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Balancing Technology between
safety and Economy:
the Classification consept and
International Technological
Competition

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Balancing Technology between Safety and Economy: the Classification Concept and International Technological Competition.

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This paper tries to explore two rather different problems[1]. Both are, however, related to maritime technology, and both are connected with organizing an industry, the shipping business. They differ in the fact that one deals with organizing a system of technological standards, the other with organizing an industry of many small firms. In the end I hope to show that in the particular historical case of Norwegian shipping, in particular time periods, these two problems fall together in one: How the Norwegian shipping industry was technologically integrated in the international shipping community, and even came to set standards for the whole industry.

Historians of technology have for several years discussed how technology is intertwined and interwoven into the seamless web of societies[2]. This

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[1] Most of the empirical evidence for this paper is taken from our work on the Norwegian classification company, Det norske Veritas: Andersen, H. W. and Collet, J. P.:Anchor and Balance. Det norske Veritas 1864-1989, Oslo: Cappelen, 1989. The book is in English.

[2] Hughes, T: "The Seamless Web: Technology, Science, Etcetera, Etcetera ..." in Social Studies of Science, vol. 16, no. 2, 1986. _

makes it, of course, very difficult to follow particular technologies over longer time[3]. Instead we have to analyze clusters of technologies or what may be called technological systems[4]. In this paper, however, we shall raise the problem in a somewhat different way. The technological system we shall look into is the international system of shipping and deep sea transportation through 130 years. Ship technology is one of the most dramatic technologies in terms of conflict with nature and her forces. Even though rivaled by rail, ships were and still are the most important means of transport, in terms of volume-kilometers.

Ship technology is not only a product of the fight to control nature, it has also a social and cultural side.[5]   Deep sea shipping is by its character international and highly ccompetitive, and at the same time has traditionally been able to avoid national control of the country of ship origin only through its characteristics. Taken in conjunction these two shaping factors, the mastering of the natural forces of the oceans and the eluding control of the territorial state raises the question of how norms or a standards of ship technology were developed and socially negotiated, and how these norms has changed in line with new technologies. The basic conflict can perhaps best be illustrated by the dichotomy safety-economy. Safe ships are expensive and hard competition may tempt the owners to use sub-standard ships to make profits. The resulting norms are the results of a long negotiating process, both

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3   Andersen, H. W.:"Different Problems - Different Ways. Control, Calculation and Mass Data as Focal Points for the Study of a Social History of Computing", To be published in Scientica Yougoslavica, 1988. Working paper no 33 from "History of Technology project, the electronic industry", Centre for technology and Society, Univ. of Trondheim and Univ. of Oslo, 1989.

4   Hughes, T.: Networks of Power: Electrification in Western Societies, 1880-1930. Baltimore, John Hopkins U.P. 1983. See also Bijker, W., Hughes, T. and Pinch, T.: The Social Construction of Technological Systems. New Directions in the Sociology and History of Technology. Cambr. Mass., MIT-Press, 1987.

5   The concept of technology balancing between nature and culture is inspired by Latour, B: "The Prince for the Machines as Well as for Machinations", in Brian Elliott: Technology and Social Process, Edinburgh: Edinb. U.P., 1988, p. 20-43. See also Latour, B.: Science in Action, Open Univ. Press, Milton Keynes 1987.

involving culture and nature. But first and foremost it is a social process.

Around the middle of the 19th century this problem was closely related to the question of insurance, both with regard to the ship itself and to insurance of the freight. And from the negotiations and standardization of the insuring companies' norms grew the concept of ship classification and ship classification companies.

The middle of the 19th century was a time when the world witnessed either the establishment or the revitalization of a series of national and international classification societies or companies, as the British Lloyds, the French Bureau Veritas, The Germanishche Lloyds and the like.[6] The American Bureau of Shipping had a somewhat special story.[7] Most of them were more or less private societies, a product of a liberal age and the very rapid growth of sea transportation that followed the industrialization and growth of international trade.

International shipping has some peculiarities compared with other activities involving heavy investments in technology. First of all the obvious but important fact that the investment is easy movable. Secondly, the investment is easy to transfer to other owners in other countries, almost as liquid as money. These peculiarities, combined with an international liberal regime of transportation, particularly after the abolishing of the British Navigation act in 1849/50, opened the field to all competitors. The buying and selling of old and new ships were an integral part of this picture. Thus, with regard to technology the competition and rivalry among different kinds of solutions came to be extremely hard.

This international competition made it difficult for any particular national government to regulate or control ships and their condition. At the same time it was obvious that there was a danger of sub-standard

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6   LeConte, P.: Le Bureau Veritas 1828-1928. Paris, 1928. Blake, G.: Lloyd's Register of Shipping 1760-1960. London, 1960. von Strizky, O.: Hundert Jahre Germanischer Lloyd, Hamburg, 1967.

7   American Bureau of Shipping 1862-1962, New York: 1962.

ships undercutting their more seaworthy competitors through lower freights, as there was the danger of insurance fraud. The first phenomenon was typical of times of crises, the second was characteristic of periods with rapidly growing markets.

The establishment of Det norske Veritas as a classification company was firmly rooted in the second problem, aiming to secure better and cheaper insurance. However, Veritas came to include particular features mirroring the conditions of the rapidly growing Norwegian fleet.

Norway with the long coas has always relied heavily on sea transport. However, in the second half of the 19th century this dependence took on a new form, shipping expanded no longer through transportation to and from Norway (and Sweden), but between third countries. The Norwegian fleet became in a sense a specialized transporter for the rapid economic development in the world, particularly through the third quarter of the 19th century. In this period the Norwegian sailing fleet grew to become the third largest merchant fleet in the world second only to the British and the US fleet. In the years that followed her ranking ocillated between third, fourth and fifth place as France and Germany had fleets of roughly the same size[8]. In spite of this the way of raising capital and the way of organizing the fleet in Norway was very different to the large foreign shipping nations and their shipping houses.

The typical way of building and sailing the Norwegian fleet was a kind of local mobilizing of resources along the Southern coast. In the early days the initiative came from local merchants, later on from other groups organizing part ownerships which could include farmers, shippers craftsmen and merchants. However, as opposed to their larger foreign counterparts, "the Houses", there were no way of organizing the accumulated capital as long as each ship was its own "company", and as long as all the partners had to agree on having another ship if the original one

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8   Worm-Müller, J. S.: <u>Den norske sjøfarts historie</u>, vol II.2 (second part), Oslo: Cappelen, 1950, p. 3. See also <u>Det norske Veritas 1864-1914</u>, Kristiania (Oslo): DnV, 1914, Statistical appendix. The size of the Norwegian fleet is also given in Andersen, H. W. and Collet, J. P.:<u>Anchor and Balance. Det norske Veritas 1864-1989</u>, Oslo: Cappelen, 1989, p. 483-485.

was lost or sold. Shipping along Norway's South coast in those days was a way of living for these small societies, it was a cultural form of its own, and not an organized large scale capitalistic enterprise.

This also put its mark on the Norwegian Veritas. To save costs the local communities cooperated and organized mutual insurance clubs. In this way they thought it was possible to get out of the hands of the expensive Hamburg and London underwriters. As long as the mutual clubs worked locally it was possible to keep an eye on the conditions of the ships that belonged to the members. However, as soon as the clubs expanded their activity beyond the local area, some kind of inspection and routine control had to be established. Det norske Veritas was founded as a response to this need for inspection and control of technical standards of the insured objects, the ships.

This was, however, only part of the problem faced by Norwegian ship-owners. Even if they got rid of the foreign underwriters, they still had to have the expensive certificates, usually from the French Bureau Veritas to be able to get insurance on the freights, and to be trusted with freights by foreign shippers and merchants.

Hence the aim of Det norske Veritas came to be two-fold: Firstly to inspect and control the ships of the mutual insurance clubs and secondly to provide them with certificates which were recognized internationally. The first part was thus to discipline and standardize the technological norms of the Norwegian-owned fleet, the second was to gain recognition for their certificates throughout the world. These tasks were seemingly very different: one regarding only the Norwegian owned fleet, the other was highly international. However, there was a very close tie between them. To gain recognition for the certificates was simultaneously to gain credibility for the ships. To ensure this credibility Veritas institutionalized the inspection and control of the hulls. However, the standards applied by Veritas' inspectors to the hulls, had to be at least in principal identical or higher have a higer standard than the ones commonly used internationally. A reputation for being second rate would be damaging not only to the Institution but also to all its members.

It is now possible to see how the different classification companies came

to level out their internal differences in standards, and why international shipping came to posses some common criteria for safety and other standards of technology. However, the classification societies were only engaged in structural problems, not on questions relating to manning, sailing and loading. This came up as a public problem later on particularly with the work of Samuel Plimsoll in Britain and in a broader sense as the so called load line problem.

The work on the problems relating to the structural strength of ship hulls came to be perhaps the most important part of the work of the classification companies: to ensure relatively common standards on technology internationally in a highly competitive environment. The system of classification was established in a time when a rather simple technology was dominant, that of the wooden sailing ship. However, classification societies came to work as normsetters and norm interpreters also in times when technology changed rapidly, as it did in the last quarter of the 19th century and have continued throughout the 20th. This raised severe problems of how to set norms and standards when technology was continually changing, and at the same time keep an eye on the international competition and the economy involved.

Det norske Veritas did succeed in fighting its way to international recognition, later on becoming one of the world's largest and most international classification societies. This is, however, not the point of this paper. We wish here to study how Veritas came to work as a link between the small Norwegian shipping companies and the international shipping communities in the question of technological development.

This problem raises the question of large scale shipping companies, integrated with trade and production can live side by side permanently with small scale companies coordinated at a level above each individual firm. Charles Sable and Jonathan Zeitlin have argued the importance of just this model to understand the industralization, or perhaps better the

modernization process in the 19th century and onward[9]. Small scale, innovative firms combined with different modes of collaboration or links between them have been an important element in the industrialization and modernization processes. One of their main observations is the systematic neglect of this kind of small scale enterprise: it is very seldom found worthy to description in the litterature and analysis. Instead it is the large scale industries with eye-catching machinery and power that has been analyzed.

This phenomenon is clearly illustrated in shipping. Even if the Norwegian fleet came to be the third largest in the world it has very seldom been described or analyzed. Instead it is the large scale shipping companies or houses of the large industrial nations that have dominated the literature, excepting the so called flagg-of-convenience countries, largely attempts from the late 1950s by US companies to sail their ships cheaply.[10]

The structure of Norwegian shipping has, however, prevailed up to the end of the 1970s: it was a very large fleet, consisting by and large of rather small and specialized shipping companies. Only few of the companies were involved in other business or industry areas. The size of the firms involved grew through the first half of the 1900s, but as late as the beginning of the 1960s 78% of the companies had between one and five ships (1/3 of the fleet in terms of tonnage)[11].

We are then obliged to ask how could this large fleet survive and even

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9. Sable, C. and Zeitlin, J.: "Historical Alternatives to Mass Production: Politics, Markets and Technology in Nineteenth Century Industrialization", Past and Present, no 108, 1985. See also Sable, C. and Piore, M.: The Second Industrial Divide. Possibilities for Prosperity. New York: Basic Books, 1984

10. Cafruny, A.: Ruling the Waves. The Political Economy of International Shipping. Berkeley: Univ. of California Press, 1987. Silverstein, H.B.: Superships and Nation-States. The Transnational Politics of Intergovernmental Maritime Consultative Organisation. Boulder: Westview Press, 1978.

11. NTNF: Skipsfarten og skipsbygging. Billag 13 til NTNF's forskningsutredning, 1964, Oslo: 1964, p. 11. The figures are from the list of members of Norsk Rederforbund, 1/7 1963 and do not include owners with no ships at all.

prosper faced with the challenges of modernization. A process which involved large scale integrated companies taking care of large scale effects and thus monopolizing major parts of international transportation, either by size or technology or through transportation cartels, the so called conferences that cartelized a large part of the liner freight field? In this way a classical situation was established: large scale firms monopolizing major trades and lines, leaving the smaller companies to the more marginal markets and to a restless search for new markets and new opportunities. Whether they were in the form of new markets, new clients or new technologies was not particular important to the owners working in this marginal fields.

However, their own expertise was not symmetrical or even. For the small Norwegian shipping companies the major effort was invested in thorough familiarity about everything conserning markets and trades. With regard to technology these firms were rather ignorant, unless it could contribute to the establishment of new markets. The size of the companies was in a way also detrimental to advanced technological competence within the company.

It was in this field that the classification company came to show some of its not intended virtues. First it is important to notice that as long as Veritas was a society for the mutual insurance clubs it was not formally but in reality a society for the Norwegian shipowners. The mutual clubs were identical with the owners as members of the clubs, and as Veritas was a society for the clubs it was consequently a society for the shipowners. From 1864 to 1907 it was in reality the only national organization for the owners. In 1907 a more traditional association of shipowners was organized, among other things as a consequence of the public pressure on the owners due to deteriorating standards of the old sailing ships.

The situation with many small companies and a cooperative organization with access to vital information about ships and ship technology, which was strong enough to enforce their technological jurisdiction over the fleet, and with a legitimacy built on voluntary acceptance by the industry, came to be an important element in the Norwegian system of small scale shipping and vital in preserving the innovative element in

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international shipping, often pioneering new trades, markets and technologies.

In a way Veritas came to be a kind of collective organized knowledge base of new technology, a center of competence that each company could not finance by itself. This knowledge was a part of the industry just as Veritas was a part of the industry. In the other large shipping countries the function of the classification companies came to be different. The need for organising the industry at the national level, both socially and technologically was much weaker and the societies could work more independently of the companies and their owners.

Let us look closer at how this kind of semi-voluntary organization worked with regard to technology, both to introduce innovations and preventing obsolete capital to live on in the fleet. We shall here only briefly look at some different situations, spanning roughly 100 years.

Much of the motivation for the establishment of a national classification company as an alternative to the closest competitor, the French Bureau Veritas, was to be found in the relative price. This phenomenon was paralleled by the mutual insurance clubs whose aim it was to save costs compared with their competitors, the Hamburg or London underwriters. Perhaps Veritas' main role in the second half of the 19th century was to establish a common technological standard on all Norwegian ships, and thus to make possible the cheap insurance of the ships and to win international acceptance for their certificates by foreign shippers and merchants round the world.

As long as international trade was expanding, the Norwegian fleet grew at an even more rapid pace. However, as the price competition grew harder in the last quarter of the century, together with a technological shift toward steamers both Veritas and the Norwegian fleet experienced severe troubles. The major strategy chosen by Norwegian owners was in line with the motives for starting Veritas, but driven to the extreme, it also came to threaten the very existence of the society.

The strategy chosen was the only one open for a large marginalized and fragmented fleet: cost-cutting transportation became the common denomi-

nator for the Norwegian fleet. This meant the use of secondhand and outdated sailing ships rigged down to reduce the crew. However, Veritas could not accept the detoriating standards of these ships, and many of them were sailed without classification and without insurance. Ship losses were abnormally high in the Norwegian fleet around the turn of the century, and combined with the public pressure for an obligatory load line (accepted in 1909) this led to severe political problems for Veritas in Norway. In this situation Veritas worked as an agent for the whole industry in the discussion with the state agencies and the public. This came to be a situation that threatened to undermine the legitimacy of Veritas as a neutral third party.

The severe crisis came to be a crises of legitimacy for the society in general. The solution was to rebuild the Institution with a very restrictive practice and bringing in a new director from Britain and from Veritas' renown British counterpart: Lloyds register of shipping. However, this made Veritas more conservative as a coordinator for the Norwegian shipping industry, and in the period from 1910 till 1950 this role worked first and almost entirely through the practice of norm-setting and interpreting technological standards. However, this was done in close contact with the industry and the norms set were detailed, tabulating sizes and dimensionss in a way that could be used as a construction manual.

From 1950 onward, however, Veritas was revitalized to an unparalleled degree. The reason for this was both external and internal to the society. Internally the wish for another type of society, more beneficiall to the industry in general and able to make up the lacking competence characterizing the Norwegian industry. 1950 was a time when science and technology perhaps reached its zenith on the sky of social recognition and expectations. At the same time the size of ships started to increase appearently without limits. At the same time the industry experienced several new problems among which the breaking in two of whole ships became notorious.

In this situation Veritas employed a professor of ship technology as managing director. His period as director of Veritas left two very distinct marks which were inter-related and which changed the whole

Institution. It was first and foremost the break through of science based ship technology. Secondly, partly as a consequence of this (even though not as a necessary consequence) the development of the Institution into an active organizer of innovation and pusher of new technology in the industry at large. Thus Veritas more actively complemented the rather weak industrial structure of small firms in a way that by the begining og the 1970s had made the Norwegian fleet the most modern (in terms of the average age on different types of ships in the fleet) in the world.

Let us look a bit closer at how Veritas achieved this dramatically changed role. The "scientification" of ship technology is of course nothing else than a way of using the legitimization and neutrality of science to build a new and more theoretically based technology. Borrowing elements from aeronautics and from other fields the new director, Georg Vedeler, launched his revolutionary program of being able to evaluate and accept or reject a new and untried technical solution before it was empirically was tested. In shipping this was a dramatic change from accepted behavior in the inter-war period when it was argued that the classification societies needed 100 ships over a 10 year period to evaluate a new design. Vedeler and Veritas challenged the established empiric and conservative tradition of the established classification societies using theoretical tools and trusting them. Hence Vedelers approach changed the role of the classification society from a break to an accelerator of technological change in shipping.

Vedeler had a particular reason for this change: Especially in times of changing technology, it must be possible both to obtain safer and at the same time more economic ships with the help of a 'scientific technology' as he labeled it to distinguish it from the empirical tradition ruling ship technology. Particularly economizing on hull strength and balancing the strength needed in the different parts of hull members became an important feature of the system Vedeler built. The attitude taken by the society also implied a total revision of the book of rules, changing from empirical tables to demand on strength calculated by different formulas. Veritas was the first society to introduce this in 1953, the other societies followed suit towards the end of the 1950s. To make the norms more abstract and more difficult to apply could be regarded as an abdica-

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tion from the role of a technological center of competence. However, it allowed for a greater freedom of design and it was very rapidly compensated by an increase in the use of the Institution as a consultancy by the shipowners and members.

To be able to understand the new role of Veritas as an accelerator of innovation in the industry, it is important to emphasis another important step. The Institution's declaration of its ability to evaluate all kinds of designs quickly implied a need for a broad technical ('scientific') competence inside the organization. Hence Vedeler at once started to build what some years later came to be the research department. As ship technology developed the department expanded and soon became not only the most important in Veritas, but one of the largest research institutions in Norway. Hence what started as a "scientification" and abstraction of construction norms developed into research institution with a broad scope so as to keep a high level of awareness and make real a declared latent competence to react quickly and independently to any new innovations or new demands which should present themselves.

This broad area of competence was established in the 1950s. However, there werw both push and a pull factors which pushed the society into the role of research department for the whole industry. The push factors were of two kinds: firstly, when the harvesting of research results derived from the second world war came to an end, the cost of technological research and innovation tended to rise sharply. This made the society eager to engage in activities which could finance a large research department. Secondly, a program involving the use of science building better and cheaper ships made little sense if the 'good message' did not get through to the shipowner. It implied a kind of missionary attitude toward innovation and technological change in general, an attitude particularly directed toward the members and clients of the Institution. Hence the technological awareness of new innovations by the industry was strengthened not by the external markets, but by the common Institution: Veritas.

On the pull side, the traditional structure of the Norwegian shipping industry with its rather small units could be seen as a call for pooling of resources on technical research, a resource that at the same time was

legitimate and held in high regard by the industry. This of course opened the field for Veritas as an integrator and accelerator of technological change in the Norwegian fleet.

The last part of this argument, the structure of the industry, became very clear both when comparing with the other classification companies and particularly when we look at what happened as Veritas plunged into the oil age classifying and certifying oil rigs and maritime installations. In this field they did not meet the small Norwegian shipping firms, but large multinationals, many times as big as themselves, with in-house expertise which rendered the classification society's style of consulting and approving more or less obsolete. The experience from the petroleum sector underlines the argument that Veritas came to work in symbiosis with the Norwegian shipping companies as the industry's main source of new technology and innovation and that this way of working was not transferable to other sectors with other structures and institutions and with quite different traditions in negotiating solutions to technological problems and opportunities.

We have so far not discussed what came to be from the 1950s and 60s the most important problem with what we may call Veritas' approach: the crisis of legitimization on a broader societal base. This was particularly clear in the conflicts with government agencies over which institution's responsibility it was to set norms of safety. This became a hot topic toward the end of the sixties and was even more debated in the 1970s as the maritime oil activity increased in the North Sea.

It was undoubtedly not without problems for an Institution which functioned as a manager of technological norms to sell its service to the customers it was later to evaluate. This situation can be visualized by an analogy: Veritas was like a court whose judges at the same time was law-giver, judged whether the laws were followed and made a business selling their advice to the accused. In such a system it is possible to make a lot of money for a short time, but not in the long run.

Veritas ran into trouble fundamentally because selling safety and selling technology are two very different things. It is possible to reconcile these two different services if one is very well aware of the limitations

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and possibilities of each, but sooner or later the roles become blurred. This was particularly the case with Veritas as the organization grew through the 1960s and early 1970s, and the ideology of the research department became the dominant ideology of the Institution. Thus the ambiguities that from the start allowed Veritas to work in the various roles as legislator, as consultant and innovator in the industry provoked towards the end of the 1970s a fundamental uncertainty inside the organization as to what they actually were - and a new identity had to be created. That is, however, another story.

Conclusion

The concept of classification societies is perhaps one of the most interesting examples on how international common standards of technology with regard to safety was created as early as the mid 19th century. However, the shape this kind of norm management took throughout the past 130 years have been shifting, differing from society to society. In the Norwegian context, with its large international fleet composed of many small enterprises, the classificatin society came to act as an integrator of international and local norms of technology. It functioned also as a development center of competence, organizing the industry with regard to technological knowledge and expertise.

This took two rather different forms over time: up to 1950 it worked mostly as a recipe book on how ships should be constructed and maintained. At the same time the Institution was strong enough to enforce its standards on the owners and even to work as a technological police by inspecting the ships with intervals. After 1950, through the scientific revolution in ship technology it still held its former function, but in addition also worked as a research center and consultants for the owners with regard to new technology. Over all it may be fair to say that the weak organizational structure of Norwegian shipping was supplemented with Veritas as a strong and collaborative technological oriented organization which was accepted and integrated internationally in its field.

The evidence supports Sable's and Zeitlin's alternative approach to large scale, mass producing units as the only feature of the modernization process the last 150 years. It also shows how internationalization and

integration can be handled in a situation without a large domestic marked and without large companies. The way to modern societies are more complex and more diverse than it usually is conceived.

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