ANNEX XVI

ECONOMIC ANALYSIS OF DISMANTLING

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Economic analysis of dismantling

I. Introduction.

There is no single economic model for the functioning of a ship dismantling facility which can be applied to all the world's regions where this activity is conducted. Also, the different dismantling sites do not all treat the same type of ships, and some have even specialised their activity to optimise their production of recyclable metal in relation to possible market outlets.

In this current period of high prices for raw materials (primary raw materials) which have an effect on old metals (secondary raw materials), and of increasing scarcity of resources (shortage of ships to be dismantled) due to the fact that time-expired ships are being kept in service by high freight rates, ship recyclers, usually discrete, have become reluctant to make any economic communication.

The strong competition for large ships that is now prevailing on a world scale only heightens this caution. As a result, economic transparency is not available and if we wish nevertheless to improve our visibility of true costs in this area and our understanding of the market, we must make a distinction firstly between the invariants and secondly between the specific parameters for each category and type of ship.

Furthermore, this analysis is highly complicated by the absence of some data and even by the desire of some economic players (companies, States) not to disclose some profitable market niches or to mislead their competitors. Therefore the invariants must first be identified so that, by cross-reference or comparison, orders of magnitude can be determined.

II. First economic analysis method

This first method is based on the comparison of the ratios of production costs at the different levels of cost analysis in order to bring to light any abnormalities or erroneous data and the different industrial strategies that are applied by the dismantling sites in the world's different dismantling regions.

The ultimate objective is to show clearly the difference in costs between a dismantling facility which uses processes that are heedful of the environment and of worker safety (European) and a current dismantling site in the Indian subcontinent which does not observe these requirements. This should enable us to set a credible level of financial incentive to be introduced into a dismantling operation between a ship owner anxious to protect workers and the environment and a dismantling site in the Pakistan-India-Bangladesh (PIB) area prepared to make the effort to come into compliance with standards for worker safety and environmental protection.

II.1. <u>Amortisation of equipment at dismantling facilities complying with standards:</u>

Visits to European and American dismantling facilities have allowed us to identify the level of equipment that is considered essential to conduct operations that are satisfactory both for workers and the environment:

On the basis of an annual flow of 100 000 tonnes of produced scrap (average-sized facility ensuring a continuous production) and an amortisation period of no more than 7 years, it can be estimated that the initial investment is in the region of €20 million in order to amortise this equipment and infrastructure: i.e. an amortisation cost of approximately €30/tonne of scrap. If production is limited to 30 000 tonnes as is the currently the case in Europe, the unit cost of amortisation then rises to €100/tonne.
On the basis of these 100 000 tonnes, the figure of €30/t is coherent both with the mean productivity of a European worker in the metal recycling sector (1000 to 2000 t/year) and with mean global costs per mechanised work station of €25 to €55/t (figures taken from trade bulletins).

II.2. <u>Data on structural and supervision costs</u>

II.2.1. For European dismantling facilities:

Those dismantling facilities that are little labour-intensive but which are highly mechanised have a high coefficient of structural costs (1.6) and supervision costs (1.3) due to very extensive management and supervision per worker in this type of economic model which has recourse to heavy dangerous equipment, this situation being reflected in the price of each tonne of recycled metal.

II.2.2. For American dismantling sites:

Structural costs are substantially the same as in Europe being similarly administrated, but as the dismantling facilities in the United States use less large-size equipment, the usual ratio for management and supervision costs is 1/10.

II.2.3. For Turkish and Chinese dismantling sites:

Structural costs are lower than in Europe and the USA. On the other hand, supervision costs are on much the same level as in the USA, the ratio applied for supervision being similar (1/10).

II.2.4. For dismantling sites in the Indian subcontinent:

Structural costs like supervision costs are very low since company administration and supervision costs (ratio of less than 1/20) are either embryonic or non-existent.

II.3. <u>Data used to calibrate the productivity of different dismantling facilities:</u>

II.3.1. Input data on individual productivity at the site in Van Heyghen (B):

Summary of industrial organisation:

A low number of production personnel and administrative staff, highly organized work structure and premises, extensive worker protection and protection of the environment, and very highly mechanised (cranes, hydraulic rippers, automatic sorters, press-shears, mobile handling equipment…) backed by an existing recycling facility for land scrap.

Productivity data collected:

- For a very simple vessel (river barge of 800 tonnes), for ripping: 2 days by 2 workers to which must be added, for all cutting and handling operations: 2 days by 2 workers. On the basis of 200 productive days/year, this gives an annual productivity of 10 000 tonnes per worker.
- For a more complex merchant ship (fire-damaged Ro-Ro vessel): 4000 tonnes on which 10 workers are posted for 4 months, i.e. 12 000 tonnes per year for 10 workers. This gives an annual productivity figure of 1200 tonnes per person.
- Estimation for a complex ship to be dismantled (frigate): 4000 tonnes requiring a mean workforce of 15 persons (including for pollutant removal) over a period of one year, i.e. an annual productivity in the region of 300 tonnes.

II.3.2 Input data on productivity at the site in Scheepssloperij (NL):

Summary of industrial organisation

Small workforce, highly organised work structure and premises, extensive worker safety and protection of the environment, and highly mechanised (cranes, hydraulic rippers, automatic sorters, press-shears, mobile handling equipment…) and backed by a recycling facility for land scrap.

Productivity data collected:

- For very simple vessels with little pollution (barges, annual supply of 60 000 to 30 000 tonnes demolished by 6 persons) i.e. an annual productivity of 5 000 to 10 000 tonnes per worker.
- Complex ships (two frigates): 4000 tonnes each, demolished in 3 months by 6 to 8 workers, not taking into account any pollutant removal. For major pollutant removal work at least around one dozen workers must be estimated, working over a period of 3 months on this type of vessel. This leads to a mean cost of around ten workers over 6 months i.e. a productivity in the order of 800 tonnes per year and per worker.

II.3.3 Input data on the productivity of an American dismantling site:

Summary of industrial organisation:

A higher labour force than in Europe, extensive work organisation and organisation of premises, good protection of the environment and of worker safety, but average mechanisation (cranes, hydraulic rippers, automatic sorters, press-shears, mobile handling equipment…) and not backing by a recycling facility for land scrap.

Productivity data collected:

- Complex naval ships containing pollutants: out of the 225 persons on the demolition worksite, 200 represented productive workers for a maximum production of approximately 100 000 tonnes per year. This gives an individual productivity figure of around 500 tonnes per year. This seems to be coherent with the productivity of more mechanised European dismantling sites.

II.3.4. Input data on the productivity of dismantling sites in Aliaga (Turkey):

Summary of industrial organisation:

A much greater labour force than in western Europe, good work organisation and organisation of premises, average protection of the environment and heed of worker safety, and low mechanisation (cranes but no hydraulic rippers, automatic sorters, press-shears, mobile handling equipment…) and without the backing of a recycling facility for land scrap.

Productivity date collected:

- The mean productivity of the Aliaga sites lies between the maximum annual workload which can be absorbed, which according to the sites is reported to be 650 000 tonnes of scrap for 2000 direct workers on this coastline site (i.e. 325 tonnes/person-year) and the plateau level in the early 2000s of 150 000 tonnes for 400 employees (i.e. 375 tonnes/person-year) which preceded the current level. This productivity relates to merchant ships of small and medium size, more complex than the large tankers and bulk carriers treated in the Indian subcontinent.

- The dismantling sites in Aliaga have already dismantled national and foreign naval vessels, but precise data on both the amount of labour involved and the tonnage of the ships dismantled is incomplete.

II.3.5. Input data on the productivity of the dismantling site in Zhong Xui (China):

Summary of industrial organisation:

Many more workers than in western Europe, good work organisation and organisation of premises, good protection of worker safety and the environment, but low mechanisation (cranes but no hydraulic rippers, automatic sorters, press-shears, mobile handling equipment…) and without the backing of a recycling facility for land scrap.

Productivity data collected:

- The mean productivity at the Zhong Xui dismantling site includes the maximum production figures reached in 2000 with 280 000 lightweight displacement tonnes and the employment of around 1000 workers. This leads to a mean production of approximately 300 tonnes/ person-year for merchant ships of average complexity.

II.3.6. Input data on productivity at the Alang dismantling sites (India):

Summary of industrial organisation:

A very high number of workers having little training, low level of work organisation and organisation of premises, no specific infrastructures, practically no protection of the environment or of worker safety, and very low level of mechanisation (cranes, mobile handling equipment..) and without any backing of a recycling facility for land scrap. Very high ratio of reuse and direct resale of collected scrap, by re-rolling metal sheet.

Productivity data collected:

- At the peak of their activity in 1999, the dismantling sites in Alang directly employed around 40 000 workers on a permanent basis and produced 3 million tonnes of scrap, i.e. a productivity of approximately 75 tonnes/person-year. During the period from 2000-2003, the sites in Alang treated an average supply of 2.5 million ship lightweight tonnes with a workforce of 30 000 workers i.e. a mean annual production of around 80 tonnes per worker. Since the start of the fall in ship dismantling work in India (2004) the 5000 remaining workers are reported to have treated 0.5 million ship lightweight tonnes i.e. less than 100 tonnes per worker. At the start of 2006, the remaining 3500 workers demolished less than 250 000 ship lightweight tonnes.

II.3.7. Input data on the productivity of the dismantling sites in Chittagong (Bangladesh):

Summary of industrial organisation:

A very high number of workers having little training, low level of work organisation and organisation of premises, no specific infrastructures, very little protection of the environment and of worker safety, and low level of mechanisation (cranes, mobile handling equipment…), and not backed by any recycling facility for land scrap. A very high ratio of reuse and direct resale of scrap collected, through the re-rolling of metal sheet.

Collected productivity data:

- The Bengali dismantling sites have specialised in large ships of simple construction. They are less willing to treat small, complex vessels such as naval vessels or small merchant ships which do not yield sufficiently long lengths of plate that can be directly sent to re-rolling workshops. In 2000, with a direct labour force of 45 000 to 50 000 workers present on the demolition sites, Bangladesh treated 1.5 million ship lightweight tonnes. This is an annual unit production of approximately 30 tonnes of scrap. In 2004, just before the fall to the present level, Bangladesh treated approximately 2.5 million tonnes of scrap, directly employing around 100 000 workers on these dismantling sites, i.e. an annual unit productivity of around 25 tonnes of scrap.

II.3.8. Conclusions on the productivity of the three types of dismantling sites:

Three categories of dismantling site can be roughly defined in direct relationship to their respective levels of mechanization, and correlatively with their labour force employment level. It must first be considered that the three types of dismantling sites do not treat the same types of ships owing to the market niches each one has carved out:

- The European and American dismantling sites are highly to very highly mechanised, and geographically have the support of large metal recycling companies. They essentially treat small or medium-sized naval or civilian vessels (merchant ships, inner water vessels and fishing vessels) that are relatively complex. Their mean annual unit productivity is approximately 300 to 1200 tonnes for small vessels of average complexity. For very simple vessels (river barges) and if there are no pollutants on board, production rises to 5000 and even approaches 10 000 lightweight tonnes per year.
- The Turkish and Chinese dismantling sites which handle small to medium-sized ships, essentially merchant ships of average complexity, have a productivity of around 300 to 350 tonnes per worker and per year.
- The dismantling sites in the Indian subcontinent which are endeavouring only to handle large, simple ships in order to maximise the direct recycling of metals by re-rolling (60 to 70%), have a mean annual unit productivity of 30 to 80 tonnes.

III. Second economic analysis method

The second method consists of comparing the operating results of the different industrial models of dismantling, after first identifying and quantifying in each one the costs and income of this operation for one same measurement unit: the dismantled ship lightweight tonne.

III.1. European or American model:

For this model, the data collected on the average distribution of blowtorch cutting and fully mechanised cutting shows a ratio of 30/70. The average recycling figures for metal materials is approximately 85% for steel and a few percent for non-ferrous metals. It can be reckoned that approximately 10% of waste is not immediately recyclable.

Ships with very little pollution

Income	Amount	Costs	Amount
Sale of scrap to steelworks (85% at $250/t)	210	Production costs using blowtorches (25% at $69/t)	17
Sale of non-ferrous metals to foundries (2% at $3000/t)	60	Production costs using hydraulic ripper (60% at $44/t)	26
Sale of the dismantling service	0	Cutting and transport costs (85 % at $50/t)	42
Sale of recovered equipment (1% at $3000 /t)	30	Costs for treatment of normal waste (10% at $120/t)	12
		Purchase of ship	100
Total	300	Total	197

i.e. a margin in the order of $100/t

Ships with average pollution

Income	Amount	Costs	Amount
Sale of scrap to steelworks (85% at $250/t)	210	Production costs using blowtorches (25% at $69/t)	17
Sale of non-ferrous metals to foundries (2% at 3000 $/t)	60	Production costs using hydraulic ripper (60% at $44 t)	26
Sale of the dismantling service	200	Cutting and transport costs (85 % at $50/t)	42
Sale of recovered equipment (1% at $3000 /t)	30	Pollutant removal costs (initial and continuous) ($200/t)	200
		Costs for treatment of normal waste (10% at $120/t)	12
		Costs for treatment of end hazardous wastes (1% at $1000/t)	10
		Purchase of ship	0
Total	500	Total	307

i.e. a margin in the order of $200/t

Highly polluted ships

Income	Amount	Costs	Amount
Sale of scrap to steelworks (85% at $250/t)	210	Production costs using blowtorches (25% at $69/t)	17
Sale of non-ferrous metals to foundries (2% at $3000/t)	60	Production costs using hydraulic ripper (63% at $44/t)	28
Sale of the dismantling service	400	Cutting and transport costs (88 % at $50/t)	44
Sale of recovered equipment (1% at $3000/t)	30	Pollutant removal costs (initial and continuous) ($400/t)	400
		Waste treatment costs (10% at $120/t)	12
		Costs for treatment of end hazardous wastes (2% at $1000/t)	20
		Purchase of ship	0
Total	700	Total	521

i.e. a margin in the order of $200/t

In the European or American model, it is evident that since there is greater competition in the dismantling trade for the recycling of simple, little polluted ships, the profit margin for this category of ships is lower ($100/t). On the other hand, for ships having average pollution or for highly polluted ships, industrialists will firstly make the customer pay directly for the surcharges generated by regulatory and technical restrictions regarding complex, highly polluted ships, and secondly will also make the customer pay the extra expertise and technical skills insofar as the customer geographically has no other option since there is no material or regulatory possibility to turn elsewhere to service providers located in an area paying less attention to these restrictions. In this case, the margin is roughly the same as the margin which the industry usually draws from trading land scrap.

III.2 Model of the Indian subcontinent:

For this model, the data collected show low salary costs and low infrastructure costs e.g. for equipment. A very large part (65%) of the steel recovered on board is recovered in the form of long lengths of plate around 1 m wide and 8 to 10 m in length, which can enter directly into a hot rolling or re-rolling cycle to produce steel for the building industry (world rate for local sale: $800 to $1000/t).

Recycled non-ferrous metals are proportionally less well paid than in Europe. On the other hand, all the equipment found on board that is in working order or which can be repaired is recovered, which increases the price rates and value of this type of equipment that can be directly resold. Some waste (sand polluted by hydrocarbons, wood, fabric) even finds buyers whereas this type of waste would be a cost item for a European or Turkish recycler. There are in fact practically no treatment costs incurred for waste to be recycled since everything is recovered by circuits outside the dismantling site which reintroduce this waste into the economic cycle, at time generating end wastes which are abandoned far distant from the dismantling site. As a result, there is no real reason to make an economic distinction for this model between ships that are highly polluted and ships which are little polluted. Solely the conformation of the ship is of importance allowing its easy conversion into long plates of steel for re-rolling.

All levels of pollution

Income	Amount	Costs	Amount
Sale of scrap to steelworks (28% at $200/t)	56	Salary costs	10
Sale of scrap for re-rolling (65% at $600/t)	390	Infrastructure costs	5
Sale of the dismantling service	0	Industrial equipment costs	5
Sale of recovered equipment (5% at $1000/t)	50	Waste treatment costs	0
Sale of non-ferrous metals to foundries (2% at $2000/t)	40	Purchase of ship (100%)	400
Sale of fuel and wastes (1% at $100/t)	1		
Total	537	Total	420

i.e. a margin of approximately $100 /t.

In this model it is evident that the high purchase price of a ship lightweight tonne is directly related to the ship's conformation (priority given to large tankers and cargo vessels, refusal to take on complex naval ships) and to high steel prices. High freight rates without an equivalent rise in steel prices makes offer scarce, which is the case at the present time. Similarly, a substantial fall in steel prices would tip this balance by directly impacting the purchase prices of ship lightweight tonnes.

IV. Conclusions

The last stage of the proposed economic analysis therefore consists of cross comparing and assessing the data obtained with the first and second methods, using a table to group together the operating costs for each of the geographical models of dismantling site, so that correlations can be drawn, corrections made and any aberrant data rejected.

It is to be noted that the analyses made do not take into account the internal costs of a dismantling site. In this respect, costs for the treatment or storage of waste have not been entered into calculations so as not to distort considerations given to conditions outside the dismantling site which largely depend on the general level of development of the dismantling country. Also, assuming that this country does not have the technical or volume capabilities to treat all or part of this waste, this method of calculation maintains the solution of repatriating these wastes to the ship's flag State or ownership State.

Table 1 in Appendix I provides the tool which can be used to draw the expected conclusions. It confirms that the impact of the supply of recycled materials is highly determinant on the production costs of dismantling sites, with a strong gradient increase between the dismantling sites of the Indian subcontinent, China, Turkey and Western European.

From this table it can be ascertained that the difference in direct production costs per tonne, between the mean figure for Western European sites complying with standards and the sites in the Indian subcontinent, ranges from $50 to $150 per lightweight displacement tonne for the same type of the ship, depending on the complexity of the ship.

This differential is one of the sources for the assessment of incentive financial measures which could be taken into consideration to compensate contracts entered into with fully standard-compliant dismantling sites in the Indian subcontinent, China or Turkey.

Appendix I   Comparison of the direct production costs of the different dismantling sites

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Country	Type of ships	Mean annual human productivity (in tonnes of scrap / man-year)	Gross annual activity (in hours)	Level of employment (in hours /scrap tonne) (3=2/1)	Gross hourly wage (in €)	Coefficient of social charges	Total hourly cost (6=4X5)	Salary cost per tonne (in €/scrap tonne) (7=3X6)	Coefficient of direct structural costs	Coefficient of management and supervision costs	Direct production cost per tonne of scrap (in €/tonne) (10=7X8X9)	Amortisation cost of equipment per scrap tonne (in €/scrap tonne) based on 100 000 tonnes per yr	Total production costs per scrap tonne (in €/tonne) (12=11+10)	Amortisation cost of equipment per scrap tonne (in €/scrap tonne) based on 30 000 tonnes per year	Total production costs per scrap tonne (in €/tonne) (14=10+12)
USA	complex, naval	500	1800	3.60	€8.00	1.3	€10.40	37.44	1.6	1.1	65.89	30.00	€95.89	€100.00	€165.89
EU	Very simple (river barges)	5000	1500	0.30	€9.20	1.54	€14.17	4.25	1.6	1.3	8.84	30.00	€38.84	€100.00	€108.84
EU	Average complexity (fishing and small merchant vessels)	1200	1500	1.25	€9.20	1.54	€14.17	17.71	1.6	1.3	36.84	30.00	€66.84	€100.00	€136.84
EU	complex, naval	800	1500	1.88	€9.20	1.54	€14.17	26.57	1.6	1.3	55.26	30.00	€85.26	€100.00	€155.26
Turkey	Average complexity (fishing, medium-size cargo	350	2200	6.29	€2.00	1.2	€2.40	15.09	1.4	1.1	23.23	15.00	€38.23	€45.00	€68.23
China	Average complexity (large merchant vessels)	300	2200	7.33	€1.00	1.2	€1.20	8.80	1.4	1.1	13.55	15.00	€28.55	€45.00	€58.55
India	Simple (Large tankers & merchant vessels)	80	2500	31.25	€0.20	1.1	€0.22	6.88	1.1	1.05	7.94	2.00	€9.94	€6.00	€13.94
Bangladesh	Simple (Large tankers & merchant vessels)	30	2500	83.33	€0.05	1.1	€0.06	4.58	1.1	1.05	5.29	2.00	€7.29	€6.00	€11.29