPORTION	.050
PROPORTION OF OWNERS EQUITY	.20
PROPORTION OF CAPITAL DEPRECIABLE	1.00
STRAIGHT LINE DEPRECIATION	
DEPRECIATION PERIOD EQUALS	10.00
INTEREST RATE ON BORROWINGS EQUAL	.110
AMORTIZATION TIME ON BORROWINGS	20.00
DISCOUNT RATE	.120





SPEED/POWER POINTS FOR HULL FORM

HORSEPOWER APPLIED	HORSEPOWER EFFECTIVE	SPEED LOADED	SPEED BALLAST	FUEL RATE	DACPUT	THRUPUT
10000.00	5319.58	13.23	14.31	.390	5.7560	1590045
10500.00	5585.56	13.38	14.48	.390	5.7788	1600397
11000.00	5851.54	13.53	14.64	.390	5.8023	1610378
11500.00	6117.52	13.67	14.80	.390	5.8263	1619996
12000.00	6383.49	13.81	14.95	.390	5.8511	1629260
12500.00	6649.47	13.95	15.10	.390	5.8764	1638178
13000.00	6915.45	14.08	15.24	.390	5.9035	1646416
13500.00	7181.43	14.20	15.37	.390	5.9323	1654045
14000.00	7447.41	14.32	15.50	.390	5.9612	1661488
14500.00	7713.39	14.44	15.62	.390	5.9902	1668749
15000.00	7979.37	14.55	15.75	.390	6.0194	1675831
15500.00	8245.35	14.67	15.87	.390	6.0487	1682738
16000.00	8511.33	14.78	15.99	.390	6.0782	1689471
16500.00	8777.30	14.89	16.11	.390	6.1078	1696034
17000.00	9043.28	15.00	16.23	.390	6.1376	1702430
17500.00	9309.26	15.11	16.35	.390	6.1676	1708661
18000.00	9575.24	15.21	16.46	.390	6.1978	1714730
18500.00	9841.22	15.32	16.57	.390	6.2281	1720639
19000.00	10107.20	15.42	16.68	.390	6.2586	1726392
19500.00	10373.18	15.52	16.79	.390	6.2893	1731989
20000.00	10639.16	15.61	16.90	.390	6.3202	1737430

SCHEDULE OF OPERATING COSTS
FOR A SINGLE VESSEL
(THOUSANDS)

YEAR	CREW	FUEL	M R	INS.	MISC/PORT	TOTAL	CARGO FINANCE
1993	2280.	1674.	202.	732.	1156.	6044.	66.
1994	2360.	1704.	236.	753.	1213.	6266.	70.
1995	2442.	1738.	272.	772.	1274.	6500.	73.
1996	2528.	1773.	312.	791.	1338.	6742.	77.
1997	2616.	1809.	354.	809.	1405.	6993.	81.
1998	2708.	1845.	401.	825.	1475.	7253.	85.
1999	2803.	1882.	450.	840.	1549.	7523.	89.
2000	2901.	1919.	504.	852.	1626.	7802.	94.
2001	3002.	1958.	562.	862.	1707.	8091.	98.
2002	3107.	1997.	625.	868.	1793.	8391.	103.
2003	3216.	2037.	693.	872.	1882.	8700.	108.
2004	3329.	2078.	765.	872.	1976.	9020.	114.
2005	3445.	2119.	844.	867.	2075.	9350.	119.
2006	3566.	2162.	928.	857.	2179.	9691.	125.
2007	3691.	2205.	1018.	841.	2288.	10043.	132.
2008	3820.	2249.	1115.	819.	2402.	10406.	138.
2009	3953.	2294.	1220.	790.	2523.	10779.	145.
2010	4092.	2340.	1332.	752.	2649.	11164.	152.
2011	4235.	2387.	1452.	704.	2781.	11559.	160.
2012	4383.	2434.	1581.	647.	2920.	11965.	168.
2013	4537.	2483.	1719.	577.	3066.	12382.	176.
2014	4696.	2533.	1867.	495.	3219.	12809.	185.
2015	4860.	2583.	2026.	397.	3380.	13246.	194.
2016	5030.	2635.	2195.	284.	3549.	13693.	204.
2017	5206.	2688.	2377.	152.	3727.	14149.	214.
Total	88806.	53523.	25052.	18028.	55154.	240564.	3172.

SCHEDULE OF FINANCIAL INFORMATION
FOR A SINGLE VESSEL
(THOUSANDS)

YEAR	REVENUE	OP.COST	DEPREC.	INTEREST	PRINCIPAL	CASH FLOW
1993	9152.	6110.	4880.	4294.	608.	347.
1994	9610.	6336.	4880.	4227.	675.	472.
1995	10090.	6573.	4880.	4153.	749.	601.
1996	10595.	6819.	4880.	4070.	832.	737.
1997	11125.	7074.	4880.	3979.	923.	880.
1998	11681.	7338.	4880.	3877.	1025.	1030.
1999	12265.	7612.	4880.	3765.	1137.	1188.
2000	12878.	7896.	4880.	3640.	1262.	1354.
2001	13522.	8190.	4880.	3501.	1401.	1528.
2002	14198.	8494.	4880.	3347.	1555.	1710
2003	14908.	8808.	0.	3176.	1726.	145.
2004	15653.	9134.	0.	2986.	1916.	346.
2005	16436.	9470.	0.	2775.	2127.	556.
2006	17258.	9817.	0.	2541.	2361.	775.
2007	18121.	10175.	0.	2281.	2621.	1005.
2008	19027.	10544.	0.	1993.	2909.	1244.
2009	19978.	10924.	0.	1673.	3229.	1495.
2010	20977.	11316.	0.	1318.	3584.	1755.
2011	22026.	11719.	0.	923.	3979.	2027.
2012	23127.	12133.	0.	486.	4416.	2309.
2013	24284.	12559.	0.	0.	0.	7504.
2014	25498.	12994.	0.	0.	0.	8002.
2015	26773.	13441.	0.	0.	0.	8532.
2016	28111.	13897.	0.	0.	0.	9097.
2017	31957.	14364.	0.	0.	0.	11259.
Total	439250.	243736.	48796.	59004.	39037.	

VESSEL VOYAGE ANALYSIS

DESIGN DWT	36336.71
CARGO DWT	35954.02
TRIPS/YEAR	44.22
TONS/YEAR	1590045.00

DEADWEIGHT DETERMINED AT LOADING PORT.

DISCOUNTED COST PER TON	5.756

BSDS – Case Studies

- DBSDS: (Dry Bulk) preliminary design evaluation of 400,000 DWT ultra-large "Chinamax" iron ore carriers
- DBSDS: Comparison of self-propelled collier vs. ATB in Jones Act coal transport
- DBSDS: Various "minor bulk" transport projects (alumina, phosphate, sugar) design proposals

- LBSDS: (Liquid Bulk) preliminary design of alternative double-hull tanker designs to comply with US OPA'90 and MARPOL pollution prevention requirements
- LBSDS: Concept design evaluation of FCOJ tanker
- LBSDS: Evaluate adaptation of single skin tanker for fresh water transport

- LGSDS: Under Development

- All modules of BSDS include sensitivity analysis capability and ability to input existing design for comparison to new optimized design proposal.

- Note … For long-term industrial transport projects where ship(s) are in captive employment for most / all of vessel's service life, optimized design <u>almost always</u> produces lower DACPUT than lower initial cost off-the-shelf standardized design.

BSDS - Eureka!

Straight Answers for Strategic and Technical Decision Makers in Dry, Liquid, Gas Industrial Marine Shipping Sectors

Innovations

A complete management empowerment tool

BSDS measures the trade-off

INSPIRATION for TransTech Marine's Bulk Shipping Develop ment System (BSDS) came from two sources, claims Geoffrey Uttmark, president of the company.

First was the intuitive appreciation that technical design and project financial/economic analyses are, as far as the shipper is concerned, simply two sides of one coin. Ideally, the ship (or fleet of ships) should be sized to cargo characteristics and throughput requirements, and around any physical constraints imposed by such details as draught limitations, berth size, storage capacity and canals. This means standardised 'off-the-shelf' designs might not be ideal and, if not, the difficulty comes in trying to balance the technical and economical trade-offs.

The second source of inspiration is TransTech's contention that shipping is not always a derivative business as commonly thought. Many examples exist of trades that did not exist until the technology to exploit them was developed, so shipping technology and economics can lead to the development of a market.

Uttmark claims that many industrial shipowners simply select the lowest freight rate from a variety of stock designs, because the industry lacks the tools the provide a better approach. BSDS has been designed to give the ship owners a tool with which "to negotiate more effectively with the builder, as well as enabling the shipyard to respond more rapidly and completely to owners' specific design requirements." The BSDS can be therefore viewed as a "complete management empowerment tool" integrating a technical design module with a complete project financial presentation, comprising loan amortisation, schedule of operating costs and cash flow projections.

To date BSDS has been used in a consultative role on projects for shipping coal, iron ore and raw sugar. Uttmark believes "there are mining, agricultural, oil and gas, and other shipping group interests who would benefit from DBSDS (Dry Bulk Shipping Development System), LBSDS (Liquid Bulk Shipping Development System), or LGSDS (Liquid Gas Shipping Development System) to help validate or develop projects where efficient seaborne transport is critical."

An example of where the system would be beneficial is for exporters of lower value commodities, which are vulnerable to being closed out of overseas markets by transportation costs. TransTech claims BSDS can assist policy makers determine if limited resources would be better invested in the national fleet or in harbour improvements, enabling deeper draught ships to load more cargo, have a faster turnaround time, hence lowering freight rates through improved efficiency.

How it works

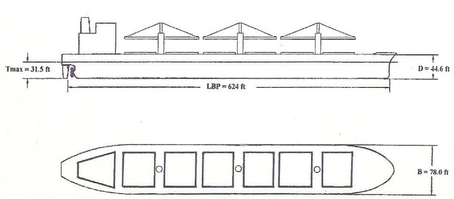
In a case study using DBSDS, a coal carrying cargo vessel operating on the Great Lakes shuttle service had some of the vessel's measurements already set by a desire not to exceed the constraints of the Saint Lawrence Seaway. The overall length was reduced from the maximum, as this is the most costly dimension. Design depth ratios and beam ratios were set within certain limits as was the block coefficient. Further measurements were also input to define hull constraints.

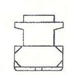
A preferred main propulsion system, with power output and propeller selection, propulsive coefficient, appendage resistance, an initial nominal fuel rate and required service margin were added into the machinery section, along with options for no bulbous bow and bunker costs and loading requirements.

A cargo unloading system involving the use of high derricks was selected in preference to conveyors to increase cargo capacity and allow the carriage of deck cargo.

Full vessel financing details including construction subsidy, vessel depreciation and owner taxing information is also input, along with construction and operation details.

In the case study the program explored 53 separate designs within the power range selected. Output of essentially redundant designs is kept to a minimum "by the judicious selection of the increments of the input variables within the allowed ranges," said Uttmark.





MAIN PARTICULARS

LOA	644	ft.
LBP	624	ft.
BEAM	78.0	ft.
DEPTH	44.6	ft.
DRAFT	31.5	ft.
BHP	10,000	total
SPEED	14.0	knots
DISP	36,400	tons
DWT	28,600	tons
PRICE	$32,347,000	
DACPUT	$5.43	

A graphical representation of the coastal collier designed for the Saint Lawrence Seaway and developed using TransTech Marine's DBSDS

Lowest cost solution

Each successive design iteration seeks a lower DACPUT (Discounted Annual Cost Per Unit Throughput) figure than previous designs, a process that continues until the absolute minimum solution is found or the specified design space is fully exhausted. The least cost transport solution within the defined design space is produced because the DACPUT measure captures all ship construction, finance and operating costs on a discounted life-cycle cost basis. To ensure that a true minimum has been achieved, the increments or bounds of the design variables can be reduced or expanded in subsequent program executions. Uttmark claims this degree of control is essential, "since in some applications (such as supplying a steel mill with limited scrap storage capacity) sub-optimisation of shipping costs might be less critical than optimising the process as a whole."

Uttmark believes perceptive use of DBSDS can point to intelligent questions, leading to improved design and project structuring. "Final absolute decisions always remain the domain of the designer, shipowner, operator or builder." He goes on to say, "this is bulk shipping project development as it should be, using DBSDS to evaluate alternatives completely and economically, so that managers charged with design, finance and operations can take their decision insightfully and authoritatively." S

TransTech Marine Co.