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Towards an equality between women and men in ocean navigation working conditions

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Abstract

To be seafarer on a long range freighter (liner or tramp cargo ship) creates some of the worst working conditions for a woman whose nature gives her the desire to be a mother and have a family. All over the world, merchant marine academies train students from both sexes, despite complete lack of factual parity at sea: what a seaman may bear -i.e. to stay away from home for a long time- is an ordeal for a seawoman. Therefore female ship officers are scarce in the ocean navigation.

A new approach for women who are looking forward ship-piloting professions requires greater access. In the days of drones, the SCMV (Shore Controlled and Monitored Vessel), a pure remote ship, provides better conditions of ocean navigation jobs for female (and male) crew. As international shipping has to observe IMO rules, a remote ship cannot be unmanned. She needs to be “womanned” (or manned).

The SCMV is based on the following assumption¹: a shortage of ship officers will increase in the following decades. It is due to two convergent reasons: first, sustained development in world trade increases demand of vessels; secondly, because of the high quality of the mandatory Standards of Training, Certification and Watch-keeping for seafarers (STCW), STCW-qualified officers will have greater chances of getting hired elsewhere, such as for office jobs with attractive employment conditions.

With seafarers being recruited to pilot remote ships from shore, women and men will finally be on an equal footing. After her (or his) duty, the officer, she (or he), sleeps at home and has a family life to raise her/his children. So genuine parity between the sexes can be achieved in the seafaring world, thanks to the SCMV.

Offering skilled employment at sea and subsequent training to women is not the only practical answer towards a better gender balance in shipping. It is a necessary condition but not a sufficient one. Let nature takes its course. Remember: *“There are three kinds of human beings: those who live, those who die, those who go to sea.”* When Plato² wrote this sentence, he was fully aware that the navigator needed to have some unreasonable mind, nearly foolish. Of all non-amphibian non-flying creatures, mankind belongs to one of the rare species that occasionally venture at sea. Humans, following in ancient Polynesian people's wake, risk being drowned, when they have no alternative, to escape an impending danger. *“A peste, a bello, a fame, libera nos, Domine.”*³ (*“O Lord, free us from plague, war and starvation.”*) May be read: *“A peste, a bello, a fame, libera nos, mare.”* (*“O Sea, free us from plague, war and starvation.”*) The 2010 quote of EU Commissioner Maria Damanaki⁴ echoes this statement of fact: *“Still today, maritime jobs are by far among the most dangerous in the world. Their workplaces are often hard, noisy and without any comfort. People are sometimes separated from their relatives for long periods of time. The sailors are probably among the last [ones] that live and work every day in a very perilous natural environment that humankind has not yet mastered, despite the many progresses in shipbuilding, oceanography or meteorology. Ships sinking, disappearances at sea and accidents are, still*

too often, the reality of these professions.”

So, given that the human race does not reproduce at sea and human life is purely ground-bound and land-based, one should never forget that man's passage on the Ocean is purely accidental, somehow just a transit, and the shortest as possible. The very evidence is statistical: every minute, 6 billion human beings (an exaggeratedly low figure) are breathing on the emerged surface of our globe; every minute, only 3 million (an exaggeratedly high figure) are roaming the seas. Based on those figures, less than one featherless biped out of every two thousand occupies 70% of the Earth's surface. And one should never believe that it's the exception, which proves the rule: anybody working in sea-related operations knows the whole point of enrolment of seagoing personnel in the shipping industry since earliest Antiquity to nowadays when shortage of skilled merchant marine officers is increasing. “*Les Sages quelquefois... Marchent à reculons, tournent le dos au port. C'est l'art des Matelots.*”⁵ (“*Wise men will sometimes... go backwards, and turn their faces from the port. As sailors tack.*”) But human exchanges throughout the multi-millennial globalization of the world economy require sea trade carried on floating plat-forms called ships and pilots to steer them.

To sail is to dare: the job remains risky, particularly in the fishing industry, is which one of the most aggressive experiences in the work force. In commercial shipping, safety is achieved by common industry standards except when a tremendous disaster occurs like the sinking of the *MV Estonia*⁶ or the *MS Le Joola*⁷. To sail is to kill time (and to bear): the job implies to leave home. To stay far away for a long time is not considered a fun idea. Except for the true misanthrope. In my view, a woman is never one. Most of all, she is a social individual. Her behaviour is ordered by nature and desire, the first being at variance with the other: nature means a maternal vocation; desire means a seafaring calling.

The way to offer real ship-piloting employment to women is to adapt the jobs to their way of life, not to force them to have a sex change or some kind of “gender reassignment”. My purpose is to demonstrate that with the help of technology, it is possible to largely reduce unequal treatment of women and men that appears more as a surface discrepancy than as a straight disparity.

Desk not deck

Adapting ship-piloting jobs for women (and incidentally men) consists in moving ship control rooms nearer women's home, i.e., from ship-bridge to a shore based office. The objective is to introduce Shore Controlled and Monitored Vessels (SCMV) to supply an appreciable part of the world merchant fleet. At the same time, this new tool for shipping enables women to be truly recruited as officers and master on the long-range sea transport system (liner or tramp cargo ship) as on the short-range one (ferry and short sea shipping). The SCMV project, initiated in 2010, developed by Franco-European FF and CF consortium⁸ on a private self-supported basis, is designed to address all issues for survivable remote control at sea and for providing commercial operation capabilities. The actual project study is on course: full risk assessment is not quite finalized yet; law issues are still in the workshop; structural, formal, technical and human dispositions are drawn up.

Applicable law

A ship in its most enlarged legal sense signifies a vessel employed in navigation. The SCMV is employed in navigation. She is a ship. The law, under which the SCMV sails, is the United Nations Convention on the Law of the Sea (UNCLOS)⁹. In accordance with UNCLOS, the SCMV has to comply with all international conventions -especially IMO¹⁰ ones- just as any manned ship, in order to complete an innocent and safe sea passage. According to article 91, the flag State shall exercise its jurisdiction and control in administrative, technical and social matters over the SCMV flying its flag.

SCMV specifications

The early XXIst century is the drone age. For safety, security and reliability purposes, many industries and States are presently using remote driven vehicles. In the nineties, pioneers were public transportation with driverless metro systems and an offshore oil industry with Remotely Operated underwater Vehicles (ROV) followed by Autonomous Underwater Vehicles (AUV). On the sea surface, the drone family is presently used by navies and research institutes. The earliest operational craft is the Unmanned Naval Patrol Vehicle (UNPV) *Rafael Protector*¹¹, which came into service in 2005. She is a remotely controlled naval patrol boat. She can conduct a wide spectrum of critical missions, without exposing personnel and capital assets to unnecessary risk. The SCMV is based on a similar approach: a breakthrough in the shipping industry with proven technology and no technical innovations, a breakthrough akin to the “container” in the sixties. She inherits the long-used practice of a remotely engine-room watch on complex commercial vessels (LNG carriers, sail cruise-ships¹²...), kept in a far away land office, the no-manned ship engine-room being linked with a 1/8 Mbit/s satcom.

The SCMVs do not intend to replace commercial ships of all kinds. They complete the supply of vessels for ship

operators. (Wo-)manned ships will remain on the shelf and in use on the seas. Present state of the art shows niches for SCMV in general cargo transportation: container carriers and dry bulk cargo ships. For a lot of reasons -less real than phantasmagorical- the SCMV is not presently intended to transport either passengers, or hazardous noxious substances in bulk. But nevertheless, she looks particularly appropriate to operate as a ferry with a single Commercial Seagoing Personnel (CSP) crew.

Its way of working is that of a no-(wo)man vessel: the bridge is simply moved from sea to land. The ship control room is situated in an office block anywhere in a city -on the coast or inland- connected with a full redundant satcom network. Everyday the SCMV officers are going to their office and performing the watch. Once their duties are carried out, they go back home like any office executive. No more sea spray fragrance, no more night watch under a starry sky, no more rolls, no more pitching, no more exotic port of call, but an ensured regular family life. The project is presently focusing on a 4-vessel SCMV control room as a first step. One master on watch supervises four additional officers on the watch. For four ships, the 5-(wo)man watch-keeping crew works as a team. Piloting the SCMV is quite different from piloting a manned ship, where one officer of the watch, all on his own for 4 lonesome hours, paces round the bridge. Any upgrading of the control room towards more than those four ships could be implemented later on, depending on a feasibility experiment. Of course, watch jobs have to be fulfilled by STCW certified officers. Predictive Maintenance (PdM) on an apparent scheduled downtime during port operations is the key to good ship running, the result of some logical, management-initiated algorithms.

Pros and cons

Like any new item supplied on a market, the SCMV project has encountered some cons. The main ones in its early days are shipbuilding costs and socio-psychological reluctance:

- The safety-first principle and the observance of IMO rules being imperative, the SCMV has to be fail-safe based. That means redundancies and a fault-tolerant approach, which make it costly to launch the prototype vessel and the subsequent first serial runs.

On the one hand, passive redundancy: two independent energy sources coupled on two propeller shafts (or pods) operating on an Integrated Electric Propulsion (IEP) mode, enclosed in separately watertight compartments; in case of shafts, two rudder systems; two satellite communication links, permitting full remote monitoring (4 Mbit/s), plus one for degraded mode operation (1/8 Mbit/s) and under normal circumstances, used as a security back-up link; three shore watch-keeping control rooms, and one back-up room.

On the other hand, active redundancy: a bridge-maneuvring system based on avionics-like high availability. The SCMV controlling process uses triple-mode redundancy (TMR), in which three independent systems perform a task at the same pace and their result is determined by a majority-voting system to produce a single answer. If one of the three systems fails, the other two systems can correct and mask the fault. To be on the safe side, it is of paramount importance that the SCMV keeps on operating on a graceful degradation based mode. Thus, in emergency cases, all lines of communication are cut off, and a degraded sailing mode on an "overcautious" autonomous program is automatically engaged, which provides the SCMV with a long survival capacity until communications are recovered. Although, there are no human beings aboard, the SCMV has to be treated like any life-critical system: she cannot be a danger for any other sea-roaming people.

- Socio-psychological reluctance is a basic way to hinder any innovation, which changes the working conditions. In space, the unmanned cargo ship (UCS) is quite a current tool, particularly to provision the international space station (ISS). However, in shipping, the UCS is presently a concept deserving praise from the critics. In down-to-earth France, sociological inertia gives patriarchal seamen unions a decisive conservative credibility. They do not wish to betray Samuel Johnson's saying¹³: "*To do nothing is in every man's power.*" So ADEME (Agence de l'Environnement et de la Maîtrise de l'Énergie), the French agency in charge of supporting future transport system innovations, is presently hesitating in its consideration of the SCMV as a future ship. But there is no limit to what one can hope for. Natural cognitive status-quo bias¹⁴ may soon vanish.

Nevertheless, European energy is working in convergence and competition towards an actual future for shipping. RWG Bucknall and P Freire¹⁵ set out at the University College London the first theoretical approach in 2004 on the unmanned cargo ships. Last year during The Digital Ship CIO Forum of Oslo on June 5th, 2013, Oskar Levander¹⁶ discussed a pure SCMV concept, optimistically assessing a 10-ship control-room. The Maritime Unmanned Navigation through Intelligence in Networks (MUNIN)¹⁷ project is a collaborative research project, co-funded by the European Commission under its Seventh Framework Programme. It is more ambitious than SCMV: it attempts to develop and verify a concept for an autonomous vessel, primarily guided by automated on-board decision systems but controlled by a remote operator in a shore side control station. Hans-Christoph Burmeister set out the project at the IEEE Oceans conference in Bergen on June 10th 2013. The objective aims cutting manning levels to an absolute minimum. As the ship is autonomous and not, strictly speaking, a shore piloted ship, it is a matter for a Shore Controlled Vessel (SCV) class. MUNIN in shipping is very near the Innovative Future Air Transport System (IFATS)¹⁸ in aeronautics, co-funded by the European Commission under its Sixth Framework Programme: no pilots, no controllers, both replaced by ground operators in the loop of future air transport.

And now the pros. Honour to whom honour is due. The prime indisputable advantage of the SCMV is to be the most welcoming door for a STCW certified woman to be one of its watch officers and later its master. One can expect the introduction of this ship in the global sea transport net could result in near-parity if not complete parity between the sexes, especially with respect to the commercial long-range seafaring labour market. The working conditions “aboard” the SCMV are far better than those we meet aboard a traditional vessel forced to sail in an unforgiving environment. It is time to develop shipping conditions that achieve both top-level work welfare and the highest level of safety. The sole role of the master and of the officers on an SCMV is to control and pilot the ship. They are freed from all commercial tasks, safe cargo stowage and maintenance operations. Ship-owners’ agents execute these tasks in port facilities.

Last but not least, the SCMV working conditions obey mankind’s nature. As most of animal life, the human race is bound to observe the circadian cycle (day/night alternation). The crewmembers’ working time is confined to business hours. As an oceanic SCMV sails on a 24 hour per day basis, the round the clock watch keeping operations are divided on three sites, each one set up on a meridian after an interval of 8 hours ($\approx 120^\circ$). The actual R&D project plans for French-flag SCMVs, and control rooms established at La Réunion (UT +4), Saint-Martin (Guadeloupe) (UT -4) and Wallis (UT +12). It envisions three crews (of 5 people) in a relay race keeping watch over 4 SCMVs.

To take no chances, one subsequent key issue is to make STCW certification more accessible to female students. It is a real issue in a great number of countries. I suggest that IMO should encourage the national maritime training and education system to use at the best, courses on Maritime Simulator System (MSS) and tutorial tuition methodology, STCW convention authorizes to get the certification. And from the same viewpoint, -that is the desire to give all youth and on-the-job adults, particularly young women after maternity leave their chance-, the international maritime community has to reflect on the capacities of long-distance e-learning¹⁹ to make training and graduation of watch keeping officers easier. Could navigation simulator games, once professionalized and secured, be used in this field? It is an approach to explore.

A lot of advantages follow both in the fields of economy/ecology and safety/security:

- Economy and ecology are the two faces of the same challenge: the survival and the growth of the shipping company. As a no-man vessel, SCMV is a ship without life and working accommodations. The conceptual structure of the ship flows from this new fact. Freed spaces are used to increase commercial capacity for the same ship size (and to reduce subsequent running costs): from a large fifth for a 7,000 dwt manned ship and a still consequential eighth for a 20 000 dwt one, to only a twentieth for a 150 000 dwt one. Expected low manning cost and reduced maintenance expenses generate noticeable savings. Therefore, the estimated bunkering cost grows to as much as 97.5 % of the total running cost at sea on a SCMV with a 100\$ priced barrel. Also, its best use would be obtained by sailing on an optimal slow steaming mode. Low consumption should facilitate a strict observance of sulphur rules in shipping. PdM, performed in dock by highly skilled engineers -not necessarily STCW certified, but graded by components manufacturers - specialists in mechanics, electricity, electronics, coatings... this all promises high-availability (from the present 97% for a two year old manned merchantman to an estimated 99.5% for a two year-old SCMV). To put SCMVs at disposal on the tramping market shows a large flexibility: idle times between charters can be endured at a lower cost because no wages are to be paid. Moreover, vessels could possibly wait at sea, thereby escaping port fees especially in horse latitudes on an En-Route-Mooring (ERM) mode. Environment preservation is also enhanced under the SCMV model: marine pollution by dumping of wastes at sea cannot occur in man’s absence aboard the vessel.

- In terms of safety/security, the improvement is a paramount topic. By shortening human elements in the loop of ship piloting, the risk of casualty is not linearly, but exponentially reduced. SCMV piloting is managed under a High Reliability Organization (HRO) paradigm (reliability-seeking organization rather than reliability-achieving organization). That means shore crewing based on the following principles: crew resource management (CRM), low authority gradient, collective mindfulness, enhancing the crew’s alertness and awareness to details, high-functioning skills of anticipation, and resilience. All these features are known to perform better with women in the loop. Three points have to be noted.

1. Emergency crisis situations require intensive training through control room simulation cases in a panic-free environment. The near misses will be processed by anonymous reporting through a Confidential Hazardous Incident Reporting Programme, the incidents by a degradation based mode remote piloting, and a crisis by a Safety Management System instantly changing the control room in an emergency crisis centre. In strict observance of the International Safety Management (ISM) code, the ship operator will be able to respond in the most efficient manner. The Safety Management System (SMS) of a SCMV fleet is based on an emergency crisis centre, where the shipmaster, the ISM Designated Person Ashore (DPA), and the officer of the watch can exchange opinions on the way to follow in the tranquillity of a common room and make decisions with full knowledge of the facts. For emergency preparedness, the risk assessment study of the project undertakes efforts to identify the greatest number of potential emergency shipboard situations, and collect a crisis pattern database to establish procedures in order to respond to them.

2. Mandatory Global Maritime Distress and Safety System (GMDSS)²⁰ will give the SCMV the same capabilities as a manned ship for Search And Rescue (SAR)²¹ operations at sea.

3. The prevention of risks is at the top level and needs much more than plugging the ship into the Universal Ship borne Automatic Identification System (AIS). Thus, as nobody aboard is able to appreciate the stress on the ship beam and hull in case of heavy swell, the SCMV will be fitted with a Remote Shipboard Routing Assistance with a 3-strain-gauge and bow accelerometer device²² to do the job, continuously giving the control-room the capacity to precisely assess risk and if necessary, to reduce speed and alter course. On the watch part, optronics including X-band radar and stereoscopic CCD plus IR cameras will bring to the control-room all the necessary imagery to be processed by ship-borne and land-based computer through software such as real-time automatic short range water-surfaces oriented detection Automatic Sea Vision (ASV)²³. ASV-Det software combined with ASV-Servo will give SCMV a unique slew-to-cue short-range watch and alert capability. SCMV artificial eyes perform night and day, inclement weather or not, and in much better conditions than those of a binoculars-fitted deck officer. The SCMV piloting organization and architecture reflect the state of the art and the best practices in the concerned fields. Thus, the watch organization is inspired by the Spanish Sistema Integral de Vigilancia Exterior (SIVE)²⁴ consisting of a Command and Control Centre (CCC) fed by a set of Sensor Stations (SS) to ensure thorough sea surveillance in the Gibraltar Straits. The dedicated SCMV control room is nearer to a CCC than a set of MSS. All of the satcom processed watch information will be displayed on a large horizontal, roughly 1/100-scale, ECDIS based chart²⁵ constantly updated to indicate real time location for all near fixed and moving data. Panoramas from deck videos are shown on PC displays with a zoom and a 3D-imaging viewfinder with on-request capacity. Control room ergonomics designs should factor in cognitive capacities of humans and the nature of watch officers' tasks at hand.

The most significant progress in maritime safety due to the SCMV is related to an expected attrition of human factors playing a role in accidents. On bridge at sea, the watch officer or the master is subjected just as anybody else to extra-professional interferences, well known in cognitive science²⁶. Human behaviour does not process pure reason as life software. So despite perfect compliance with IMO rules, a well maintained ship and the best crew, "Concordia" Complex (CC) occasionally prevails: it gives the most trained and experienced master or watch officer the "ability" to order what he should not order. In the SCMV control room, CC vanishes: in absence of a bridge atmosphere, there is neither stress, nor boredom, and far less distractions²⁷. Responsive-born women who are present will in most cases prevent the waking of the latent CC virus. Moreover, I draw your attention to well-known bad manners of certain seamen's way of life. Addictions, especially alcoholism on board ships, lead to dereliction of duty. Some of these situations endanger the ship and its crew. They may last long at sea and not come to an end in the next port of call. These human hazards cannot occur "aboard" the SCMV control room.

The same holds true with respect to security. Piracy and hijacking primarily are a matter of seamen kidnapping and ransoming. On a "phantom ship" such as the SCMV, there is no (wo-)man to blackmail a ship operator. And because there are no accommodations for humans on the SCMV, stowaways embarking in a port of call are easily spotted by security patrols before casting off.

In case of an unexpected encounter with a boat of illegal immigrants in peril, sea law forces any ship to save the people in distress. The law equally applies to the SCMV, which is fitted with throwable inflatable salvage equipment and pilot's ladders for shipwrecked persons to climb aboard. There is no difference in this regard with a manned ship, but the SCMV low running costs may incite ship operators to land any such passengers in a nearby port rather than in the next port of call.

For the SCMV, security also means preventing malware in the loop, given that security processing cannot disturb safety-piloting processing. Satcom may be a serious weakness of SCMVs if their security is not ensured. SCMVs have to pass on control-room true data on their real-navigation situations and to comply with orders given by a sole recognized control-room. It is not only a question of pure ciphering but just as well a question of system architecture and organization. Without revealing the measures, it can at least be said that at the master's request, priority-controlling mode will be able to take back the wheel on the discrete security back-up link, and the use of integrated advanced spam filtering technologies combined with link failover technologies will build a fail secure system.

Conclusion

With the SCMV, all the ancestral romanticism of the sailor disappears. We can still recite "The Rime of the Ancient Mariner"²⁸, though expressing a nostalgic flavour. But the ancient mariner is a male, generally forced to embark, a pure sailor in spite of himself. The rare one we meet on the port's quay is the only retired survivor. During his last days, he keeps turning over his dreams of adventure, forgetting the tough reality of the true sailor's life. The 1983 film by Federico Fellini "E la nave va"²⁹ ("And the ship sails on") tolls the bell of the manned ship.

The SCMV makes the door wide-open for seawomen and seamen to lead a comfortable, sedentary lifestyle. Surely the SCMV provides equal opportunity access to women in long-range ship piloting. And that is our wish for today.

Keywords: Employment, Policy and Practice (EPP) - Shore Controlled and Monitored Vessel (SCMV) - working conditions – maritime training - maritime safety and security – cognitive science in shipping management

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