Development of Marine Consulting Business in Advanced Shipping Countries -Use of Simulation for Safety Management as Part of an Effort toward the Revival of Maritime Society-

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ABSTRACT

It has already been two decades or more ever since the shipping and its related industries began to mature in advanced shipping countries. During that period, such countries have made various attempts for the survival of the industries. The advent of the so-called flags of convenience in a big way for the purpose of replacing crew members of their own expensive seamen by those of developing countries and the emergence of ship management companies, which are literally engaged in the management of ships, are the results of such movements. Some countries have been making efforts, as measures for the continued existence of the maritime industries, to create new marine-related businesses without regard to the traditional concepts of the industries. The movement toward the restructuring of a maritime society in Norway is well known as a typical example of such endeavors. The business of marine consultancy relating to maritime safety management field in our country is also a business that came into existence in such a stream toward the revitalization of the maritime society.
In this paper, as well as placing in focus the current picture and problems of marine industries in our country, we would like to present approaches to tackle these problems employed by advanced industrial nations in the West, that is, moves toward the revival of maritime communities. Next, we propose, as one of the answers to solve such problems, the further development of a consulting business which takes advantage of simulators. Lastly, we show specific examples of application of a simulator to the consulting business, while commenting on the effects of its use.

1. Introduction

The maritime industries in our country have now been enjoying, after a long while, a high freight market in the shipping sector, resulting from skyrocketing demand–which began in August 2003–from China's expanding economy. Any one of the parties concerned, however, does not believe, as it seems, that this trend will continue for a long time.
The maritime industries–represented by shipping, shipbuilding and port industries–are recognized, by everyone, to have importance as key industries in our country. They have been, however, marginalized, as structurally-depressed industries, in the business world, for a long time. The major reason for the maritime industries being unable to enjoy market attention is their low profitability. Industries with a low profitability will be isolated from the center of economic activities and left out in the cold. The low profitability of the maritime industries is said to arise from their pattern of business operation. It means that these industries all involve labor-intensive work, and, that the pattern of their operation has not undergone changes for a long time. For this reason, an increasing number of new competitors have entered the market internationally, depriving our industries of their competitive edges. When an industry wants to raise competitiveness and maintain high profitability, it takes a never-ending quest for innovation. When viewed from this aspect, our maritime industries can be said to have been extremely slow.
We do not think that their current situation—less competitive and left out of the market—should be left as they stand, but rather strongly believe that, from a national viewpoint, they should restore a sound condition.
To achieve that end, there is a need to encourage innovation across the entire maritime industries, through reforms of industry-related administration, education and corporation. The road to the recovery of the maritime industries will be a bumpy one, but the solution of each obstacle by innovation will surely bring them to the goal. This paper proposes the development of a marine consultancy which employs computer simulation as one of such innovations toward the revival of our maritime industries.

2. Actual picture and problems of maritime industries in Japan

The maritime industries in our country have been in a slump, continuously, for a long time after they reached their peak in the 1970s.

A particularly dramatic change was seen after the Plaza Accord in 1985, with the shipping industry in the center of such change. Its ripple effect ran through our shipbuilding and port industries, bringing about the current situation. The most prominent change in the shipping industry can be observed in the reduction of the size of the Japanese merchant marine and in the number of Japanese seafarers working on board foreign-going vessels.

The merchant ships under the control of Japanese shipping companies have undergone nearly no change in number, during the recent two decades, at a level of 2,000. The composition of the fleet, however, has dramatically changed from 1,000 Japanese-flag ships, twenty years ago, to 110–approximately 10% of the former–in 2002.[1]

In their place, FOC (flag of convenience) ships are on the increase. Together with it, Japanese seafarers on board ocean-going ships have dramatically decreased.

Fig. 1 shows that the number of seafarers, which registered close to 55,000 around a quarter century ago, has nowadays fallen below 5,500.[2]

When you look at this curve, you can easily understand how rapidly the number of Japanese seafarers dropped.

The greatest cause of this drop is the cost difference between Japanese seafarers and their foreign counterparts, as you are aware.

Fig. 2 shows a rough comparison of crew costs for a general cargo ship. According to this figure, the ratio of the cost which assumes all crew is Chinese to that which assumes all crew is Japanese, is 1:14, clearly placing before us the fact that Japanese seamen are no match for the cost competition.

Japan once implemented the so-called "Pioneer Ship" Program, on which eleven Japanese seafarers were envisioned to operate a merchant ship. It can be seen from the same table that, even with a vessel manned with eleven Japanese seamen, there are big differences in costs from those manned with Chinese and Filipino seafarers—at ratios of 1:7 and 1:4, respectively. The Program, as a result, was brought to a halt.

The change in the shipbuilding sector is also conspicuous, with a reduction of employees from 250,000 to the current level of a mere 70,000. On the other hand, the Japanese port industry also has sharp decline.

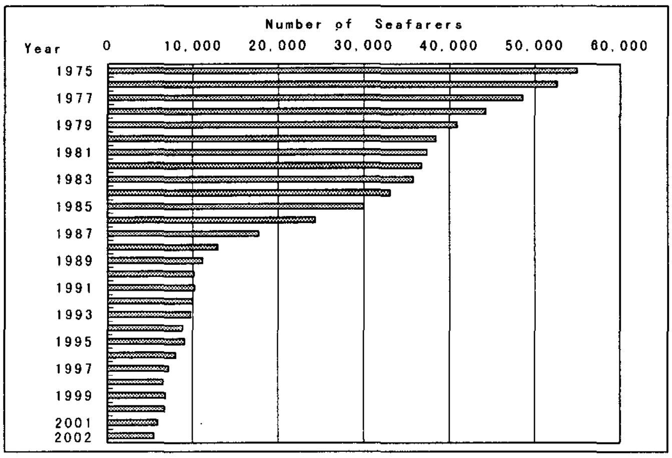

Fig. 1 Change in the number of seafarers for ocean going ship

◎Annual Expense for Seafarers
(Including : Salary, Travel-expense, Agent commision, Medical cost, Provision cost, Miscellaneous)

Constitution of Crew	Annual Expense for Seafarers	
	US$	Index
All Chinese (24-Crews)	$250,000	1.0
All Filipino (24-Crews)	$450,000	1.8
4-Japanese & 20 Filipino	$1,300,000	5.2
All Japanese (24-Crews)	$3,500,000	14.0
All Japanese (Pioneer ship 11-crews)	$1,900,000	7.6

Fig.2 Comparison of annual crew costs of an oceangoing ship (shouldered by shipowners)

In the volume of containers handled, Kobe ranked third and Tokyo and Yokohama 13th and 15th, respectively, in 1975. In 2002, however, Tokyo retained the 18th place with difficulty, but other Japanese ports were not included in the top 20 list. In addition, the volume of containers handled by Tokyo was 2.9 million TEU, a far cry from 19 million handled by Hong Kong and Singapore.[3]

The maritime industries in our country stand as described above and the major reason which has brought about such a situation is a reduction in their relative cost competitiveness. The change in the exchange rate after the Plaza Accord, boosted, in a stroke, the labor cost of our nation in the international market. The maritime industries, which are labor-intensive, were severely affected by the rise of the labor cost since it rapidly cut down on their strength in international competition. Thereafter, parties concerned have made efforts to restore competitiveness through technological innovation, but they have failed to close the gap.

On the other hand, the maritime community, with the past experience of being the leader of the world, has resisted changes of its systems, preserving their major portion intact.
In order that such industries regain competitiveness, such reform (which may be called a type of innovation), including deregulation, as may change the system of the maritime society, is inevitable. Innovation should be encouraged through administrative, educational and corporate reforms. While such an idea has been increasingly gaining ground among parties concerned, it has not been put into practice—a sad picture of our present maritime community. The root of the problems plaguing the industries can be said to be deep for that reason.

3. Approaches by advanced Western nations in this field

In advanced shipping countries in Europe, the decline of maritime circles started considerably earlier than in our country. In some of such countries, the shipping industry once failed almost completely. In parts of Europe, activities are vigorously conducted toward the revitalization of the maritime society. The movement of "maritime cluster" in Norway, in particular, is famous and is in the process of reaping good results.
In Norway, various types of business, such as shipbuilding and insurance firms, universities, research institutions, makers and consultants, have been successfully coordinating in organizing such clusters as a movement toward the revival of maritime industries.
Specifically, for example, a bridge system, close to a cockpit of an airplane, called IBS (integrated bridge system) was produced and supplied for ships free of charge and shipping companies which used the system took various data and gave them to the relevant maker as feedback. The maker, in turn, used such data to give a finishing touch to the system. Such is how the movement functions.
Another example is the start of the real-time distribution business of electronic navigational charts (ENC). This is a service established by ten European nations, including the United Kingdom, France and Germany, to provide contracted vessels–on a real-time basis and by use of a satellite–with ENC information gathered in Norway.
What is remarkable in the cluster movement, is that it has a concept of cooperation among various types of business to create new business sectors, not an exclusive thinking to "force the use of Norwegian products on Norwegian shipping companies only because they are Norwegian".
Partly because of the results of such movement, the marine society in Norway is gradually recovering its dynamism.
Fig. 3 shows a comparison of the size of the fleet and number of seafarers between Japan and Norway. The population of Norway is only 4.3 million, about one thirtieth of the Japanese population. It is surprising when you hear that such Norway has a fleet of 52 million deadweight tons, about a half of our fleet, with seafarers four times greater than ours. This fact makes us pause to think even though there are differences in the size of the nation and the national trait concerning maritime matters.

	Population	Volume of Merchant Vessel	Number of Seafarers
Japan	120 Million	100 Million D.W.T.	70,000 (Including 5,000 Japanese Seafarers)
Norway	4.3 Million	52 Million D.W.T.	60,000 (Including 20,000 Norwegian Seafarers)

Fig. 3 Comparison of Norway and Japan

Fig. 4 is a table showing major ship-managing companies in Western Europe.
Ship management business is a type which has emerged naturally in the flow toward the revival of the maritime society. The size of the business sector has now become huge, with the biggest companies managing more than 20,000 seafarers and 600 vessels, and achieving sales close to one billion US dollars. These figures correspond to the size of the foreign-going merchant marine of one nation.
As these examples illustrate, the key phrase in the context for the revival of Western maritime communities can be said to be "the improvement of shore-based maritime-related industries".

Name	Established	No. of Shoreside Employee	No. of Seafarers (Pool)	No. of Management Vessels
V.Ship	1984	1,100	22,500	600
Wallem Shipmanagement Ltd.	1971	150	5,600	170
Columbia Shipmanagement Ltd.	1978	-	8,000	310
Barber International	1975	400	6,000	230

Fig. 4 The major ship-managing companies in Western Europe

4. Development, in our country, of consulting business which employs simulators

Facing such a decline of the marine community in our country, those concerned, including us, became extremely anxious. That is, we had a concern that the maritime know-how and culture in our country nurtured over a period of 100 years might perish if the situation was left unattended. No man may consider that the maritime industry, including shipping and shipbuilding, is utterly unnecessary for our country, which is surrounded by the sea. We cannot overemphasize that if we leave the maritime society as it stands, the maritime skills and expertise of good quality will quickly disappear. This would surely be a worrisome situation for the life of our people.

Then, what measures are available to improve such a situation for the revival of Japanese maritime community? Basically, it is self-evident that there is a need to make a structural reform of the maritime society, that is, to change various systems of the maritime society which was structured to suit the past social situation, into one which is adapted to the modern society. That, however, will take a long time and is not an easy task to achieve.

Hence, we would propose, from 15 years of experience, the development of the marine consultant business which uses computer simulation, as one of the practical measures to revive the maritime community. We propose it because this type of business is expected to gain more and more importance in the area of maritime safety management in advanced shipping countries and, therefore, is expected to achieve further development.

Since marine consultants are required to be equipped with special knowledge in the maritime field, the business offers a particularly good opportunity for seafarers when they seek jobs ashore.

It was in about 1985 that marine technicians like us and naval architects teamed up in starting to enter a new business sector called "marine consultancy". Up to that time we, of course, had marine consultants in our country. But their services were provided almost by individuals on a small scale. Furthermore, their business stance was to offering their services mainly on the basis of their personal experience. As a consequence, their services produced uneven results stemming from personal differences.

We improved such a situation and established marine consultancy as a business. What was inevitable in the process was the method of using simulation as described below.

Then, why the method of simulation is necessary for marine consultants? In the business of marine consultancy which deals with "ports" and "shiphandling", when consultants verify their safety or economical feasibility, it is almost impossible to make a comparison by using actual ships or by building many ports.

Hence, in the past we were forced to resort to data or experience.

This, however, allows the generation of a wide variation in results, which may impede adequate verification.

Instead, the simulation technique, if used, would make it possible to achieve things as shown in Fig. 5, for example. This figure shows simulation results when a VLCC is turned port by 180° with the aid of a tugboat only. The two cases share the same turning method and wind direction, with the wind speed varied from 13 m/sec and to 17 m/sec. When you look at the figures, you can easily understand that the turning area of the vessel is conspicuously expanding along with the increase of the wind speed.

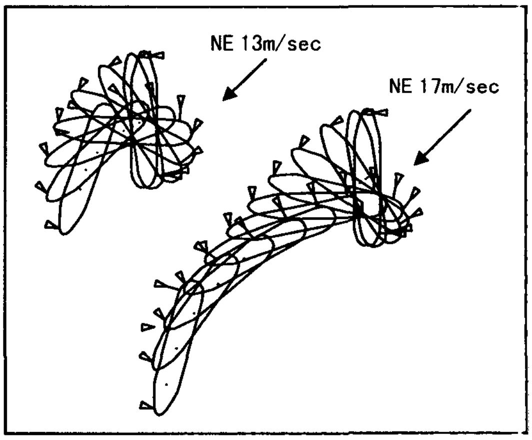

Fig.5 Example of 180° turn of VLCC

In this way, the use of simulation technique allows experiments for comparison without using actual ships and, as a result, enables a quantitative assessment of safety and conveniences, which tended to be appraised only qualitatively before. This is the reason simulation technique is often used in the sector of maritime safety management, which is one of the most important fields for marine consultants.

The consultant business we started, had a staff of two persons with a paid-in capital of 10 million yen, when it first came into existence, and has now grown to a corporation boasting of about 70 employees with a capital of 420 million yen. Competitors have also emerged in the market.

As already stated in Chapter 2, seafarers of our country have lost their competitive edge in the aspect of labor costs, resulting in a sharp drop in their numbers. This would translate into Japan's rapid loss of maritime skills, which, in turn, is feared to lead to a decline of the maritime industries themselves—a serious situation we cannot turn a blind eye to.

As seen in advanced Western nations, the key phrase for the revival of the maritime community is the improvement of shore-based maritime-related industries. Maritime consulting business is in line with that concept—in the sense that it encourages the transformation of seafarers to a shore-based workforce—and has great potential as one of the innovative initiatives toward the revival of the same community.

On the other hand, since the business is yet to develop fully, there are many problems to be solved, such as the expansion of its market and the establishment of assessment standards in the area of safety management. It is hoped that parties concerned will give serious consideration to our proposal, including the solutions to various problems.

5. Examples of the application of a simulator to consulting business and its effects

This chapter will show specific cases of application of simulation to safety management in the maritime field.

5.1 Application to designing of ports

This is an example of the application of shiphandling simulation to verify the construction of a new jetty—before its actual construction—by studying such issues as (1) the safety of maneuvers to approach the jetty; (2) whether the turning basin is sufficiently spacious for shiphandling; (3) whether the jetty orientation is reasonable from the aspect of safety management when seasonal winds are taken into account.

Before the evaluation, a CG visual scene is produced as shown in Fig. 6 on the basis of the master design plan of the port. Then, pilots are called from the relevant locality to conduct experiments for entering/leaving port repeatedly against this scenery on the simulator, with the weather and sea conditions changed in a variety of manners.

In this case, close to a hundred scenarios were experimented. The scenarios include those to examine a waiting area for tugboats to provide for the ship's engine failure and to study the optimum location of buoys.

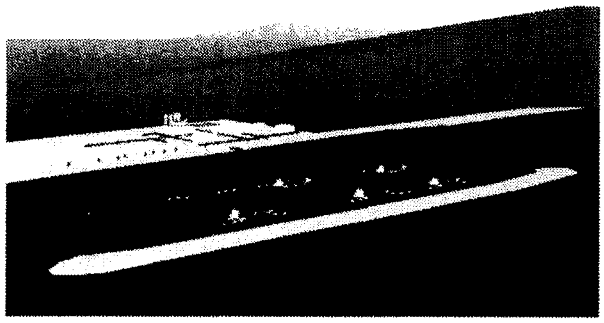

Fig. 6 CG Visual Scene

In this example, experiment results highlighted mainly the following problems:

(1) In the experiment results, there were many cases observed in which the vessel drew too close to the south end of the breakwater or proceeded excessively toward the shore side. These cases were seen, without exception, in shiphandling under strong SE winds, which tend to drift the vessel toward the breakwater. This fact means that the projected space off the south end of the breakwater is insufficient for shiphandling for approaching the jetty.

(2) When other vessels are berthed on both sides of the jetty (shore side and breakwater side), the present space available makes it extremely difficult to turn a vessel 180°.

The measures adopted to solve these problems were as follows:

(1) To change the shape and angle of the south end of the breakwater;

(2) To extend the area to be dredged toward the shore side and to increase the number of buoys showing a shoal, from one to two;

(3) To devise a method for departure when other vessels are berthed on both sides, that is, to set a rule—under seasonal winds of summer—to sail out, without making a turn, through the fairway lying north of the breakwater.

The picture of completed berth is shown in Fig.7. After seven years since the completion of the berths, the terminal has been safely operated without any major accident.

As shown in this example, if computer simulation is applied to the consultation of port design, it is possible to build a port in many different ways in a "*virtual*" environment—a matter which is impossible in reality. Consequently, it is possible to feed necessary information, including problematic points—by taking full advantage of consulting work—back to the designer.

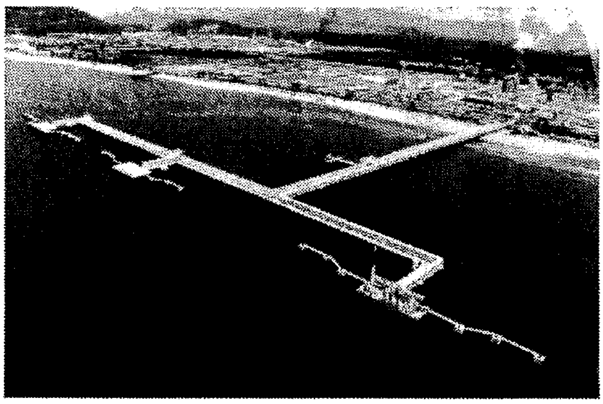

Fig. 7 The completed Berth

5.2 Application to law suit

The investigation into the causes of a marine accident is generally considered extremely difficult since it is often the case that: (1) there is no third-party eyewitness and (2) no physical evidence is available. The case we present here is the first civil lawsuit in our country in which a shiphandling simulator was used on the basis of the sole physical evidence available.

At a certain port, an unfortunate accident occurred where a pilot fell into the sea from a ship as it rolled, while he was disembarking, and died. The focus of the trial was on whether the vessel made a lee safe enough for the pilot to disembark by sheltering against winds and waves.

That is, the ship argued that the pilot fell through his own carelessness. On the other hand, the plaintiff—the pilot side—contended that he fell because of the pilot boat's oscillation since the ship did not provide a sufficient lee for the pilot boat.

Fig. 8 is a record on the course recorder chart, the only physical evidence of the case.

The arrow mark in the figure shows a fact that the vessel made an abrupt course change close to 30° at this point in time.

The defendant on the ship's side argued that the vessel made a sufficient lee by this course change and, in the first instance, the defendant's claim was admitted and the plaintiff on the pilot's side lost the case.

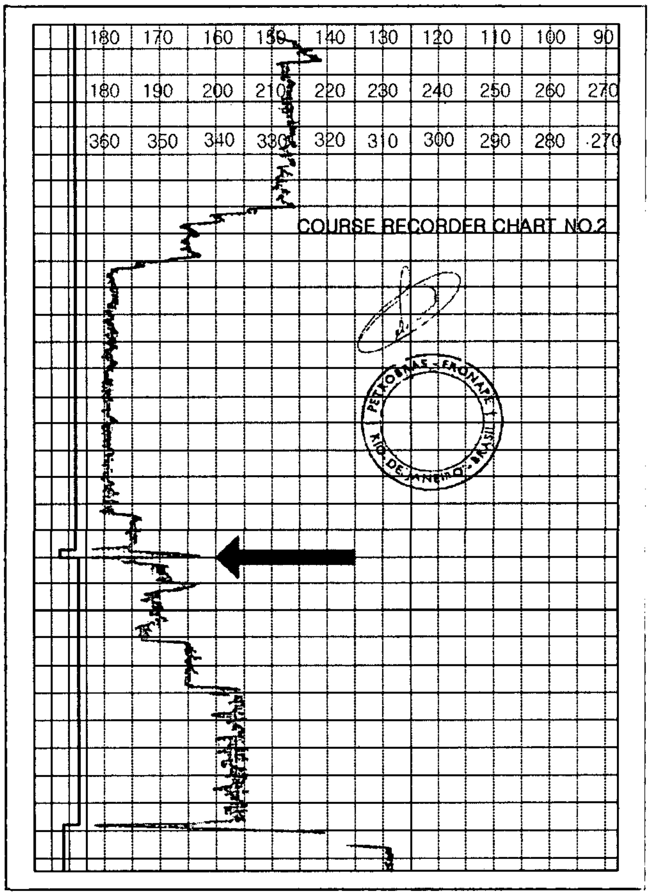

Fig. 8 The ship's course

It was after the plaintiff's loss in the first instance that a request was made by the plaintiff for consultation. Following the receipt of the request, a team, including us, magnified, by tens of times, the part marked with an arrow; and reproduced the ship's course with a dotted line curve in Fig. 9.

Then, considering what rudder actions were required for the vessel to follow the course, we made an attempt to reproduce the rudder actions by using a simulator. After trials, we succeeded in extracting the rudder actions shown by a series of trapezoids on the middle level in Fig. 9.

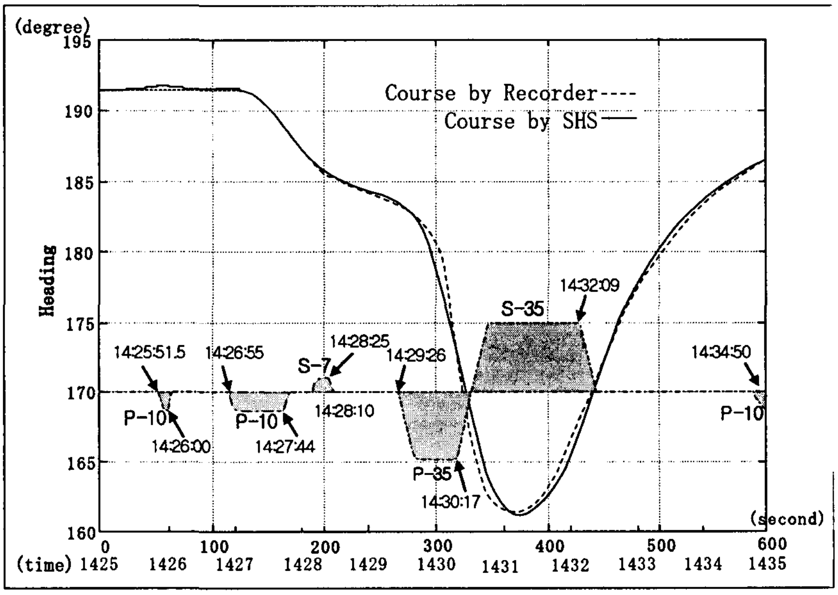

Fig. 9 Reappearance of Ship handling

The lower direction shows a rudder action to port and the upper a rudder action to starboard, with the X axis showing the passage of time (in seconds). The two larger trapezoids in the center represent a rudder angle of 35° to port for about one minute from 1429 hours and a subsequent abrupt rudder angle of 35° to starboard for about two minutes. In the event of such rudder actions, the simulator would draw a track curve represented with a solid line as shown in the figure. As a result, the solid and dotted lines almost completely agree with each other.

This reproduces the way the ship was steered, from data on the course recorder.
Then, how about the movement of the vessel when such rudder actions are taken? Fig. 10 shows the answer. When you look at the figure, it can be seen that the vessel was greatly meandering at around 1429 hours when the fall into the sea occurred. And, it is readily apparent to the eye of marine experts that this maneuver was not an operation to provide a lee but a reflexive action taken in response to a man overboard. This was a maneuver instantly taken by the deck officer on watch to avoid the person in the sea from being sucked into the propeller. It could not have been a maneuver to provide a lee. This simulation result, at last, was adopted as evidence and the plaintiff won the case completely in the second instance.
This example shows a case where material was provided as evidence for a lawsuit through the reproduction—on the basis of data left on a course recorder, by use of a simulator—of the manner of steering and the resulting movement of a ship. In addition to this case, the simulator is often used to identify causes of marine accidents, such as collision and grounding.

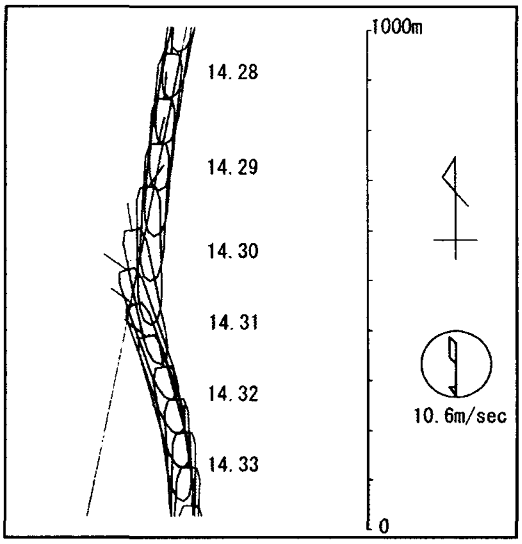

Fig. 10 Ship movement by SHS

In lawsuits involving marine accidents, both parties concerned, generally, tell mutually-contradicting stories since no third-party witnesses are available, making it, as a result, difficult to identify their causes. As shown by this example, the application of simulation technique would reveal contradictory points, if any, in a statement, paving the way to an earlier settlement of the case than otherwise.

5.3 Training by use of a shiphandling simulator

The shiphandling simulator is, of course, used for training. We estimate that training by use of a simulator is provided for about 1,500 to 2,000 men-days a year, in Japan, offering an important business field for marine consultants.
We experienced a very interesting case among simulator training sessions and would like to present it.
It was a few years ago. A young master who had been recently promoted was undergoing training in berthing by use of the simulator. In the simulation scenario, the location was in Yokohama and the vessel was a 30,000-ton class container ship. Fig. 11 shows his performance of his shiphandling. It is apparent that he took 54 minutes in bringing the vessel alongside the wharf with a considerable difficulty. At that time, a Yokohama pilot happened to watch the training and indicated his willingness to challenge a shiphandling simulation himself. His result of performance is shown in Fig. 12.
For the pilot, it was his first experience to use a shiphandling simulator. In spite of such a fact, the difference of their levels of skill is clear. The pilot completed the berthing operation in 24 minutes only.
There is a large difference between the two tracks, revealing the difficulty the young master experienced in his attempt for berthing as compared to the easiness with which the pilot maneuvered.

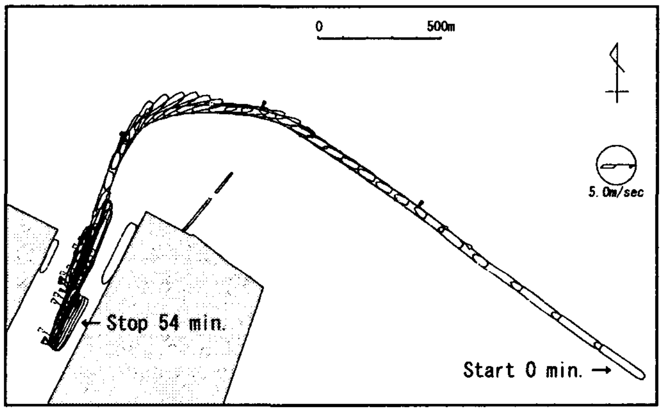

Fig. 11 Ship's wake (By the young captain)

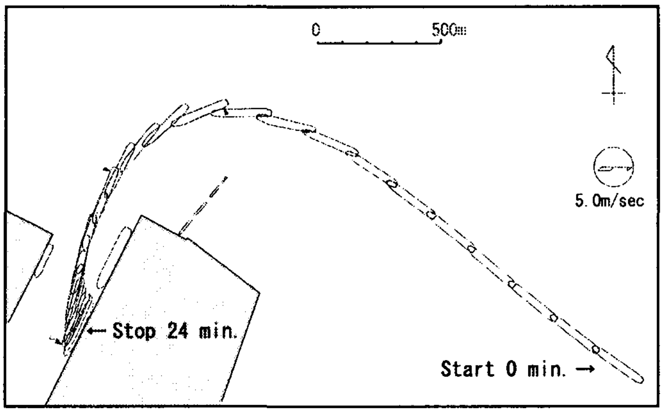

Fig. 12 Ship's wake (By the pilot)

People there watching the scene applauded involuntarily his splendid shiphandling, when the pilot commented on his performance that he did it as usual. Upon hearing the words, I (one of the co-authors) became more confident about the small difference between the performance of the simulator and that of an actual ship. At the same time I was surprised at the difference in the skill level demonstrated so clearly on the simulator. This experience unwittingly shows the correlation between shiphandling on the simulator and actual shiphandling and it can be said that this fact indirectly proves that if you gain skills to handle a ship on the simulator, you also have skills to maneuver an actual ship.
We have yet to develop an indicator to show the effect of simulator training in numbers. In such a situation this example will serve as a good hint toward quantification.

6. Conclusion

This paper highlighted, at first, the actual picture and problems of the maritime industries in Japan and furthermore, approaches taken by Western countries in these fields.
Next, the paper proposed the further development of the marine consultant business born 15 years ago, with the aim of reviving the maritime community of our country and, at the same time, reported services marine consultants offer through the use of computer simulation.
The marine industry represented by shipping and ship building, is a labor-intensive industry; as a result, its center shifts in search of cheap labor at all times. For this reason, advanced shipping countries of the past are troubled with the decline of this industry. However, what such shipping countries are expected to do, may not be to recover the central role for a traditional shipping industry but to make efforts to develop new areas concerning marine matters.
We believe that such efforts are the only way for the maritime industry in the world to slough off mere price competition and evolve in a more sound direction.
The application of simulation to consulting work presented above, is only a small attempt toward the development of new sectors in the maritime community. We sincerely hope that advanced shipping countries will amplify such attempts and turn them into a ground swell of movement.

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