ENVIRONMENTAL POLICY FACTORS IN THE MARITIME INDUSTRY AND ANTICIPATED REGULATORY TRENDS

A Senior Scholars Thesis

by

RICHARD DAVID HAYES II

Submitted to the Office of Undergraduate Research
Texas A&M University
in partial fulfillment of the requirements for the designation as

UNDERGRADUATE RESEARCH SCHOLAR

April 2010

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Associate Dean for Undergraduate Research: Robert C. Webb

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ABSTRACT

Environmental Policy Factors in the Maritime Industry and Anticipated Regulatory Trends. (April 2010)

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Increased environmental regulatory policy has been put in place by the International Maritime Organization (IMO) in response to waterborne oil pollution events. We examine the IMO regulatory response to these incidences. This paper covers literature on the subject of environmental norms in the Maritime Industry. Starting with the Oil and Pollution Act of 1954 (OILPOL) and the International Convention for the Prevention of Pollution from Ships 1973/78 (MARPOL), there has been increased frequency of adoption and amending of environmental maritime treaties. Better practices in the form of policy are implemented to change behavior of IMO members. Using institutional theory as a framework with other consensus forming theories, we identify possible cycles in policy amendment and adoption. Data to be used includes (1) oil spill data from the International Tankers Owners Pollution Federation Limited (ITOPF), (2) IMO convention and amendment, (3) labor statistics from the Baltic and International Maritime Council (BIMCO) and International Shipping Federation (ISF), and (4) ages of the World Fleet collected from the yearly publication Review of

Maritime Transportation. The linear regression model drawn identified a significant relationship between the severity and number of oil spill incidents to the length of time the policy was given to enter into force. This research concludes with a discussion of anticipating regulatory trends based on waterborne pollution events.

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NOMENCLATURE

GIIS	Global Integrated Information System
IMCO	Inter-Governmental Maritime Consultative Organization
ITOPF	International Takers Owners Pollution Federation Limited
IMO	International Maritime Organization
MARPOL	International Convention for the Prevention of Pollution from Ships
MEPC	Marine Environment Protection Committee
OILPOL	International Convention for the Prevention of Pollution of the Sea by Oil
SOLAS	Safety of Life at Sea
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development

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CHAPTER I

INTRODUCTION: GOVERNING THE GLOBE – ANTICIPATING TRENDS IN MARITIME ENVIRONMENTAL POLICY

Origin of the maritime policy mechanism

International treaties in the Maritime Industry date back to the sinking of the Titanic and successive Convention of the Safety of Life at Sea (SOLAS) in 1914 [1]. At the time, there was no organization charged with oversight of global shipping. As a result of major incidents, such as the sinking of the Titanic in 1912, in 1948 with an international conference in Geneva the International Maritime Organization (IMO) was established. The original name was the Inter-Governmental Maritime Consultative Organization (IMCO), but the name was changed in 1982 to IMO. The IMO was a product of the United Nations (UN) and entered into force in 1958. The reasoning behind the Organization as stated in Article 1(a) is:

> to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships [2].

This thesis follows the style of Journal of Marine Policy.

Though the IMO was originally established for safety, the scope of the organization has expanded over the years Fig 1. The IMO currently has five main committees but for the purposes of this research we will focus on the Marine Environmental Protection Committee (MEPC). The primary goal of the MEPC is the prevention of pollution form ships through implementation of policy. Previous research has analyzed effects of regulatory structures on the industry. Understanding the trends in behavior of IMO in the context of a consensus organization has gone unexplored.

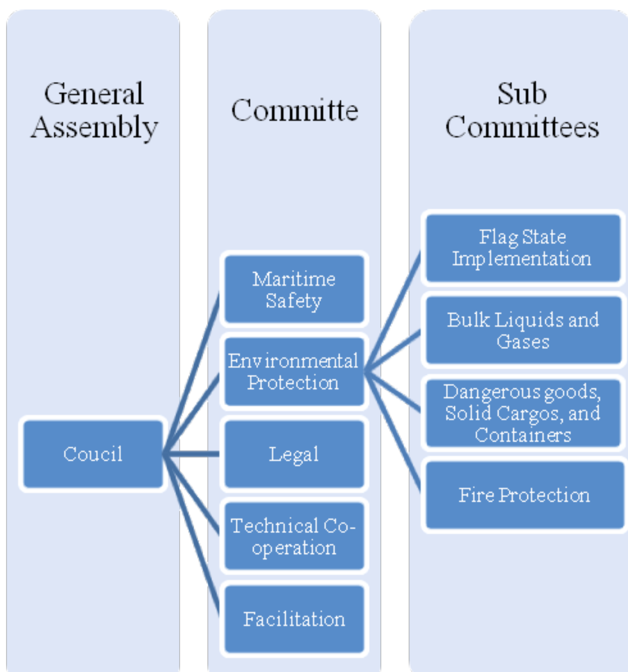

Fig 1. General Structure of the IMO.

In March 1967, the Torrey Canyon, a large oil tanker, ran aground and spilled the entire cargo of 120,000 tons of crude oil. The increased demand for fossil fuels transported by sea and human error resulted in an unprecedented environmental disaster. Concerned with a lack of regulatory authority, the IMO held a convention where a treaty was adopted. The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978, relating thereto (MARPOL) covers the prevention of pollution in the marine environment. MARPOL is a combination of two treaties adopted in 1973 and 1978 respectively, and it has been amended over the years.

The MEPC, a committee of the IMO meets every 9 months to develop international conventions. The majority of amendment and convention topics cover marine environmental concerns including ship recycling, emission control, ballast water control, and waterborne pollution from ships. Our research focuses on waterborne oil pollution from ships. Incidents involving pollution at sea can be catastrophic. Prevention is the goal of regulatory policy; enforcement of policy has been linked to a decreased volume of incidents [3].

Cycles in the regulatory process

The role of waterborne shipping is secure, accounting for approximately 90% of global trade [4]. Better understanding of the factors that contribute to the implementation of regulatory policy is an important principal in pollution prevention. There are mechanisms that can be used to anticipate policy. Looking at the total number of oil spills, total oil spill volume, labor shortages, the average age of the World Fleet Fig 2. and whether it was a time the MEPC met are mechanisms that can be used to anticipate policy. For a policy to put into force there must be consensus among IMO members.

Research in the Maritime Industry has already explored costs of pollution, trade volumes, effects of policy enforcement, and analyzed other general shipping statistics. There are databases containing empirical data of incidents involving pollution at sea. This research explores cycles in policy implementation from international conventions granting insight to anticipating regulatory trends. This research will use put the proposed cycle into context. We draw models from oil spill data, along with IMO conventional data and use labor statistics and the age of the World Fleet as controls. The findings are useful for regulators, ship owners, engineers, and could be used as a case study in consensus formation.

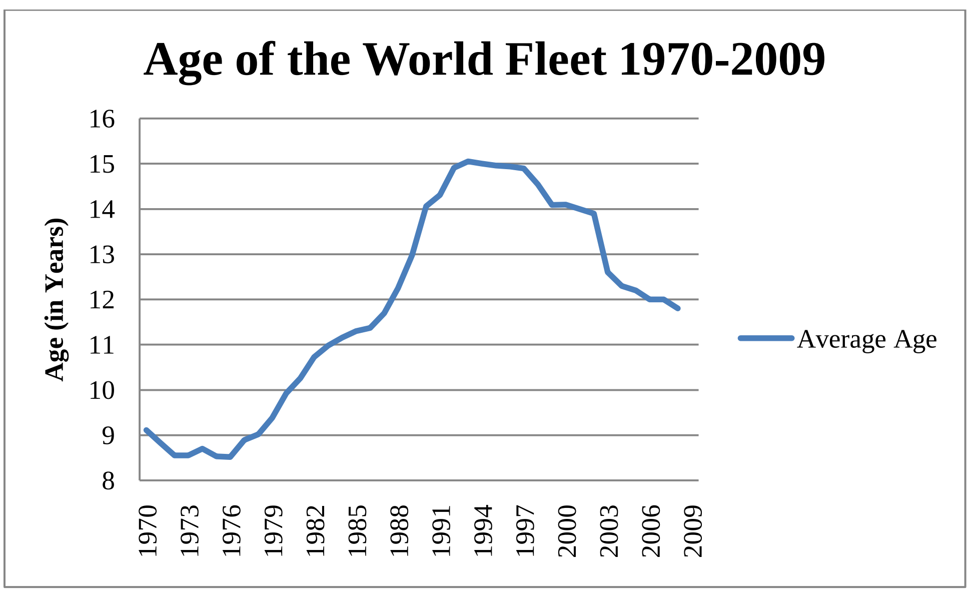

Fig 2. Age of the World Fleet 1970-2009

Project overview

This research identifies the key elements that contribute to the implementation of environmental policy in the scope of the Maritime Industry. There is an overview of data used for comparison, such as the dates of environmental disasters, conferences, treaties, date entry into force of policies, number of oil spill incidents, and total volume of oil spilled. The data to be used for environmental protection conventions is archival information previously collected by the IMO. This information pertains primarily to the dates of convention and when those conventions enter into force. The conventional data will be compared to other statistical sources previously collected and used to draw models. These other sources include the Lloyd's Register, the UN, and other shipping associations and federations.

The IMO is a consensus organization whose members are required to follow the treaties they establish. To test our hypotheses the dates of these treaties are compared to shipping statistics from the Lloyd's Register [5], and the United Nations Conference on Trade and Development (UNCTAD). The dates used from conventions associated with environmental policy, such as MARPOL, will be adoption, and entry into force, and amendments (if any). Our goal is to explore the factors that influence the time it takes for a policy to be entered into force.

The following questions are answered and compared to empirical convention data. What does the Maritime Industry contribute to waterborne oil pollution output? What are the major factors in the enviro-regulatory process? Is there a correlation between severity of incidents and expediency of policy implementation? Is there a correlation between number of incidents and expediency of policy implementation? Does the age of the ship and presence of a labor shortage have any effect on the expedience of policy implementation? Finally, what effect, if any, does environmental policy have on waterborne oil pollution output? Systems and Organizations referenced include the International Maritime Organization, the Lloyds Register, Marine Environmental Protection Committee, and the International Takers Owners Pollution Federation Limited.

The importance of this analysis comes in the form of anticipating future trends in the Maritime Industry. Covering an area that has previously lacked exploration, the following research aids the decision making process in anticipating when environmental policy will come into force. The industry is looking for solutions for pollution, and a result of adopting policy pollution output has been reduced. Policy working through the IMO has already manifesting itself in responses by the industry. Models drawn of environmental disasters, the outcomes of past policy implementation grants insight to the process. Understanding the outcomes and potential outcomes for past and future policies will explain current trends and anticipate future ones.

CHAPTER II

LITERATURE REVIEW

Subject material

Implementation of environmental regulatory policy, with regard to the origin of norms and possible cycles based on waterborne pollution incidences of ships, is analyzed in terms of previously established theories that relate to the adoption of norms and the formation of consensus. Consensus formation during strategic change as is used to frame our hypothesis. We hypothesize that as the number of oil pollution incidents and volume of oil spills increase, there will be an increase in entry into force time of IMO regulations. We further hypothesize that consensus formation adds time between adoption and the time the policy enters into force. Journals covering marine policy and adoption of norms and those pertaining to the IMO and treaties published by the IMO will examined to put this research in context. The objective of this review is to locate sources of data, theories, and relevant publications. The data is be used to draw models of enviro-regulatory policy implementation and correlates it to the dates of incidences involving waterborne pollution from ships.

Pollution events

Oil spill event history data is taken from the ITOPF's oil spill history publication [6] and can been seen on page 15. The oil spills as collected by the International Tanker Owner Oil Pollution Federation Limited (ITOPF) and are recorded by (1) incidents per year and

(2) volume of oil spilled. The events for this research were measured by categories established ITOPF. Events resulting in 7-700 tons (seven to seven hundred tons) will be referred to as serious incidents. The category of events resulting in >700 tons (greater than seven hundred tons) will be referred to as very serious incidents.

The operational definition for waterborne pollution events will from here on be called oil spills. The ITOPF [6] keeps a database of oil spill from tankers, combined carriers, and barges. The ITOPF like the MEPC was established in the wake of the Torrey Canyon in 1968. It is a non-profit organization "involved in all aspects of preparing for and responding to ship-source spills of oil, chemicals and other substances in the marine environment" [7]. Oil spill data contains only accidental spills, and excludes those from acts of war.

The ITOPF system is similar to the system used by the IMO's global integrated shipping information system (GISIS). However, GISIS is self reported and has no criteria for classification. This can be seen in the spills of the AMOCO CADIZ the third largest oil spill in history resulting in 223,000 tons spilled [6] self reported as "serious" and SEA the PRINCE (265,518 tons spilled) [8] HYUNDAI INDEPENDENCE (500 tons spilled)[9] both reported as "very serious". This information as stated by the ITOPF, is gathered from published sources, such as the Shipping Press and other specialist publications such as vessel owners and their insurers.

International norms

Oil pollution emitted from ship activities or accidents has multiple detentions when it comes to the impact on the environment. It can damage local ecosystem, and cross national jurisdictions. These complex legal concerns are illustrated by one scholar:

> A ship may strand on the high seas and cause pollution in two neighboring states, i.e., France and England (as with the *Torrey Canyon* in 1967). She may be owned by a Liberian company, bareboat chartered to a Bermuda company, managed by an English company, time chartered to a Greek company and voyage chartered to an American company. Her cargo may have been sold during the voyage by the American company to a Japanese one. The officers may be English and the crew Indian. The international nature of the shipping business creates such diversity of interests, with potential conflicts of law and jurisdiction. [10]

The IMO has created two primary mechanisms for combating oil pollution from ships. The first is the 1959 International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) [11]. The second is the 1973/1978 MARPOL [12]. These international treaties are agreed upon by the member states of the organization. Following stated treaties are regarded as typical of the membership and are considered a norm. Because it is a consensus organization a major environmental event is needed in order to begin the process of regulatory policy making. Norm origins are later explored following the linear regression analysis in methodology. These norms are measured by the point in time in which the policy is adopted or amended and then moved into force. This will illustrate urgency or moderation in policy implementation importance. That will then compared against oil spill event history data and an event history analysis will take place.

Source of policy norms

This research used the adoption date and entry into force date in the comparison against the negative pollution events. The name and publications were used to determine the relevance to this research. The amendments and conventions included for the comparison are as follows: (1) All conventions or amendments relating to OILPOL (2) all conventions relating to MARPOL 73/78, and (3) amendments to MARPOL Annex 1 that relates to the prevention of oil pollution from ships. These international treaties were collected from a listing of all treaties and amendments provided by the IMO [13]. Fig 3. is an example of a typical IMO amendment and convention entry. The convention and amendment dates to MARPOL and OILPOL can be seen on page 14.

International Convention for the Prevention of Pollution of the Sea by Oil, 1954, as amended (OILPOL) 1954

Adoption: 12 May 1954
Entry into force: 26 July 1958
Authentic text: E/F
Printed text(s):
IMO publication(s):

- International Convention for the Prevention of Pollution at Sea by oil (OILPOL), 1954. 1981 edition, (includes the 1962 and 1969 amendments), sales numbers: IMO-500E, ISBN 92-801-1118-3; IMO-501F, ISBN 92-801-2100-6; IMO-503S, ISBN 92-801-3068-4; IMO-511R (1962 edition) ISBN 92-801-4001-9.

Fig 3 IMO Convention Entry

The scope of this study does not cover all Annexes of MARPOL and excludes Annex II: Control of pollution by noxious liquid substances, Annex III: Prevention of pollution by harmful substances in packaged form, Annex IV: Prevention of pollution by sewage from ships, Annex V: Prevention of pollution by garbage from ships, and Annex VI: Prevention of Air Pollution from Ships. However, it should be noted that, if measured and collected similarly to how oil has been for the purposed of this research the scope could expanded upon to analyze cycles in policy adoption relating to those substances.

Institutional theory is “organic” [14] and the premises are semi universal but takes certain shapes for specific communities. We are informed by Philip Selznick that values are instilled[14]. Institutional theory will be evaluated as it pertains to policy implementation and further compared with the theory implementation and the effect on the ultimate target[15]. The latter states that when a new mandate is assigned to an established agency the new patterns of individual activity required may compete with old ones. It goes on to argue that agencies participate in creating situations in which traditional institutional tools for eliciting and coordinating efforts are not controlled by a single actor. Also the "missing links between economic theory and environmental policy"[16] will be used to explain certain tendencies of implementation.

Institutional theory[17] as it relates to the adoption of practices of organizations will be assumed for this research to be a repeated process of policy adoption by firms over a period of time, where such policies are assigned similar meanings by firms are institutionalized. With regard to the environment Dan A. Tarlock states "Environmental norms are initially established to address problems that are defined without regard to national boundaries. These norms initially address physical not political problems." He later gives a short example "a ton of soft coal burned in China is the same as a ton burned in England" [18]. A negative environmental event that results in norm adoption may also influence the timing of the adoption depending on the severity.

Division of works

The larger contribution to the understanding of the subject area is found in the intergovernmental documents adopted by the IMO specifically MARPOL. The IMO, a specialized organization under the UN adopts policies as agreed upon by the members. The adopted environmental policies then become international treaties. These treaties can be found in the acts adopted by the IMO, for example MARPOL, the origin of these policies then comes into question. While evaluating enviro-regulatory policy institutional theory help evaluate the adoption of norms. The categories of works supportive of the idea of a cycle of implementation and those not supportive have been identified. Both are rooted in previously stated theories the idea of consensus formation during strategic change poses a unique challenge elaborated on in our conclusion.

Where the works are similar and depart relate primarily in theory. The information collected by the IMO is in the form of raw data whereas the journals (not maritime sector specific) discuss the effects of policies as a result of implementation in organizations. For the consideration of the argument the (institutionalized) institutional theory will have some bearing on the analysis of the models drawn.

In argument of our hypothesis we marry institutional theory and the theory of consensus formation during strategic change. Because policy in the IMO is assigned a similar meaning by the members (they must follow the law) it is therefore institutionalized. The members of the IMO have a vested interest [19] in the Maritime Industry. When consensus is formed it is a result of (1) the members understand the policy goal to achievable in the time period (2) they will have losses (if any) that would otherwise have made them not agree.

CHAPTER III

METHODS

The data assembled are three main types. Table 1 is the adoption and entry into force dates of oil pollution policy. Oil spill incidences and volume as collected by the ITOPF is in Table 2. Table 3 relates to policy implementation and the entry into force time. Also in Table 3 it is indicated if there was a very serious casualty. Finally, presented in Table 4, the age of the World Fleet and whether there was a labor shortage in that year.

Table 1
Dates of IMO amendments and conventions, adoption and entry into force

Policy Adoption	Adoption Date	Entry Into Force
MARPOL Convention	11/2/1973	8/2/1983
Amendment	9/7/1984	1/7/1986
Amendment	12/1/1987	4/1/1989
Amendment	3/16/1990	2/3/2000
Amendment	11/16/1990	3/17/1992
Amendment	7/4/1991	4/4/1993
Amendment	3/6/1992	7/6/1993
Amendment	3/6/1992	7/6/1993
Amendment	11/2/1994	3/3/1996
Amendment	9/25/1997	2/1/1999
Amendment	7/1/1999	1/1/2001
Amendment	4/27/2001	9/1/2002
Amendment	12/4/2003	4/5/2005
Amendment	10/15/2004	1/1/2007
Amendment	8/1/2007	3/6/2009
OILPOL Convention	5/12/1954	7/26/1958
Amendment	4/11/1962	6/28/1967
Amendment	10/21/1969	1/20/1978

[20]

Table 2

Oil spills and total oil spilled in metric tons, from, 1970-2009

Year	7-700	>700	Total # Incidents	Total Oil Spilled	Year	7-700	>700	Total # Incidents	Total Oil Spilled
1970	7	29	36	330,000	1990	50	14	64	61,000
1971	18	14	32	138,000	1991	30	7	37	430,000
1972	48	27	75	297,000	1992	31	10	41	197,000
1973	28	32	60	164,000	1993	31	11	42	140,000
1974	89	28	117	174,000	1994	26	9	35	130,000
1975	96	23	119	355,000	1995	20	3	23	12,000
1976	67	27	94	398,000	1996	20	3	23	80,000
1977	68	17	85	291,000	1997	28	10	38	72,000
1978	59	21	80	352,000	1998	26	6	32	15,000
1979	60	35	95	641,000	1999	20	6	26	29,000
1980	52	13	65	206,000	2000	20	4	24	14,000
1981	54	7	61	48,000	2001	17	3	20	8,000
1982	45	4	49	12,000	2002	13	3	16	67,000
1983	52	13	65	384,000	2003	15	4	19	42,000
1984	26	8	34	29,000	2004	16	5	21	15,000
1985	31	8	39	85,000	2005	22	4	26	18,000
1986	28	7	35	19,000	2006	13	5	18	23,000
1987	27	10	37	30,000	2007	13	4	17	18,000

[6]

Policy collection

If there was a condition relating to preventing oil pollution from ships presented in an amendment or convention by the IMO it is presented Table 3 as 1 for an affirmative policy action and a 0 to indicate no policy action. When indicated as a 1(affirmative) there was a policy passed in that year therefore there is an entry into force time. The entry into force time is the time between when the amendment or convention passed and when the members of the IMO agreed to begin to following their policy denominated in years. To calculate the entry into force times we simply calculated the difference between the passage date and entry into force date. Listed in Table 1 is the adoption and entry into force dates of all IMO conventions relating to the prevention of oil pollution from ships from 1970-2009. If there was more than one amendment in a given year the average entry into force time was used.

Age of the World Fleet collection

In 1979 the age of the World Fleet also known as the average age of all merchant ships is published yearly by the United Nations Conference on Trade and Development's (UNCTAD) in their Review of Maritime Transport [21-49]. Prior to 1979 the age of ships is given as a percentage for the categories 0-4, 5-9, 10-15, 16-25, and 25+. To calculate the fleet age we took the median of the range and multiplied by the percentage of ships in that rang. Adding the multiplied ages together we arrive at the age of the World Fleet for that year. Note, our system favors a younger Fleet age from 1970-1979. The multiplied percentage of ships 25 or older is 25. In all instances the percentage of ships 25 and older was 3% or less so it is not significant.

Table 3

Major incident and policy adoption indication and time to enter into force by year, 1970-2009

Year	Major incident	Policy Adopted in this Year	Entry Into Force	Year	Major incident	Policy Adopted in this Year	Entry Into Force
1970		0	0	1990		1	5.6
1971		1	11.82	1991	x	1	1.75
1972	x	0	0	1992	x	1	0
1973		1	9.75	1993	x	0	0
1974		0	0	1994		1	1.3
1975	x	0	0	1995		0	0
1976	x	0	0	1996	x	0	0
1977	x	0	0	1997		1	1.35
1978	x	0	0	1998		0	0
1979	x	0	0	1999		1	1.5
1980	x	0	0	2000		0	0
1981		0	0	2001		1	1.35
1982		0	0	2002	x	0	0
1983	x	0	0	2003		1	1.33
1984		1	1.3	2004		1	2.21
1985	x	0	0	2005		0	0
1986		0	0	2006		0	0
1987		1	1.3	2007		1	1.6
1988	x	0	0	2008		0	0
1989	x	0	0	2009		0	0

[6, 20]

Table 4
Age of the World Fleet and maritime labor shortage by year 1970-2009

Year	Fleet Age	Labor Shortage	Year	Fleet Age	Labor Shortage
1970	9.11	0	1990	14.06	0
1971	8.83	0	1991	14.31	0
1972	8.55	0	1992	14.91	0
1973	8.55	0	1993	15.05	0
1974	8.7	0	1994	15	0
1975	8.53	0	1995	14.96	1
1976	8.52	0	1996	14.94	1
1977	8.89	0	1997	14.9	1
1978	9.02	0	1998	14.54	1
1979	9.38	0	1999	14.09	1
1980	9.93	0	2000	14.1	1
1981	10.26	0	2001	14	1
1982	10.98	0	2002	13.9	1
1983	10.98	0	2003	12.6	1
1984	11.16	0	2004	12.3	1
1985	11.3	0	2005	12.2	1
1986	11.37	0	2006	12	1
1987	11.7	0	2007	12	1
1988	12.25	0	2008	11.8	1
1989	12.98	0	2009		1

[21-49]

Regression analysis

Two models are drawn to examine our hypothesis. The first was a logistical regression model that is used to describe the likelihood of an amendment being passed. The second model is a Generalized Least Squared to explain the impact the variables has on the time of entry into force. The following methods for logistical regression are used from Steven

E. Wolf[50]. The variables and number of variables are the only contribution we made to evaluate our hypothesis.

All values are expressed as mean ± standard error of the mean or percentages. Each of the variables was tested for differences between date to adoption and date to entry into force by univariate statistical methodology with significance accepted at $p < 0.01$ (chi square, Bonferroni's test between groups based on the binomial distribution, Student's t test,or Mann-Whitney rank-sum test where appropriate). The <.01 is used is used as opposed to <.05 because of the nature of international business. This improves the significance of the model as an indicator of probability. A Logistic regression analysis was used to test the hypothesis that the temporal groups of variables affect the probability policy adoption.

This was performed using the Statistical Analysis System Package (SAS, Cary, NC). For this analysis, the dependent variable was adoption of environmental regulatory policy, and our model determined the odds of increased entry into force time given the independent variables. Specifically, the model estimated was,

$$\log(\pi\_i/1-\pi_i) = \log O_i = \propto + \beta_i(I_i) + \beta_2(T_i)$$

$$+\beta_3(A_i) + C + E$$

Where $\log O_i$, is the log odds of a policy entering into force, $\beta_i(I_i)$ is the vector of the total number of oil spill incidents, $\beta_2(T_i)$ is the vector of the age of the World Fleet, and, $\beta_3(A_i)$ is the vector of the categorical labor shortage for the year. C is the control variable, and E is the error term. To determine the significance of each variable, the chi square probability (p) value, which within multiple logistic regression corresponds to a standard probability value, was calculated for all variables in an analysis within their assigned category, and significance was accepted at 0.05. This chi square probability value is reported in the tables for each independent variable in addition to the probability value from standard univariate analyses.

In conjunction with the above models, nested models based on sequential addition of significant variables along each additional time course were determined. This was performed by adding significant independent variables from the subsequent category to those of the previous model (e.g., category 2 variables were added to category 1 variables to form cumulative model 1, category 3 variables were added to cumulative model 1 to form cumulative model 2, etc.). Further analyses lead to models containing only the significant variables described in the regression equations. When variables were colinear, the strongest reasonable variable was retained. Variables that lost significance in progressive equations, even if significant within their category, were eliminated. White noise tests, including a concordance value, were performed to verify the results.

Because this analysis is not experimental, constancy of time intervals and the breadth of measurements were used as controls. All factors affecting time to entry into force were how to entry into force time has been effected since 1970; time was divided into 1-year intervals and compared using only complete years.

To determine if time to entry into force was associated with the presence of a labor shortage, the average age of the world was regressed over the range of burn total number of oil spill incidents. With the increasing use number of environmental regulatory policies implemented we sought to determine the effect on time to entry into force.

Models were developed from the Generalized Least Squared analysis that describes the nature of the entry into force time of environmental regulatory policy. The models integrate our research questions and hypothesis in the describing the theory influence whether consensus is reached among IMO members and subsequently policy is implemented. If Y represents the entry into force time if IMO regulation and X represents the characteristics of oil spills and the World Fleet, then the model can be written as follows:

$$Y = a + X_{i=1,2.3,n}\ \mathrm{B}\ +\ \mathrm{e}$$

B represents the coefficient, which measures the expected change in Y given a unit change in X. (X and B are vectors and parameter estimates). This general model (1) describing the nature of policies is based on the key points that IMO policies adopted are directly related to the internal, non-policy oil spill and World Fleet characteristics. To test the characteristics of policy determinates of time to entry into force of amendments we used a Generalized Least Squares. When using regression several issues were raised. A random coefficient model (GLS) is used to treat error as random in time and space. And appropriate controls are included in all analyses.

CHAPTER IV

SUMMARY AND CONCLUSIONS

Conclusion

The hypothesis was confirmed as total number of oil spill incidents increased the dependent variable of time of entry into force also increased. This same result is found for the log of total incidents. The sub categories of 7-700 tons, and >700 tons did not show any significant correlation to entry into force time. However, just as total number of spills increased the entry into force time, the total volume of oil spill also have a significant correlation to the entry into force time of an adopted amendment or convention. Fig 4. displays the SAS results from the likelihood of implementation of policy. It is significant on its own but lost some when the controls were added.

Analysis of Maximum Likelihood Estimates					
Parameter	**DF**	**Estimate**	**Standard Error**	**Wald Chi-Square**	**Pr > ChiSq**
Intercept	1	0.6540	0.7165	0.8331	0.3614
TotInc	1	-0.0297	0.0166	3.2201	0.0727

Fig 4. Likelihood Estimates of Adoption

As the age of the World Fleet increased the depended variable of the time it took to enter a policy into force decreased. Vice versa, as ships became older there was a significantly shorter time of entry into force. Fig 5. displays the results for the estimated entry into force time when a policy is amended. This too confirmed our hypothesis.

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	1	13.58004	4.37681	3.10	0.0127
TotInc	1	0.11822	0.05802	2.04	0.0720
ftAGE	1	-1.15870	0.31992	-3.62	0.0056
Labor	1	0.62651	1.71357	0.37	0.7231

Fig 5. Estimates of Time to Entry into Force

Discussion

This research marries consensus formation during strategic change and institutional theory. Because consensus formation impacts the speed at which norms are adopted, and norms become institutions of the maritime industry.

The institutionalization of a policy takes place when consensus is reached to adopt policy. Our hypothesis was confirmed, because the IMO is a consensus organization made up of individuals represented in the Maritime Industry. Individuals are less likely to make decisions that would financially injure themselves beyond a voluntary point. It is represented in our findings that a significant determinate in the time until policy enters into force is the age of ships. Because retrofitting a ship to meet policy demands is potentially expensive, it is less probable that members of the IMO would give their consent if they face considerable losses. Likewise if a ship is nearing the retirement or it is going to be scrapped it is not as greatly affected and the policies are passed. That is why the age of the World Fleet is a good indicator with regard to the likelihood of policy adoption, and estimating the time to entry into force.

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