

Environmental Requirement of Ship Scrap Yard at the Arvand Free Zone

Yaghoob Khosravi^{*1}, Homayoun Yousefi², Nasser saeedi³, Mostafa Zaredost⁴, Mojtaba Abaspour⁴

1. MSc student of maritime transportation, Faculty of Marine Economics and Management, Khorramshahr University of Marine Science and Technology

2. Asst.Prof, Faculty of Marine Economics and Management, Head of Department of Maritime Transportation, Khorramshahr University of Marine Science and Technology

3. Asst.Prof, Faculty of Marine Economics and Management, Khorramshahr University of Marine Science and Technology

4. Educator, Faculty of Marine Economics and Management, Khorramshahr University of Marine Science and Technology

Email: yaghoob_khosravi@kmsu.ac.ir

ABSTRACT

In this paper, the author is going to investigate the concept of ship recycling which implies to the materials and equipment including end of ships life. The scraped steel is melted down and is commonly used in the construction industries of ship recycling countries, and some equipment might be re-used in other industries too. A segment of this paper is dedicated to describe about the strategic position of Arvand River and the location of Arvand Free Zone area at the Persian Gulf. It should be noted that ship recycling commonly takes place in developing countries which tend to have a competitive advantage due to the low cost labor, may have weaker environmental protection/worker health and safety regulations, and have national demand for the outputs of the activity. The International Maritime Organization (IMO) adopted the Hong Kong International Convention related to the safety and environmental sound recycling of ships to address the growing about the environment, job health and safety risks related to ship recycling. A part of this paper dedicated to review the role of the Hong Kong Convention in order to ensure the process of ship recycling without risks to human health and to the environment. The main part of this paper is designated to evaluate the role of establishment of a ship scraping yard at the Arvand Free Zone Area, its market at the Arvand Free Zone and improving the safety of navigation at the Arvand River. The research methodology of this paper will be designated to consider the qualitative part of this research by using interview with the experts in order to find out and select the key factors for further consideration; as a result of that a model will be created which can be tested by a questioner. In addition to the above explanation, relationship between the variables and testing hypotheses of this research will be analyzed by using SPSS and Lisrel software as quantitative part of this research.

Key words: Ship Recycling, Arvand Free Zone Area, Dismantling, Scrap Yard.

Received 02/01/2016

Revised 18/01/2016

Accepted 30/01/2016

Citation of this article

Y Khosravi, H Yousefi, N Saeedi, M Zaredost, M Abaspour. Environmental Requirement of Ship Scrap Yard at the Arvand Free Zone. Int. Arch. App. Sci. Technol; Vol 7 [1] March 2016: 44-49. DOI.10.15515/iaast.0976-4828.7.1.4449

REVIEW OF SHIP RECYCLING

First of all we have to know what is meant by ship recycling, although there are many reports about ship breaking or scraping in different sources, nevertheless the best definition of ship recycling is related to Salvage Code Red Site which stated that "Ship breaking is the process of dismantling ships and selling their parts primarily the steel for scrap. It is estimated that between 200 and 600 large, end-of-life ships are broken up and recycled every year worldwide". Ships are recycled primarily to recover their steel, which forms approximately 75% to 85% of a ship's lightweight, or lightship [1]. Usually, ship lightweight (LDT) is the mass of the ship's structure, propulsion machinery, auxiliary machinery, outfit and constants. Another way of defining LDT is as the displacement of a ship when fully equipped and ready to proceed to sea but with no crew, passengers, stores, fuel, ballast, water or cargo on board. Some authors believe that the issue of ship recycling has been on the international agenda for many years, as the dismantling of end-of-life ships in beaching facilities without adequate minimum standards raises environmental, safety and health concerns. Bangladesh's ship-breaking yards stated that ship breaking is the process of dismantling

an obsolete vessel's structure for scraping or disposal. Conducted on a dismantling yard, it involves a wide range of activities. From removing all the gear and equipment that are on the ships to cutting down and recycling the ship's infrastructure.

Salvage Code Red Site also expressed that Ship breaking is becoming increasingly important economically. In the developing world, ship breaking not only employs thousands of people in breaking down a ship, but the material produced is important to other industries, such as re-rolling steel plants. It should be noted that the four largest ship breaking nations in the world are India, Bangladesh, Pakistan and China. These four countries handle an estimated 85 percent of the world's ship recycling by weight. Bangladesh shipbreaking yards stated that oceangoing vessels are not meant to be taken apart. They're designed to withstand extreme forces in some of the planet's most difficult environments, and they're often constructed with toxic materials, such as asbestos and lead [2]. When ships are scrapped in the developed world, the process is more strictly regulated and expensive, so the bulk of the world's ship breaking is done in Bangladesh, India, and Pakistan, where labor is cheap and oversight is minimal. Industry reforms have come in fits and starts. India now requires more protections for workers and the environment. But Bangladesh, where 194 ships were dismantled in 2013, the industry remains extremely dirty and dangerous.

Does the Ship Recycling is a Dangerous Activity?

It is true; ship dismantling is a very dangerous activity involving several risks, although many of those risks can be avoided as a result of simple health and safety factors put into operation. Therefore, ship breaking is only really economically practical in countries where wages are low and there is less regard for safety in the workplace. The Inventory of Hazardous Materials (IHM) is a list of hazardous materials, waste and stores in a ship. It identifies their location and approximate quantities onboard the ship. Usually ship breakers encounter with harmful substances such as asbestos, lead, mercury, Polychlorinated Biphenyls (PCBs), radiation and low levels of radium, among others. Another risks during ship breaking are related to workers activities at ship scrap yard which accidents caused by falling material, fires, electric shocks and fumes. The other dangerous factor of creating many disasters is related to re-use ropes and chains or even cranes and lifting gears from recycled ships at yard without inspecting and testing them for fitness. In fact, president from a ship dismantling yard stated that after buying a ship, we have to give it to a contractor for dismantling. They engage workers to do it. So the responsibility lies on the contractor to manage all kinds of safety equipment and to establish training facilities for the workers (Xiaodong, 2008).

Model of Research

When selecting the research method it is usually advisable to consider whether we can base our work on an earlier theoretical model. Sometimes a model, even a preliminary one, can help our work determinedly, and sometimes it will affect the logical process of analysis too. It should be pointed out that model hypotheses is specified, it means that the specific set of hypotheses to be tested and usually the model is drawn through a diagram. According to the literature review of this research and the interviews which carried out by the expert and specialized persons, the research model is given as follows (see fig 1):

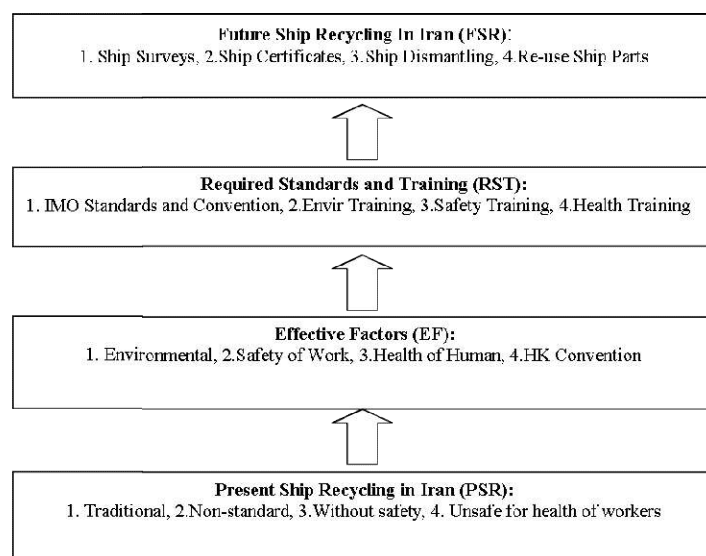


Fig.1: Model of Research

The Hong Kong and Basel Convention for Ship Recycling

The Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships, 2009 (the Hong Kong Convention), was adopted by the IMO diplomatic conference held in Hong Kong, China, from 11 to 15 May 2009, which was attended by delegates from 63 countries. After the Convention came into force, the development and maintenance of an Inventory of Hazardous Materials, which identifies the amount and location of dangerous and harmful materials onboard a ship, will be required for all ships over 500GT. We understood that the IMO guidelines related to the process of recycling ships practically nothing goes to waste. Nevertheless, the materials and equipment are almost completely reused [3]. It should be noted that ships' generators and batteries are reused. Moreover, new steel production from recycled steel requires only one third of the energy used for steel production from raw materials. More or less all the materials on board the ship can be recycled, reused, restored or renovated. It should be noted that the Key requirements of the HKC (Hong Kong convention) are as follows:

- Provision of the Inventory of Hazardous Materials (IHM) for ships.
- Compliance of ship recycling facilities to the Convention's safety, health and environmental standards.
- Preparation of a Ship Recycling Plan for ships destined for recycling.
- Authorization of Ship Recycling facilities by the relevant Competent Authority.
- Reporting requirements for ship-owners and recycling facilities [4].

The convention shall enter into force 24 months after the following conditions are met:

- not less than 15 States have either signed it without reservation as to ratification, acceptance or approval, or have deposited the requisite instrument of ratification, acceptance, approval or accession
- the combined merchant fleet of these States constitute not less than 40 % of the GT of the world's merchant fleet
- the combined maximum annual ship recycling volume of these States during the preceding 10 years constitutes not less than 3% of the GT of the combined merchant shipping of these States

It is difficult to predict its entry into force, but it is unlikely that the HKC will enter into force before 2015 [4].

Surveying of a Ship for Dismantling

According to the resolutions of the International Maritime Organization, the Assembly of the IMO adopted on 5 December 2003, by resolution A.962 (23), the IMO Guidelines on Ship Recycling with the aim of providing guidance to ship-owners, ship recycling facilities, flag and recycling States and other involved stakeholders as to "best practice", which takes into account the ship recycling process throughout the life cycle of the ship. Ships will be required to have an initial survey to verify the inventory of hazardous materials, additional surveys during the life of the ship, and a final survey prior to recycling. Ship recycling yards will be required to provide a "Ship Recycling Plan", specifying the method in which each ship will be dismantled, depending on its details and its inventory [7]. The following resolution have been developed and adopted to assist States in the early implementation of the Convention's technical standards: MEPC.197(62), MEPC.196(62), MEPC.210(63), MEPC.211(63) and also the following two resolution after the Hong Kong Convention enters into force: Resolution MEPC.222 (64) and MEPC.223(64). Usually, the surveyor is on board the ship and having been introduced himself to the master or responsible ship's officer, the surveyor or port State control officer should verify that there is on board the International Certificate on Inventory of Hazardous Materials (regulation 11.11) or the International Ready for Recycling Certificate (regulation 11.11), both supplemented by the Inventory of Hazardous Materials, and examine reports of previous port State control inspections [5-8].

Review for Normal Condition of Variables Distribution

In order to test variables distribution we must choose from the four tests listed such as Normal, Poisson, Uniform and Exponential methods. The question that we would like to answer is whether the latent variables of this research follow normal distribution (see Tab.1).

Latent Variables	Amount of 'Z'	Amount of 'Sig'	Result of distribution
Present ship recycling (PSR)	1.786	0.028	Normal
Effective Factors (EF)	1.672	0.026	Normal
Required and standard of training (RST)	1.516	0.022	Normal
Future ship recycling (FSR)	1.465	0.018	Normal

Tab.1: The result of Kolmogorov-Smirnov test for normal distribution of variables

Structural Equation Modeling (SEM)

SEM is a very common, very powerful multivariate analysis technique that includes specialized versions of a number of other analysis methods as special cases. Furthermore, we will also assume that you are familiar with the concepts of variance, covariance, and correlation before attempting to use structural modeling. It should be noted that Guttman, 1954; Wiggins, Steiger, and Gaelick, 1981 on the subject of the major applications of structural equation modeling stated the following items:

1. Causal Modeling, or Covariance Structure Models, which hypothesizes causal relationships among variables and tests the causal models with a linear equation system. Causal models can involve either manifest variables, latent variables, or both;
2. Confirmatory Factor Analysis, an extension of factor analysis in which specific hypotheses about the structure of the factor loadings and inter-correlations are tested;
3. Second Order Factor Analysis, a variation of factor analysis in which the correlation matrix of the common factors is itself factor analyzed to provide second order factors;
4. Regression Models, an extension of linear regression analysis in which regression weights may be constrained to be equal to each other, or to specified numerical values;
5. Covariance Structure Models, which hypothesize that a covariance matrix has a particular form. For example, we can test the hypothesis that a set of variables all have equal variances with this procedure;
6. Correlation Structure Models, which hypothesize that a correlation matrix has a particular form.

A classic example is the hypothesis that the correlation matrix has the structure of a circumplex.

Most structural equation models can be articulated as path diagrams, consequently the author find out the following diagram (see fig.2 and fig.3) as standard coefficients in this research in order to consider the relationships between the variables by using SEM.

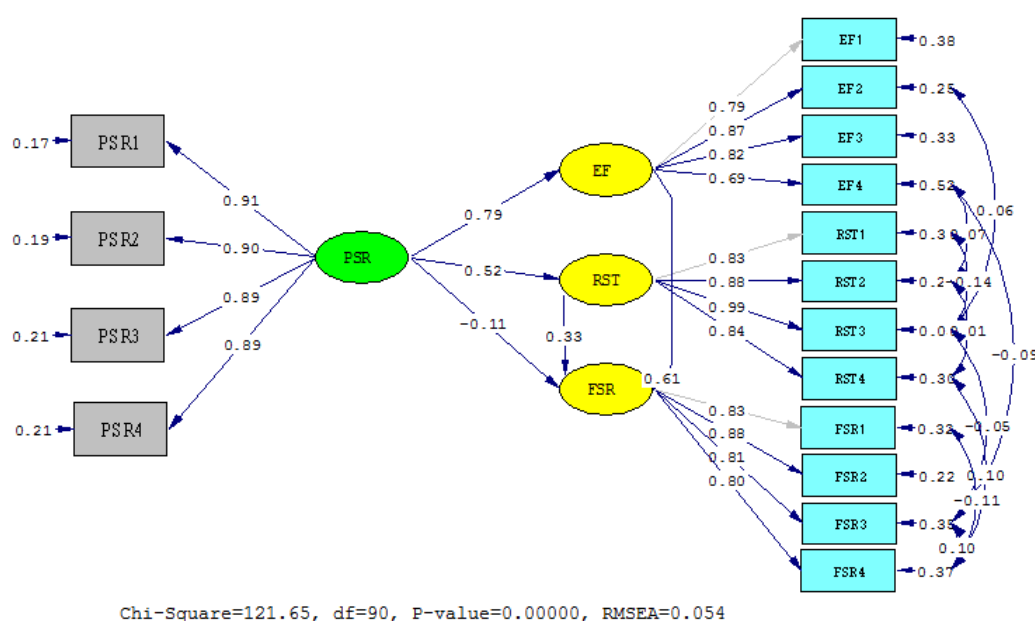


Fig.2: General Model (path analysis) of this research with standard coefficients

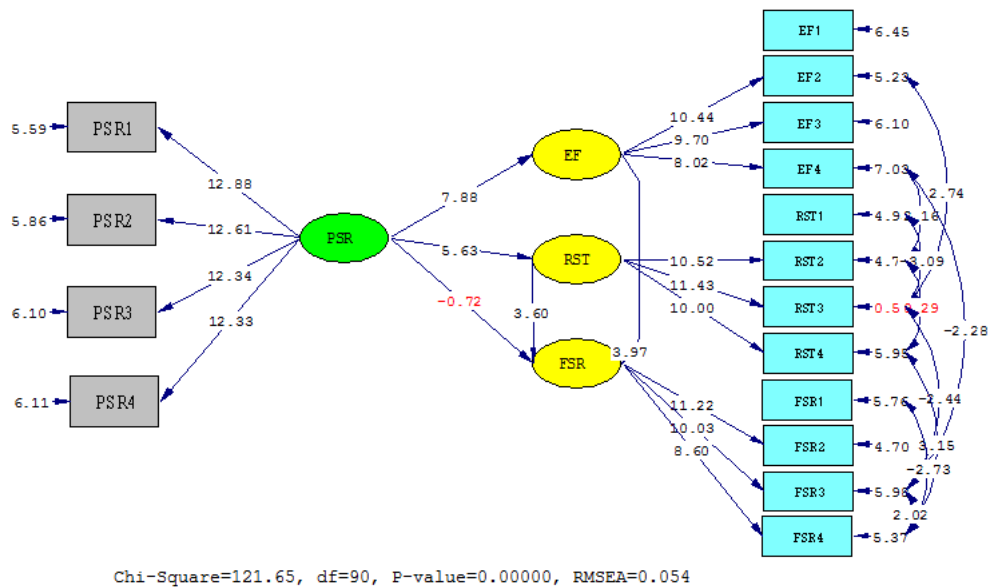


Fig.3: Model of research, path analysis of the significant number which is in red color. It indicates that the relationship between the independent variable PSR and the latent variable FSR is inappropriate.

The Structural Equation Modeling of this Research

As a result of the final model of this research, hypothesizes causal relationships between the variables have been analyzed and tested through the causal models with a linear equation system. In addition to the above, Confirmatory Factor Analysis or an extension of factor analysis about the specific hypotheses regarding the structure of the factor loadings and inter-correlations are tested too. It should be noted that the relationship among the observe and latent variables of this research are in good order apart from the relationship between PSR and FSR variables which is equal to -0.77, it means that the correlation is not significant. Therefore, there is no direct relationship between present ship recycling variable and future ship recycling variable in this study. As the linkages between PSR and the other two latent variables such as EF and RST is significant, and also the connections among the EF and RST variable with FSR is significant; consequently, the relationship between the PSR and FSR variables through the environmental factors (EF) and required standard and training (RST) is significant. So, for the purpose of dedicating a place around the Arvand River in order to be used as yard for ship recycling, it needs to concentrate on the two above latent variables such as EF and RST.

Table.2 shows the Chi-square, Goodness of fit index, adjusted goodness of fit index, of the general model of research (See tab.2). It illustrates that the model has good situation as a consequence of fit indicates.

Chi-Square	P-Value	Df	RMSEA	GFI	AGFI
121.65	0.00000	90	0.054	0.93	0.92

Table.2: Variables fit indexes in the path analysis model

In addition to the above, in the following table all the coefficients or indexes of the model such as Normed Fit Index, Comparative Fit Index, and Incremental Fit Index and so on are offered. Usually, indexes indicate how well a model fits data, even if, it does not do so correctly from the statistical point of view; of course sometimes it shows that the fit is not acceptable. (See tab.3).

No	Factors	Numerical
1	Normed Fit Index (NFI)	0.91
2	Non-Normed Fit Index (NNFI)	0.95
3	Parsimony Normed Fit Index (PNFI)	0.93
4	Comparative Fit Index (CFI)	0.96
5	Incremental Fit Index (IFI)	0.96
6	Relative Fit Index (RFI)	0.90

Table.3: Fit indexes of the final model (model path analysis)

Based on fig.2 of this research and according to the following table, the author states that the all hypothesis of this research verified except the one which is between PSR and FSR variable that is uncorrelated, as the significant number of the two variables is red and is assigned between the interval of $-1/96$ to $1/96$. It means that it indicates the absence of any meaningful relationship between the independent variable PSR and the latent variable FSR. Therefore, the hypothesis is rejected. (See tab.4).






No	Hypothesis or studied path in the model			PathCoefficient	Sig	Result
1	PSR		EF	0.79	7.88	Verification
2	PSR		RST	0.52	5.63	Verification
3	PSR		FSR	-0.11	- 0.72	Rejection
4	EF		FSR	0.61	3.97	Verification
5	RST		FSR	0.33	3.60	Verification

Table.4: Path coefficient and significant correlation of the model

CONCLUSION

As the main part of this paper is related to assess the role of establishment of a ship scraping yard at the Arvand Free Zone Area; therefore, the author of this research has focused on the model where the data can be summarized using some statistical factors. It should be noted that this business has an optimistic market at the Persian Gulf, on the other hands; it will improve the safety of navigation at the Arvand River. This paper provides statistical data in order to clarify the ship recycling activity as standard action in order to solve the discussions at IMO on the development of the International Convention for the Safe and Environmentally Sound Recycling of Ships. The adoption of the Hong Kong Convention certainly is a way forward to deal with health, safety and environmental concerns associated with ship recycling. According to the outputs of this research, the author believes that two main variables such as Environmental Factors (EF) and Required Standard and Training (RST) are essential factors to leave behind from traditional or present ship recycling at the Arvand Free Zone to Future ship recycling as clean, safe and standard activities base on the Hong Kong Convention in Iran.

REFERENCES

1. Mikelis N.E., (2006). "Developments and Issues on Recycling of Ships", the East Asian Seas Congress, Haikou City, Hainan Province, PR China, 12-16/12/2006
2. Mikelis, N., (2012). "Hong Kong Convention: The origins of a convention", presentation at World Maritime University, Malmo, Sweden.
3. Mikelis, N., (2013). Ship recycling markets, Bulletin 2013, Volume 108 # 3, pp54-61. Fang, Y., Mejia Jr, M. Q., 2012, "Reinforcing the Legal Framework for the Environmentally Friendly Recycling of Ships: A Brief Look at the Hong Kong Convention", International Proceedings of Economics Development and Research, vol. 48. No. 20, pp. 91-95.
4. IMO, (2009). "Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships", International Conference on the Safe and Environmentally Sound Recycling of Ships, Hong Kong.
5. IMO, (2012). Calculation of recycling capacity for meeting the entry into force conditions of the Hong Kong Convention, International Maritime Organization, MEPC 64/INF.2, 2012.
6. IMO, (2013). "The development of the Hong Kong Convention," Recycling of ships, accessed 22 July 2013.
7. IMO, (2013). "Marine Environmental Protection Committee - 44th session: 6-13 March 2000," in MEPC Meeting Summaries, accessed 21 July 2013.
8. IMO, (2013). "Marine Environment Protection Committee (MEPC), 47th session: 4-8 March 2002," in MEPC Meeting Summaries, accessed 21 July 2013.