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A REGULATIONIST APPROACH TO THE
OCCUPATIONAL STATUS OF NAVIGATION
OFFICERS IN THE U.S. MERCHANT MARINE

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Abstract

Regulation theorists are concerned with the economic manifestations of social factors such as attitudes and norms that at first appear to be unrelated to economic activity. These forces interact to influence the fortunes of industries and regions. While typically the regulationist approach is applied to place-specific processes of change, the perspective can also profitably be applied to industries that are not place-specific. Using merchant shipping as an illustrative case, the paper begins with a broad overview of regulationist principles and then applies them specifically to technological and organizational changes that are occurring in the marine workplace. It then discusses the role of merchant officers in that industry and the effects of technological change on the organization and character of their work. The paper will show how the regulationist approach evokes a richer theoretical understanding of change in the workplace and, in so doing, will expand understanding of the mode of social regulation.

Introduction

Within the last quarter-century and accelerating during the 1990s, numerous technological changes have appeared aboard ship, particularly in navigation and communications equipment and in management information systems. These innovations, which have shown potential to reduce risks or costs, or both, have also brought about profound changes in the practice of seamanship and in the organization of the marine workplace. This paper expands on prior work (Kendra, 1998) and analyzes one subset of those effects, namely, the impact of changing shipboard technologies—and the rationale for

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their adoption--on the occupational status of merchant marine officers. One of their many duties is the identification and reduction of various sorts of operational risks in the complex marine environment. Through the application of skills learned in formal and informal training, bolstered by experience, merchant mariners confront hazards posed by concentration of shipping traffic; congested ports; narrow channels and shallow water; and extremes of weather; all against the backdrop of high tempo operations and tight schedules.

The occupational status of merchant officers, particularly deck (navigation) officers, is troubled, however. Technological change is displacing much of the traditional skill set by calling into question its continued practicality, while a shift in research toward “human error” as a cause of accidents has made merchant mariners look perhaps more dangerous than a hurricane or a coral reef. At the same time, relentless searching for cost-reduction focuses on comparatively high salaries as a drain on competitiveness in the merchant fleets of the more prosperous countries, particularly against the low wages paid on many “flag of convenience” or “second registry” ships.

This paper situates these technological and organizational shifts in the marine workplace within the regulationist schema. First it introduces relevant findings from the sizable regulationist literature, and it then presents the relevant aspects of the marine workplace. The paper discusses how the concept of risk functions as a fulcrum for converting social regulation into “juridico-legal” regulation (Jessop, 1995) and argues that the marine workplace is oriented around this fulcrum. Finally, it shows that occupational status--professionalism--which is closely linked to skill, is both a socially regulating force and a product of negotiations that occur at different scales within the mode of social regulation.

Regulation theory: General Principles

Reviews and critiques of regulation theory include Peck and Tickell (1992), Jessop (1995), Peck (1996), and Barnes (1996). Regulation theorists attempt to explain features of the economy, such as the structure of labor markets, by examining the social contexts within which those markets operate (Peck, 1996). Peck (1996: 97) observes that “A unifying characteristic of this wide body of work is its concern to demonstrate ways in which institutions matter to the operation of the economy...” Jessop notes that for regulationists, there is no “distinction between the economic and the extra-economic” and that they are interested in “‘integral economics,’ i.e., in the socially embedded, socially regularized nature of economic activities, organizations, and institutions” (Jessop, 1995: 309, citing Jessop, 1990: 6 and Jessop, 1992: 233-234).

The foundation of the regulationist view is its conception of regimes of accumulation, or periods of stable economic growth (Peck and Tickell, 1992; DiGiovanna, 1996). The decades following World War II comprised such a period, characterized by rising wages, high consumption, and a high rate of profit; while there may have been small perturbations of the system, the functioning of the “accumulation system” continued relatively untroubled (Peck and Tickell, 1992). The Fordist system of accumulation was dominant during this period, known for the mass-production manufacturing which enabled great productivity (Schoenberger, 1988: 247), and also for technical changes and deskilling (Peck and Tickell, 1992). By the end of the 1960s, however, stresses appeared in the Fordist regime, as productivity gains failed to match wages and the rate of profit fell. The industrial response of intensifying the labor process soon reached the limit of human capability, while at the same time provoking worker unrest (Schoenberger, 1988: 247).

Central to a conception of a regime of accumulation is the “mode of social regulation.” the panoply of social and political structures which enter into economic activity

but which are not explicitly economic, such as local customs, social norms, institutional norms, propensity for governmental involvement, and positions held by and toward labor unions. Regulationists portray crisis as normal within capitalism (Dunford, 1990; DiGiovanna, 1996), and it is through the mode of social regulation that the inherent conflicts in capitalism (class struggle and competition) are resolved (Peck and Tickell, 1992: 192, Dunford, 1990: 300). Of the various dimensions of the mode of social regulation, two are particularly relevant for this paper: the role of the state and the wage labor relation.

The role of the state includes the actions and interventions of government (DiGiovanna, 1996). The ideas of *regulation* and *governance* differ in their application in the literature. Governance refers to institutional and legal structures while regulation refers to the social norms that orient economic activity—in other words, regulation in the sense of moderating or tempering. There is, however, a clear role for government in the regulationist scheme: to convert social norms that exist outside of economic activity into economic forces that govern production via laws and statutes. The mode of social regulation takes on its greatest potency when expressed through the power of the state. The overlap between the regulationist concept of regulation, and the juridico-legal concept (Jessop, 1995) occurs in a variety of laws which govern the operations of firms--statutes governing stock-trading, banking, insurance, and other financial transactions codify a certain accepted view of how such activities should be conducted--and the overlap is also seen where social concerns for safety result in regulations that govern operating standards, thus directing the firm's resources toward safety precautions that would otherwise become part of profits. In shipping and in other industries, especially other transportation industries or industries where systems failure might have catastrophic consequences, the concepts of

regulation and governance frequently overlap with respect to labor. Reducing risk, especially environmental risk, has become a social norm which bears on and regulates marine transportation through the medium of governmental action. While the number of workers to employ is customarily a decision left to the firm, in shipping and in other industries such as aviation those numbers are fixed by law, for reasons related not just to issues of seafarer's welfare and working conditions (themselves the product of an evolved social view that seafarers should not be mistreated) but also because of safety. In merchant shipping, the fixing of those numbers typically involves negotiation, both tacit and explicit, between industry, seafarers, and government agencies such as the Coast Guard and at the international level the International Maritime Organization. The role of the state in marine transportation is thus complex: governments enable marine transportation by providing harbors and aids to navigation; they regulate (in a statutory sense) marine transportation by mandating construction, equipment and personnel standards; they advance their national shipping interests through protective legislation; and they provide technical support, funding, and other benefits of all sorts.

The relationship between government, technology, and organization is not unidirectional: government can prompt changes in technology and organization, but government also responds to technological and organizational innovations, by adjusting its regulations to permit their application in industries such as marine transportation. Government policy and regulation thus structures the use of technology. In merchant shipping, there are multiple layers of government at work: national laws, international treaties and conventions, and sometimes, as in the United States, even state and local regulations. Thus there is a pastiche of overlapping interests and lines of authority, some of which are complementary, others conflicting. The salience of risk in shipping has been

intensified, largely through the public outcry that followed a few notorious disasters and that was crystallized into public policy. Following the Exxon Valdez grounding, the Oil Pollution Act of 1990 mandated sweeping changes in the operations of ships, including workday limits, increased local participation in industry management, and the adoption of new technology. More recently, a strategy of regulators has been to emphasize that “safety pays,” and a prime goal of the Coast Guard’s Prevention through People program is to develop a “culture of safety” in shipping: to purposefully create a set of safety-oriented, intra-industry social norms where such norms are thought to be feeble or non-existent. Here the Coast Guard seeks to translate public concern about safety, especially environmental quality, into operational realities in the industry. While the Coast Guard does have the power to compel action, a view has developed that fostering a culture of safety has the most promise for achieving reduced operating risks.

Government alone, of course, is not the only institution involved in shipping. Labor unions have been involved in work re-organization projects, mostly in Europe but to some degree in the U.S (Walton, 1987; NRC, 1990). There are other agencies and organizations, some quasi-official or operating under government charter, others private, that have some impact on risk, technical application, and environmental concerns.

The other dimension of the mode of social regulation is the wage-labor relation, which

includes the organization of work, the determination of the length and intensity of the working day, the ways in which labour power is recruited, the structure and acquisition of skills, conditions of employment, the factors that determine the level and distribution of direct and indirect wages, and the ways of life and modes of reproduction of the wage-earning

class which are more or less dependent on the acquisition of commodities and the use of collective goods and services.

(Dunford, 1990:

307)

The paper next considers the marine workplace in some detail, with particular focus on the organization of work and the skills that are applied in shipping organizations.

The marine workplace

The marine workplace is not fixed in space: the ship's bridge, engine room, and decks comprise a mobile industrial plant that, unlike many other industries, is not necessarily rooted to the economy of a particular place. The dispersed character of vessel ownership and financing are well known and have long frustrated the efforts of those who would attempt to regulate and standardize the industry. This workplace is not identical from country to country because merchant fleets have adopted technological and organizational changes at different rates. While in the strictest sense shipping is a service industry, it bears many of the features of a terrestrial manufacturing facility: a workforce employed in the operation of a system or systems of machines for the delivery of a particular product or service. Ships produce transportation, a necessary component of the chain of production bringing goods from producer to consumer. Braverman (1974) has in fact suggested that the commonly-made distinction between manufacturing and service industries may be spurious, arguing that a hotel housekeeper can be seen as manufacturing neatened beds. Aboard ship—though technology has made incursions—people continue to operate machines: engineers operate the variety of machines which supply propulsion, heat, light, electricity, and drinking water throughout the vessel; deck officers operate equipment

for steering, communications, navigation, and cargo handling. The jobs are not just those of equipment operation, however; mariners also make things, from raw material of steel, wood, and plastic, applying imagination and ingenuity to meet the various exigencies of the sea.

Aboard US-flag merchant ships, the officer complement is statutorily divided into three departments: deck, engineering, and radio. Officers in the deck department are called mates, and the number required to operate a ship is statutorily based on the size of the ship and the length of the voyage. Large ocean-going merchant vessels will have at least a third, second, and chief mate, each of whom stands two 4-hour navigation watches per day, and then performs other “collateral” duties in off-watch hours. Twelve-hour workdays at a minimum, seven days per week, are the norm, and workdays of 24 hours or more are common in spite of statutes governing working hours. The navigation watch is conducted in the wheelhouse (the bridge). In addition to keeping a visual lookout, the navigator frequently inspects the radar display for other traffic. On older radar units, “targets” are plotted with a grease pencil and course, speed, and closest point of approach (CPA) determined by vector analysis. Newer radar units, equipped with Automatic Radar Plotting Aids (ARPA), perform the same functions automatically.

It is a principle of sound navigation practice that the watch officer should not be absorbed by a single task for a disproportionate amount of time. How much time is “disproportionate” depends on the external environment; the open ocean presents fewer immediate dangers than close, in-shore waters. In either setting, the officer continually checks one instrument after another. On ships equipped with the Global Positioning System (GPS), when the ship is on the open ocean the officer will plot a “position fix” at fairly long intervals, usually hourly. These fixes are used not just to determine position and whether

the ship must be maneuvered to return to the planned course, but also to determine average speed over a period of time. At sea, the watch officer normally plots only one electronic fix on the chart at a particular time; however, the officer will check the position indicated by GPS with that shown on a Loran (radio navigation system) receiver (where/when Loran signals are available) or SATNAV (an older satellite navigation system). If the positions shown are within a few tenths of a mile and correspond to the “dead reckoning” position of the ship, the officer accepts the GPS position.¹ Other sources of navigational information include the fathometer, which is normally operated when the ship is within the 100-fathom (600 feet) isobath. If the fathometer display shows a water depth which does not correspond with what is expected, the mariner is alerted to the potential for navigational error. Apart from collision-avoidance functions, the radar is an important navigational tool. By measuring radar ranges to prominent points of land (and though less accurately, radar bearings) excellent navigation fixes are possible.

Beyond attending to the work of navigation and collision avoidance, the watch officer prepares a weather report, maintains various logs, and completes other tasks depending on the service of the vessel. The importance of celestial navigation by observation of sun, moon, stars, or planets has clearly receded; electronic means of navigation have been consistently edging celestial navigation from the merchant ship and principally into the realm of hobbyists, yacht sailors, and other aficionados. Celestial navigation, with a practical accuracy of a half-mile or so at best, clearly cannot compete with the extreme accuracy of GPS. Nevertheless, many mariners continue to practice celestial navigation as a point of professional pride. And paradoxically, as one shipmaster pointed out, celestial navigation is evolving into the remaining independent check on GPS as Loran and SATNAV are phased out. Work off-watch consists of attending to the cargo,

and a variety of maintenance and administrative jobs.

Evolution of the marine workplace

As in other industries, technological change has enabled and thus impelled changes in the configuration of the marine workplace. Because these modifications have not occurred at the same rate or to the same degree in the various merchant fleets of the world, there is no single type of workplace organization. Nevertheless, technological changes are reflected in the declining numbers of people who work in these spaces as computerization and automation have gradually prompted the elimination of crewmembers from the various ship's departments. For example, the engine rooms on new merchant ships are designed to operate "unattended:" that is, there is no need for an engineer to be on duty because all of the ship's systems are monitored by computer, sounding an alarm if any equipment's "vital signs" move outside established parameters. On some ships the number of engineers can be halved, since they are needed only to perform maintenance or to respond to problems, not to tend to equipment continuously. Similar changes have taken place on the bridge, where jobs previously done by several other crewmembers are now performed by the navigation officer. In some merchant fleets, for example in the Netherlands, crewmembers are "cross-trained" to work either in the engine room or on the bridge (NRC, 1990).

Occupational status of merchant officers

A major focus of regulators now is human error: which is normally defined in terms of operator errors but can be framed as management or systemic errors as well. Human error as a cause of accidents is now a part of the wisdom guiding risk management efforts in marine transportation, in both technological and programmatic ways. Probably no event sparked a greater fury of research into technology and programs for the reduction of maritime hazards than the grounding of Exxon Valdez in 1989. The broad outline of that

disaster and its aftermath are well-known and will not be detailed here. The accident is widely (that is, popularly) attributed to the drunkenness of the ship's master. Less well-known, however, are the other factors contributing to the accident.² Rather, the proximate cause of the grounding was navigational error, due to the fatigue and/or other distraction of the watch officer (NTSB, 1990). The causes of that fatigue or distraction are open to several interpretations but it is the reduction of navigation failures which motivates much research and statutory rulemaking. A good example is the speedy passage of the Oil Pollution Act of 1990 which sets maximum work hours for tanker crews and specifically calls for applications of the Global Positioning System and electronic charts as tools for reducing risk.

GPS and Electronic Chart Display and Information Systems are intended to enhance safety not only by providing navigation information of superior accuracy to that reached by older methods, but also by reconstituting the various tasks of the maritime watch officer. An older or more conventional style of navigation requires the watch officer to walk around the bridge, looking at and recording information from several instruments. The work is time-consuming and leaves much to the judgment and manual dexterity of the navigator. It is also presumed to increase the possibility of mistakes, especially if the navigator is fatigued or distracted (See NRC, 1994). Navigation technology that is GPS-based and linked to electronic nautical charts condenses the work of the navigator and places it in one distinct location on the bridge. At the same time the layout of the bridge has been redesigned to resemble an airplane cockpit, and various engine control tasks that were previously done by an engineer on duty have been automated and brought to the bridge as well, under the oversight of the navigator. Not only are these changes thought to enhance safety, but they also facilitate crew downsizing, and thus cost-savings.

Seafarers are thus seen, by industry, regulators, and sometimes by themselves, as both operational and economic “risk objects” (Hilgartner, 1992), costly and prone to failure. When ships fail to function adequately, blame in some measure can usually be placed on human beings, often ships’ officers. Today’s merchant mariner, whether or not flexibly specialized, occupies a problematic conceptual space: as risk managers they make decisions about the safety and efficiency of immediate operations; yet they are considered to be risks in themselves--a problem to be addressed through improved human factors research (NRC, 1994).

The organization of work and the structure of skills are tightly connected, since the organizational and spatial distribution of work is a function of the tasks to be done and the capabilities required to accomplish them. Technological change, with accompanying shifts in or displacement of the required skill set, therefore induces organizational and spatial change. Introduction of new technologies in shipping has raised concern about the erosion of mariners’ skills (Anderson, 1994), but the question of deskilling is a problematic in the literature. Peck and Tickell (1992) accept it as a given during the post World War II boom, but whether there is an ongoing process of deskilling since the advent of CNC and other computer technologies is a matter of considerable debate. The chief exponent of the ‘deskilling thesis’ is Braverman (1974). In his classic *Labor and Monopoly Capital* he proposed that the assembly line and other features of Fordist work organization were employed as part of a deliberate effort by managers to deskill jobs, so as to progressively erode the ability of workers to control their own productive efforts. At the time he wrote computerization was only beginning to move onto the shop floor; nevertheless he extended his thesis to the new workplace as well. His work spawned nearly two decades of research on skill, but the corpus of deskilling research has yielded results that are either broadly

ambiguous or tilted against the concept of deskilling (see, for example, Zicklin, 1987; Wood, 1987; Penn and Scattergood, 1985; Ray, 1989).

Schoenberger (1988) notes that the demands of flexible specialization will increase the demand for technical specialists, so that a firm's total skills mix may be upgraded, though the least-skilled workers will be displaced. To some degree this is now evident in shipping: the ordinary seaman, previously the entry-level position, requiring no real skill, is vanishing, and certainly in fleets employing the dual-trained officer, skills may indeed be increasing at least along certain dimensions of ship operations. At the same time, Schoenberger notes the possibility of increased "stress on workers who end up with increased responsibilities without a concomitant increase in authority or autonomy" (1988: 259). Schoenberger has gone on to suggest that professional workers may eventually suffer some loss of their own skills and autonomy as automation moves into design and programming (1988: 259; 1988b). Aronowitz and DiFazio (1994) for example found that while planners and designers can take creative pleasure in the use of Computer Aided Design software—freed from the need for laborious redrawing—the technology can be degrading to the profession (129). The occupation of drafter, of course, recedes in importance.

Less important than a change in skill level, however, is a change in skill *type*. A change in required skills, and concomitant changes in organization and job roles, destabilizes work relationships among workers and between workers and firms. In a study of locomotive engineers, Grzyb found that the switch from steam to diesel power eliminated the need for a cherished skill of the engineer: the ability to finesse the control of the boiler for proper operation. In turn, the loss of those skills disrupted the social organization of the engineers. He observed that changes in the type of skill employed, even

without a significant change in skill level, can jeopardize “the ability of workers to advance their own interests in conflicts with managers’ (185).”

Treating skills in some quantitative fashion, counting those lost and those remaining, is inadequate; if changes in skill requirements have a decollectivizing effect, whether they result in some net quantitative loss or not, the damage of greatest interest to the new industrial sociologist--a reduction of workers’ control--is done. (Grzyb, 1990: 184-185).

An analog exists in shipping. The process of streamlining the navigation job, apart from its ramifications for risk, robs the navigator of one dimension of the specialized skill set which had distinguished the job: the ability to construct meaningful navigation information from careful observation and measurement of natural and artificial features on earth, or of celestial bodies. With Grzyb’s steam engineers, it was the work of fine throttling which provided the distinctive pleasure in the job; with mariners, it is visual piloting and celestial navigation. As noted earlier, the practice of celestial navigation is receding, but when it is practiced, it is common for mates to boast to each other about a particularly elegant celestial fix they had obtained, and to leave the plot on the chart, rather than erase it, as a kind of trophy. No one boasts about the last GPS fix, because it does not reflect any application of skill. As a consequence, the value of navigation work, and thus the value of that aspect of the deck officer’s job, is diminished. As one shipmaster put it, “They want to dumb the job down so that the only thing for the guy to do up there [on the bridge] is make coffee.”

Mariners’ responses and the mode of social regulation

Now regarded by industry and regulators as both economic and operational risk

objects, mariners are in a weakened position to argue their case in matters of risk. To assert that there is still a place for celestial navigation would appear hopelessly anachronistic, while arguing a need for more crewmembers could easily be portrayed as blue-collar featherbedding, hopelessly out of step with trends toward smaller crews, and smaller workforces in general. The ability of seafarers to affect the adoption and implementation of new technologies via union activity, though not non-existent, is quite variable, especially in the United States. Numbers of ships have declined in recent years, and many of those remaining are subsidized by the Maritime Administration because of their potential military utility. Thus mariners occupy a precarious position, and as a consequence, they've had to acquiesce in some cases regarding crew sizes and distributions of work (NRC, 1990).

There is no one definition of "skill," and no single conception of the way in which skills, however defined, are developed and applied in the workplace. Peck (1996: 135) notes that "...skill should not be seen simply as a resource that is rewarded in accordance with the precepts of human capital theory, but as an ideological construct reflecting the distribution of power in the labor market." As a result of these changes, mariners are in some danger of devolving into a lay population, since their views about how work is to be done, via what skills, must compete with those of ergonomists, industrial engineers, and psychologists who have specialized credentials to offer alternative views of the proper arrangement of work. In some cases, researchers into new technology explicitly devalue mariners' critiques of the technology. The use of scare quotes in the following passage from a research article on electronic charts demotes the mariners' views.

Many of the comments from the participating mariners suggested negative as well as positive consequences from this new technology. For example, "owners" will take a person off the bridge for every ECDIS they

put on it. Moreover, “junior officers” will be overconfident or overly complacent, they will fail to “keep proper lookout” or to notice targets not acquired by ARPA, they will not learn or will not maintain the skills needed to function in case of system failure, and they will not be aware of system inaccuracies or malfunctions. On the positive side, however, when the system is working well, these same “junior officers” will have integrated navigational information immediately available to them, making decisions and experience slightly less important...

(Gonin et al, 1993: 371)

Thus there is a kind of disciplinary struggle underway, wherein the participants deploy different types of knowledge--mariners with craft skills and experiential understanding, and industrial engineers and others with experimental methods and quantitative analysis--to assert control over the function and organization of the marine workplace. For mariners, the development of new technologies and the validation not just of the skills required to use them but of older skills, play a key role in that distribution of power, tied directly to their employability, the conditions of their workplace, and their ability to affect practice.

The strategies available for mariners in resisting change and asserting the value of their work are oriented around an emphasis on different kinds of risk. Risk is a phenomenon which is readily politicized. Ship operators and governments are able to invoke concepts of risk and risk reduction to justify or accelerate technological change. At the same time, being treated as risk objects restricts mariners' ability to resist those changes and also fundamentally affects their employability. They are, however, able to

challenge those constructions of riskiness to slow downsizing. For example, while staunch proponents of change might argue issues of competitiveness, mariners have argued that the national security interest requires a strong merchant marine, and plenty of merchant mariners, to support the military in conflict. During the Persian Gulf war, for example, numerous mariners were called from retirement to crew cargo ships under military contracts, because the existing pool of regularly-employed mariners was inadequate.

They can also argue that it is dangerous to operate ships with crewmembers below a certain threshold number, a view which the Coast Guard has so far generally shared. They are able to argue this in spite of the reduced-crew ships which are operating without major accidents, stressing a view of risk that is not rooted in incidence or absence of casualties, but on principles of best practice.³

Risk thus becomes a trump card in a variety of social transactions; in transportation it is a card that all opposing sides can play. Mariners can argue that electronic devices are fallible, and that it is necessary to be able to maintain older skills in order to be able to work without those devices.

We must also ensure that our watch mates can, in the event of failure of all electronic navigation systems, confidently navigate using the sun, stars, sextant, chronometer and magnetic compass...one must always be prepared for that one failure. *We lessen the safety risks this way, plus it's important to our reputation as professionals* (Leback: 1996: 3. Emphasis added).

Smith (1988), in a study of risk perception among fishermen, noted that traditional skills can erode, so that non-technical methods are not available in the event of equipment failure or other emergency. Proponents of automation clearly do not want to keep

apparently superfluous people around just to practice craft skills to apply in the off-chance of an emergency; they thus “risk” that the technologies will not fail or, if they do, that the atrophied craft skills of seafarers will still be sufficient. However, most mariners can describe occasions in which all electronic means of position fixing were inoperative, yet navigation by visual bearings or celestial observations was entirely adequate. At the same time, these tasks require a certain dexterity, or *craftsmanship*, for their execution, as well as an instinctive alertness for possible sources of error and the knowledge to make the necessary corrections.

Seafarers can also point to the problem of fatigue which can arise when ships are operated with small crews. The issue of crew fatigue is complex and contentious: complex because measuring it is challenging and developing institutional programs to prevent it is difficult, and contentious because the strategic invoking of fatigue can suit a variety of agendas. Seafarers, especially marine unions, can emphasize the fatigue which accompanies downsizing (NRC, 1994), but over time this may prove to be a risky strategy. Shipowners might argue that the fundamental human susceptibility to fatigue simply justifies displacing people with equipment, which does not fatigue.

At least in the US, mariners have aligned themselves with certain dimensions of risk-minimizing imperatives to hold off massive reductions in crew sizes: that ships and mariners are needed in times of war; that equipment can fail; that crewmembers need to be on board in the event of an emergency, such as fire; and that fatigue can be a problem. At the same time, in order to be successful, mariners need more than merely their own powers of reasoned persuasion. They have to get policymakers to agree with them, and they do this in several ways. First, the unions maintain vigorous, old-fashioned lobbying efforts in the Congress. Second, organizations such as the Council of American Master Mariners issue

“position papers” which analyze new developments and present those papers to the Coast Guard. Third, mariners have seats on advisory councils that advise the Coast Guard on matters of navigation safety and personnel standards. These councils also have shipping company representatives and members of the affected public. The capacity of mariners, first, to have seats on such councils and second, to influence decision making, is a function of an accepted view that they have something important to contribute. And that, in turn, depends on the occupational or, more specifically, professional status that mariners possess.

Peck (1996) has noted that regulation is a dialectical process in that the diverse social and political institutions engaged in economic regulation do so through mutual interaction. Agents within this array of institutions are shaped by and consciously attempt to shape the nature of their transactions and thus their status with respect to other agents or institutions. In merchant shipping, status orients around skill and professionalism. Just as there is no precise definition of skill, there is no precise definition of professionalism. Both are constructed in a negotiated process. Some analysts such as Freidson (1983) and Vollmer and Mills (1966) prefer to look at professionalism as a process rather than as a fixed thing.⁴ Nevertheless, the significant feature of professionalism, whether granitic or transient, is the credibility that such status confers on a group of practitioners and hence the right to control work and the structure of the workplace. Goode (1969) for example denied mariners professional status, noting that they did not control the production and application of knowledge as did physicians and lawyers. He also argued:

The profession should be accepted as the final arbiter in any disputes over the validity of any technical solution lying within its area of supposed competence.

(Goode, 1969: 278)

Grzyb (1990) argues that a change in skills, even without a change in skill level, had a decollectivizing effect on the locomotive engineers he studied. A comparable evolution is underway in merchant shipping, not strictly in terms of decollectivization (though that can certainly happen as jobs are merged, and crews downsized), but in terms of the professional status of seafarers, who must compete with researchers in various disciplines for the authority to speak on matters of marine work and safety.

Seafarers have begun to realize, collectively, that their ability to determine proper practice has been eroded, or perhaps never existed to the degree they thought it did, and much has been written recently on the subject of professionalism. The Council of American Master Mariners sponsored a two-day “professional development conference,” which included a paper competition focusing on whether the occupation of merchant marine officer constitutes a profession or a vocation.

One episode at that conference shows the sensitivity that mariners feel toward their skills, their occupational status, and the efforts of others to address navigation issues. Two Coast Guard researchers presented a paper on the preliminary development of a questionnaire that would attempt to determine the relative importance of various aids to navigation—buoys, lighthouses, beacons, etc.—by asking mariners which they tended to rely on under various maneuvering conditions and which navigation tools they used. They passed around a hand-out which showed some sample questions and responses of Coast Guard Academy cadets who had been testing the questionnaire. Some of these responses struck members of the audience—nearly all master mariners—as being so unrealistic and

divorced from actual practice that they began to severely criticize not only the composition of the survey but also its dissemination. How would the Coast Guard determine if the respondent was skilled enough to answer the questions—would the responses of a recreational boater be treated the same as those of a licensed master mariner? A captive audience of Academy cadets might answer such a lengthy survey; a civilian would not. And so forth. Worse, when asked if the survey would form the justification for removal of “navaids” scoring low in importance, the researchers were evasive, emphasizing their Congressional mandate to carry out the survey but sidestepping the potential implications. As the presentation faltered and the mariners became increasingly vituperative, the researchers moved to an easel and attempted to marshal a focus-group atmosphere by listing the mariners’ points on a large pad of paper. It must have been a richly unpleasant experience for them, and probably not what they expected when they first undertook to solicit the mariners’ views on the topic.

This episode, and the renewed interest in professionalism in general, represents an attempt by mariners (specifically navigation officers) to reconstruct their roles as sites of particular knowledge and expertise in the marine environment, a status that King (1995: 472), himself a master mariner, has observed has eroded as human habitation has pushed further into the sea—on oil rigs for example. Questioning the received wisdom that seafaring constitutes a unique endeavor that stands apart from other industrial activities because of the particular demands of the marine environment, King argues instead that multiple occupations are carried on at sea so that merchant seamen are no longer privileged in their knowledge.

Another example is provided in a NAVSAC summary report (1999: 8). The council recognized the issue of fatigue, especially of the master and chief mate because of

the increase of administrative duties. In endorsing a National Transportation Safety Board recommendation for “scientifically based hours of service regulations, and...limits on hours of service,” the mariners indicated that they must cede ground to other occupations—presumably in this case psychologists and ergonomists—on matters directly affecting the workplace. It was not enough that the mariners on this council had identified a fatigue problem, and probably a longstanding one at that. Rather, their considered views on the matter had to be subjected to external validation.

Consequences of these changes parallel those observed by Grzyb. No widely-accepted definition of skills exists; instead, merchant officers possess an amalgamation of skill-sets that allow them to perform work aboard ship. One engineer interviewed told me that he had to be a welder, a machinist, a pipefitter, an electrician, and a refrigeration repairman. The range of skills required by deck officers is not as expansive but it penetrates deeply into a number of specialized areas, including navigation, cargo handling, and a sub-amalgamation of skills falling into the category of seamanship, including “marlinespike seamanship” (knots, splices, line-handling), general maintenance, and shiphandling.

New technologies disturb the distribution of skills and thus destabilize the relationships that exist among crewmembers and between mariners and companies. Mostert (1974) observed that the introduction of the “electrical officer” changed the distribution of expertise aboard ships that had previously had only navigation and (marine) engineering officers. Mostert portrayed the EO as a rival for relevance in the shifting technological environment. It is not quite accurate to present the electrical officer as some sort of outsider. Working regularly aboard ship, the EO would be considered a merchant

mariner, like the radio officer, but the fact that the addition of this position raised issues shows how work relationships can be disrupted.

These discussions are meant to show how professional status is the product of a negotiation between an occupational group and the larger society. In the case of merchant shipping, the centerpiece of that negotiation is whether the skills possessed by navigators, not just in navigation specifically but in ship operation in general, are specialized enough to warrant professional status. Mariners' expertise, and the validity and acceptance of that expertise, affects the capacity of mariners to influence the industry and thus is a *regulating* (in the regulationist sense) factor—a limiting or modulating factor—in technology adoption, crew size, and operations in general. However, the acceptance of that expertise is the product of a negotiation between mariners and other agents. Mariners tend not to be policymakers. They are advisors—sometimes valuable ones, as in the navigation safety advisory councils organized by the Coast Guard—but they remain a stakeholder group whose views must be considered along with others. Negotiating professionalism is not straightforward, since mariners do not have a monopoly on ship management or navigation skills--the Coast Guard operates ships, too. Thus merchant mariners must argue that they operate ships of particular types, sizes, and functions in such a way that they have particular skills, largely by emphasizing that they are specialists with more in-depth marine skills than anyone else. Although merchant mariners function as risk managers, other groups have a stronger command of the discourse of risk. These groups include psychologists, cognitive scientists, and human factors researchers who focus on human error as well as the policymakers whose decisions help shape the workplace. If the professionalism of mariners is challenged further, they will lose all ability to influence practice and from there the ability to influence other aspects of their workplaces.

In some ways, then, mariners are a lay population, one whose views must be consulted but not necessarily heeded by regulators. Seafarers are simply not in a good position to argue against the application of technologies that herald a loss of their jobs or a diminution of their importance. Yet research in the sociology of work and in design suggests a cautionary note that should be considered by those who would, from scratch, rearrange the marine workplace around the desires of companies and designs of ergonomists. Darrah's (1994) research shows the complexity of the work environment and the unpredictable ways in which skills must be deployed in order to accomplish work. It also shows that attempting to account in advance for the way in which work is done leads only to a highly stylized conception of the workplace. Segmenting tasks leads designers to rely on an artificial or fictitious workplace, since in reality those tasks do not occur in discreet, segmented modules. Brown and Duguid (1994) are explicitly skeptical of human factors research, noting that designers' effectiveness decreases with distance from practitioners. Their identification of a conceptual gap is similar to Darrah's view of the workplace which is a product of designers who imagine and design equipment for a workplace that does not exist. The workers, of course, work in the real workplace, in effect managing the poor fit between the fictitious workplace of designers and the real workplace on earth so as to prevent the complete collapse of the system (That's why "work to rule" job actions cause production slow-downs). Workers create the workplace by working in it.

It is largely through their risk management function that navigation officers negotiate their relationships with the industry, and through which they have been able to maintain crew sizes. Mariners may yet be able to resituate their older skills as still-vital components of an advanced technological system. The grounding of the cruise ship *Royal Majesty* off Nantucket in 1995 occurred because of a GPS failure which no one noticed,

because conventional means of navigation were either not employed or employed inadequately (NTSB, 1997). And there may be consequences if the professional status of ships' officers weakens. Cahill (1990), in a discussion of the capsizing of the ferry Herald of Free Enterprise, noted that ferry masters had asked for indicator lights to be installed on the bridge, so they could monitor if the bow doors were closed. These requests were met with derision. The Herald of Free Enterprise sailed from Zeebrugge with her doors open, and capsized. A lack of ability to influence the workplace, by those close to the work, may therefore have repercussions outside the occupation.

Conclusion

This paper has drawn on regulation theory to examine the social control of the marine workplace, particularly focusing on risk and risk reduction as elements of the mode of social regulation. In turn, the paper has used the marine workplace as a case study to explicate one of many processes of social regulation. The paper has argued that social control in that industry is the product of struggle between different stakeholder groups that bring different, often competing, competencies to bear on the problem of risk decision-making. The paper has presented the occupational status of mariners as being troubled; nevertheless, emphasis on risk allows mariners to assert a measure of influence over different aspects of the industry, both in terms of shipboard operations and at a larger scale through invoking both national defense and environmental protection concerns.

The paper was finished just prior to the World Trade Center attack in September, 2001. Events since then have emphasized the importance of social norms, particularly those toward risk-reduction, on economic activity and on the arrangement of work. The aviation industry comes to mind immediately in this regard, but a heightened awareness of vulnerability will lead to changes in other workplaces as well. At this early time,

implications of the attack on the nexus of risk, work, and social regulation can only be speculative, but it seems likely that the issues presented in this paper will emerge as analogs in other industries, oriented around such questions as who is best suited to make risk decisions? What are the boundaries of competence of the different occupations? What is the best combination of technological support for human operators, and who is suited to decide? As in shipping, risk and risk reduction will be fulcrums around which workplaces are organized, and old and new skills deployed. Future research might bring these questions to the relationship of airline pilots to other risk managers, such as security specialists, or to shifts in the airport security operation. The U.S. Postal Service is currently under criticism for its handling of the anthrax risk, especially with regard to its protection of its employees. To what extent are workers able to argue that risks exist, and that there are certain mitigating steps that need to be taken? Funtowicz and Ravetz (1992: 254) noted that, when confronted by great uncertainties, even the experts are amateurs. How does social control of the workplace evolve when scientific understanding of the ambient risks is low? Similar research might be carried out in other industries where new vulnerabilities are identified.

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1. The "dead reckoning" position is found by extending the ship's course and speed for an interval of time. An "estimated position" is found by correcting the dead reckoning position by applying direction and speed of current. Current information is shown on charts and is obviously only an approximation. Often an anomalous fix is revealed when it doesn't correspond with the expected, or DR, position.

² The subject of the captain's drinking is controversial. The NTSB (1990) cited it as a factor in the grounding; however, the captain was acquitted of charges of operating a vessel while intoxicated (Pagano, 1998). The watch officer on duty at the time of the grounding had had little sleep in the previous 24, and had worked for much of the day prior to the accident. Furthermore, he stayed on watch longer than he was scheduled to, to allow another officer time to sleep longer (NTSB, 1990). At the time of the grounding, there were no well-rested navigation officers aboard Exxon Valdez. They were all overworked and exhausted, largely because of downsizing.

³ However, an American labor-union officer emphasized to me that those ships routinely carry extra "non crew" personnel, so that it is a "reduced crew" only on paper.

⁴ Segments of the discussion on professionalism appeared in *Sidelights*, a publication of the Council of American Master Mariners (Kendra, 1999).