Time Pressure in Ship Operations

Discussion Paper

Note that this is a discussion paper and includes some ideas and concepts which are being considered in a larger review of time pressure in shipping operations. It is not a precise model for operations

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Time Pressure - Introduction

Time pressure is at the heart of many shipping incidents. The reason for this is to a great extent embedded in the business model.

The position of shipping at the heart of the global supply chain means that any attempts to optimise that supply chain affects ships. Removing margins in shore manufacturing and distribution systems to reduce stockholding costs increases pressure on ships to deliver precisely on time despite the shipowner having to deal with the unpredictable nature of sea transport. Punitive contracts may reinforce this.

The shipowner may also desire to use the ship more efficiently putting pressure on operations and maintenance.

Finally, those onboard may perceive time pressure and consequently take decisions based on an implicit rather than explicit requirements.

The nature of the supply chain, especially in a period of economic uncertainty, is such that 'optimisation' of the supply chain is progressive and time pressure is likely to increase. Any consideration of time pressure has to include not just the problems of increasing time pressure but dealing with that which is already there.

This paper looks at what time pressure is and what drives it. It includes some examples of incidents worthy of discussion. It also includes some concepts that may be helpful in combatting time pressure.

What is Time Pressure?

'Time pressure' is often used interchangeably with 'commercial pressure'. In fact, time pressure is a sub set of commercial pressure. This paper does not consider specifically the impact of cost pressure other than in the context of reducing the resilience of the operation.

Time pressure is linked to workload, fatigue and stress. However, workload, fatigue and stress can be seen as a general or cumulative effect. They impact on general, non-specific, performance and may result in accidents from fatigue and impaired decision making.

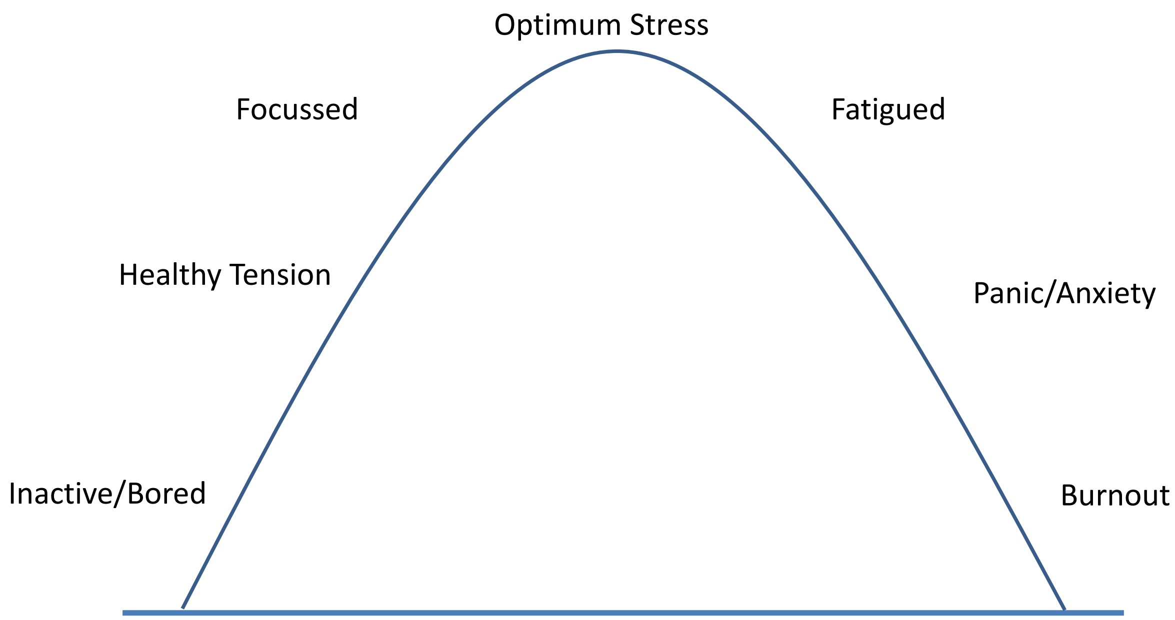

Figure 1 Stress

For the sake of this paper time pressure may be defined (interim definition) as 'pressure placed on the ship or its officers and crew to complete a defined operation or task within a specified time'. In absolute terms any specification of a time to complete a task, other than 'in your own time', is 'pressure'. This does not mean it is wrong. Figure 1 shows a well-known illustration of stress and the concept that there is an optimum point for stress. Intuitively, and without evidence, it may be that the same relationship exists for time pressure.

Resilience is a key concept when considering time pressure. A definition of resilience is as follows- '*A system is resilient if it can adjust its functioning prior to, during, or following events (changes, disturbances, and opportunities), and thereby sustain required operations under both expected and unexpected conditions'.* In simpler terms resilience is the ability of a system to react to pressure. A resilient system will be able to adapt to pressure placed on it because it will have some spare capacity. If there is no spare capacity then the system will be 'brittle' and prone to failure. So, the ability to cope with high intensity and unpredictable operations requires some spare capacity onboard the ship.

What types of incidents may be attributed to time pressure?

Navigation Incidents

These may result from steaming too fast, or attempting to maintain a course inappropriate for the weather conditions. The most famous example is the Titanic in 1912 which allegedly maintained speed to reach New York on eta in conditions which made it difficult to see an iceberg. The recent El Faro [1]incident also highlighted the possibility that the Master was maintaining the intended course with a wind on the beam which caused a failure of the lubricating oil systems.

The UK MGN [2] highlights several incidents where vessels either processed from port in fog or steamed too fast in fog.

There are cases where vessels change their course to meet an eta. The Torrey Canyon is a famous example of this. The container ship Rena[3] cut a corner to maintain an eta resulting in a grounding and a high profile fuel oil pollution.

While not navigation per se, pressure to maintain a schedule may override good engineering practice as in the following reference where main engine alarms were ignored resulting in severe damage to the engine [4]

Port and Cargo Operation Incidents

In the Hoegh Osaka [5] incident, the vessel sailed, listed and grounded due to incorrect ballasting before leaving port. The Herald of Free Enterprise[6] is a well-known example of time pressure. The example of a container ship allision in case 1[7] of the MAIB Digest is also interesting in that the ports performance targets were directly cited.

There are numerous examples of enclosed space deaths related to tank cleaning. In reference 9 entry was made to a tank while cargo operations were underway. A recent submission to IMO has highlighted the large number of deaths of ship's crew and shore workers on bulk carriers, often where shore workers access holds before it is safe to do so.

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[1] *https://www.ntsb.gov/investigations/AccidentReports/Reports/MAR1701.pdf*

[2] *http://solasv.mcga.gov.uk/m_notice/mgn/mgn202.pdf*

[3] *https://www.taic.org.nz/inquiry/mo-2011-204*

[4] *http://www.gard.no/web/updates/content/11831792/hull-and-machinery-incident-engine-breakdown*

[5] *https://assets.publishing.service.gov.uk/media/56e9a7afe5274a14d9000000/MAIBInvReport6_2016.pdf*

[6] *https://assets.publishing.service.gov.uk/media/54c1704ce5274a15b6000025/FormalInvestigation_HeraldofFreeEnterprise-MSA1894.pdf*

[7] *https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835520/2019-SD2-MAIBSafetyDigest.pdf*

Maintenance Incidents

Pressure to make the first cargo post drydock or from new build can result in not completing essential maintenance or re-commissioning. In one case a shuttle tanker was fitted with a new position reference system. To make the agreed departure time from the drydock final commissioning and testing was deferred to the field. During the testing of the equipment in the oil field, the shuttle tanker collided with the FPSO and put it out of commission for six weeks.

While time charters often have maintenance days built into them, carrying out repairs on the run or carrying them out during cargo operations can improve performance targets. In the former case planned maintenance is being traded for unplanned breakdowns. In the latter case the vessel is unable to move in an emergency or, if the main engine should start inadvertently mooring and loading arm damage may results.

In some cases. the pressure to complete a job results in it being carried out without planning and precautions. In the case of the reference [8] repairs to a lift were carried out without correct planning resulting in a fatality.

What drives Time Pressure?

Systemic Pressure

This is pressure imposed by the nature of the shipping business: -

Just in time manufacture

Shipping is an essential part of the global supply chain. The ability to transport components and products long haul at low cost was the driver of China's growth as an economic power. Lean and 'Just in Time' manufacturing philosophies depend on components and products being delivered on time. Container ships and car carriers are subject to this pressure.

Cruise and Ferry Trade

Cruise ships are high value units and for maximum profitability need to operate to fixed timetables to ensure that when passengers book their holiday it will not be delayed in any way. Ferry traffic similarly has rigid sailing times which in some cases, such as the Herald of Free Enterprise, resulted in disaster.

Tanker and Bulk Trades

The tanker and bulk trades are not, generally, liner trades. Loading ports are near mineral extraction facilities and discharge ports are at manufacturing facilities. The manufacturing facilities may further export materials and finished products to distribution terminals.

Terminal design takes into account berths, channels, storage designed to match the throughput of the terminal. There may be a variable or seasonal market which makes demand unpredictable. The design of the terminal may have compromises built into it to control capital spend. While system

[8] https://www.atsb.gov.au/publications/investigation_reports/2007/mair/mair235/

modelling will take place, these compromises may limit throughput and future opportunities to 'debottleneck'.

Operational Optimisation

Optimisation of systems or shore facilities is progressive once installation comes into operation. In the case of a tanker loading facility increasing the production from the oil field may put storage under pressure with a knock-on effect on the need for vessels to load in marginal conditions or arrive early for cargoes.

Ship Performance

While system factors are important there is less freedom to change the system in the short term, so this paper focusses on the ship owner.

At the shipowner level it is worth explaining the business model. Ships costs consist, generally, of: -

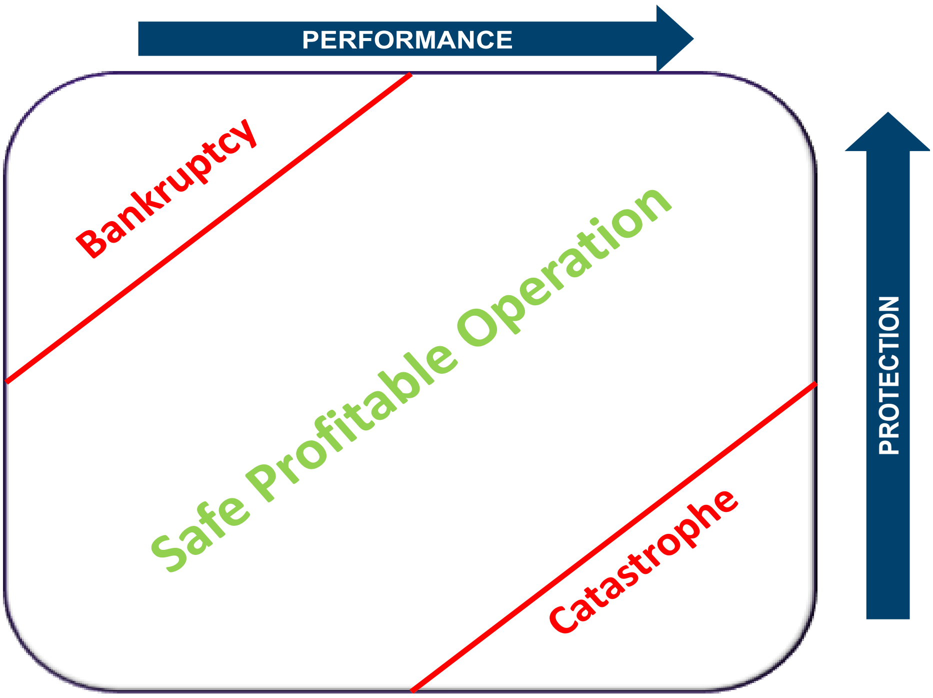
1. Finance costs. This can be shown in accounts as either debt or capital write-down.
2. Capital costs during the ship's life to update and modify it to the latest requirements.
3. Costs of maintaining the vessel in accordance with class rules and good maintenance practice. This includes spares, stores, drydocks.
4. Costs of operating and crewing the vessel.
5. Voyage costs such as fuel and port costs.

Of these the first four are 'fixed'[9] to some degree and would be paid by the owner whether the vessel is carrying earning/carrying cargo or not. Item 5 is generally paid for by the charterer or included in the rate (eg world scale) in some way. It is obvious therefore that to maximise return, irrespective of market rates, there is a need to spread the fixed costs over the maximum number of earning days. Literally time is money.

Ship operations is, however, a trade-off as shown in Figure 2 below. The shipowner must find the balance between financial performance and protection. If performance is overemphasised by high intensity operations and cost cutting then the risk of catastrophe is increased. Catastrophe, even if insured, can be costly and can damage a shipowner's reputation to the extent that they cannot trade. Overemphasis on protection will have financial consequences. The safest shipping company is of little value if it is bankrupt

The balance is dynamic and over time optimisation will lead to reduction in 'protection'. As an example, radar was introduced to improve navigational safety. If the use of radar encourages ships to go faster in fog then safety margins are then reduced. There is a perception that, in cars, having seatbelts and airbags encourages drives to go faster.

[9] *In this context costs are 'fixed' in the short to medium term. Options are available in the medium or longer term to reduce crewing and maintenance costs' layup or sell the vessel.*



After James Reason
Managing the Risks of
Organisational Accidents

Figure 2 Performance versus Protection

The decisions facing the shipowner shape the risk created by time pressure. If an operation is designed and resourced with sufficient 'resilience' then a safe high intensity operation is possible. If, in parallel with increasing the intensity of operations, resilience is being reduced to emphasise performance then risk will increase. The challenge for the owner is understanding the intensity of operations that can be safely maintained by the operation as designed.

As mentioned earlier, 'optimising' ships programmes can result in increasing time pressure. If the optimisation is accompanied by a review of resources and processes then the consequences may be limited. If, however, the 'optimisation' is not controlled then it may reduce the 'resilience' of the system. Initially uncontrolled 'optimisation' may have no consequence as it uses up the spare capacity in the system. The lack of immediate consequences encourages further optimisation. Over time the optimisation will use up all the resilience in the system and risk will increase dramatically and suddenly.

Contract Terms

Charter party terms are the means by which time-pressure is applied to the ship.

Charter Parties may include terms to proceed with 'due' or 'utmost' despatch or an obligation to load or discharge quickly. In product tanker operations instructions to arrive at a port with tanks in a specific condition may overlook the fact that while the ship can easily meet the navigational eta there may be insufficient time to complete tank preparation safely.

Demurrage clauses may also put pressure on ships port time. Often relatively small amounts of money drive extreme time pressure and incidents.

How is Time Pressure Applied and Perceived?

Time pressure can be perceived and applied in different ways. The figure below illustrates one model.

Explicit Time Pressure
Where a clear instruction is given by someone with apparent legitimate authority that imposes time pressure

Implicit Time Pressure
Where some implied incentive or punishment created by management or management systems generates time pressure.

Perceived Time Pressure
Where an individual is motivated to complete task quickly due to a perceived need.

Note that when a person with legitimate authority is influenced by implicit time pressure which results in them issuing instructions based on that pressure those below in the hierarchy are reacting to explicit time pressure

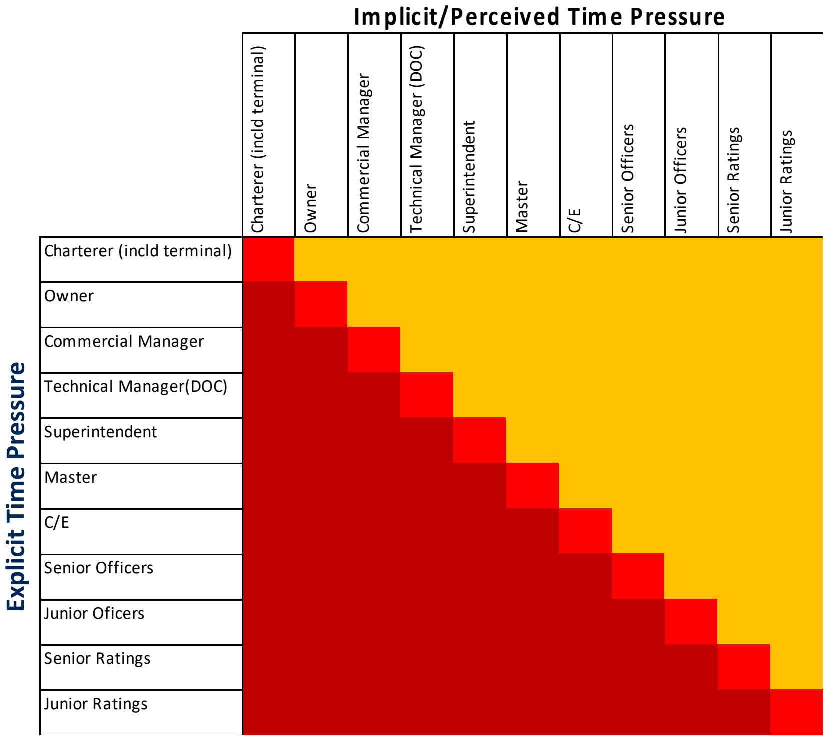


Figure 3 Types of Time Pressure

Explicit Time Pressure

Explicit time pressure is where a person with 'legitimate' authority imposes time pressure on the ship. This may be a charterer, terminal operator, pilot, loading master or shipowner employees such as charterers, ship operators, superintendents. The time pressure will then be adopted by all. It should be noted that the person imposing an explicit deadline may be reacting to implicit time pressure and not to direct pressure from above. Those below this level in the organisational structure are blind to this being implicit pressure and will react as if it were explicit.

Implicit Time Pressure

Implicit time pressure may result from organisation factors which create pressure due to either inappropriate motivation or fear. These may include: -

Performance Targets

Where a ship is managed as a profit centre there may be targets for utilisation, earning days or availability. These targets may be linked to reward systems. This may lead to time pressure on those aboard. There are several problems with this: -

1. Increasing intensity of operations, to be safe, requires consideration of resources and process. Those aboard may not be able to adapt resource and processes to cope with the changed circumstances.
2. The time pressure may be invisible to shore management and may conflict with the expressed views on safety of the organisation.

3. In the event of an incident those aboard may be blamed for disobeying procedures and rules and will be unsupported by the organisation.

Shipboard Operating Procedures

The ships management system may create expectations regarding the time taken to complete specific operations. The system may include charterers requirements for, eg, wall washing

Planned Maintenance System

The maintenance system may create an expectation as to how long a job should take and how often it should be carried out. An example of this is the need to inspect ballast tanks.

Perceived Time Pressure

As individuals those aboard may create their own time pressure. They may believe that as a professional they should complete tasks in a specific time. They may feel peer pressure. An interesting example is that working hours monitoring which limits the hours worked can impose time pressure to complete task within those working hours.

Dealing with Time Pressure- Ideas and Useful Concepts

This section considers some ideas and concepts for dealing with time pressure as distinct to earlier sections which are about preventing excessive time pressure.

Change industry practice

There is a need to review industry practice when it comes to the design of systems and terminals. There is also a need to consider charter party terms. This is a subject in itself and outside the scope of this document.

Shipowner as Circuit Breaker

The shipowner may act as a 'circuit breaker' and manage requests from charterers and terminals.

Relationships and Organisational Culture

The role of the Master and is critical to dealing with time pressure. The Master is the main contact with the charterer, terminal and shipowner. The Chief Engineer may also have a role to play. The Master should be able to challenge unreasonable demands without fear of punishment and they should also avoid passing on their own implicit or perceived time pressure to those onboard. ISM states the Masters responsibility for safety and the Owners responsibility to support this.

The figure below shows the relationships in two different models of ship ownership. As can be seen

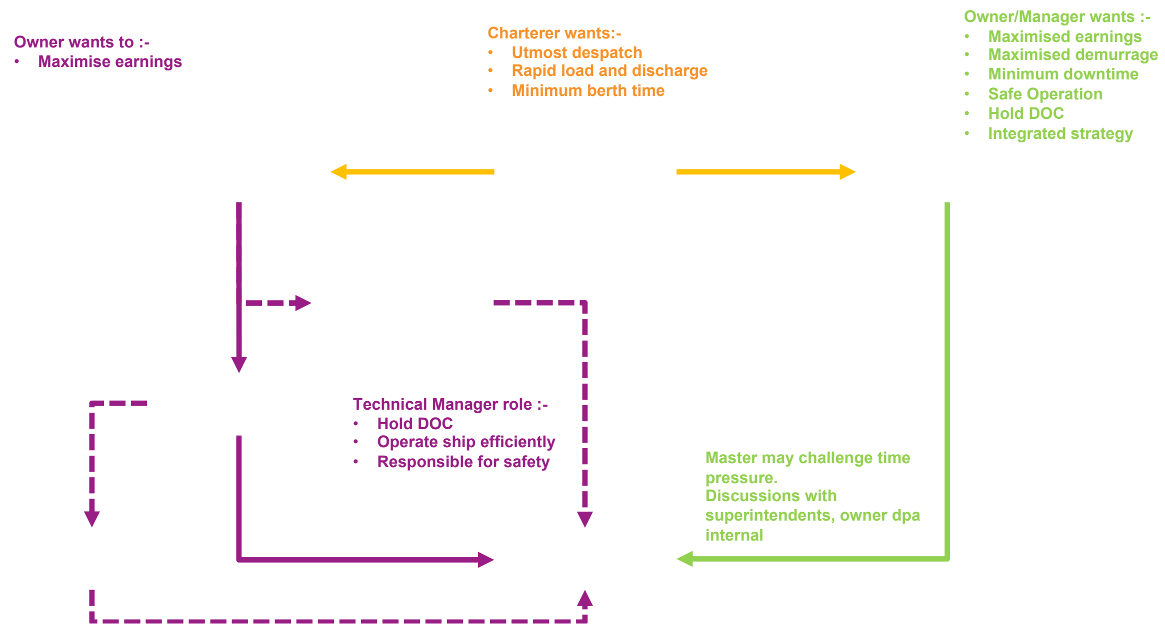


Figure 4 Relationships

the left-hand model is more complex and the ability of the master or chief engineer to resist time pressure is more limited. The key though is dialogue. In an organisation or culture with high 'power distance' the masters, or chief engineers voice will not be heard.

STOP Culture[10]

Safety is the responsibility of all. The concept that each crew member is responsible for the safety of their colleagues should be obvious but it takes a considerable effort to overcome ‘power distance’ and encourage experienced but organisationally junior people in the organisation. This is discussed in reference 10. In once recent incident[11] an able seaman was ordered down a tank, in port, by the second officer. The rating refused as it was dangerous. The 2/0 then entered the tank, was rendered unconscious and died. The attached report has some interesting features and make for an interesting discussion.

ETTO-The Efficiency Thoroughness Trade-Off[12]

This principle states that in real life (work) there is always a trade-off between thoroughness and efficiency. By inference you can never maximise both. The trade-off is often based on the time available to carry out the task. The book also highlights the reasons why people make particular trade-offs. Chapter 2 in the referenced book sets the scene effectively and could form the basis of a useful discussion.

Fast and Slow Thinking[13]

This book highlights that there are two systems of thinking. System 1 or Fast thinking operates automatically or quickly with little or no effort and no sense of voluntary control. System 2 or slow thinking allocates attention to the effortful mental activities that demand it. Fast thinking may be used when limited time is available and may result in things known deeper within the mind to be neglected. In the Hallam casualty, for example, the 2/0 had been involved in copying and posting guidance about enclosed entry the previous day and therefore had some revision of the issues.

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[10] *http://www.hse.gov.uk/construction/lwit/key-principles.htm*

[11] *https://www.register-iri.com/wp-content/uploads/Republic-of-the-Marshall-Islands-Office-of-the-Maritime-Administrator-HALLAM-Casualty-Investigation-Report.pdf*

[12] *The ETTO Principle Erik Hollnagel*

[13] *Thinking Fast and Slow by Daniel Kahneman*

Conclusion

1. Time pressure can be imposed by: -
    a. The shipping system, including charterers and terminals.
    b. Shipowners and operators.
    c. By the individual's perceptions.
2. Time pressure has been identified in various types of incidents including: -
    a. Navigation
    b. Cargo and Port Operations
    c. Enclosed Space Entry
    d. Maintenance
3. While it is related to fatigue, workload and stress, in the context of this paper time pressure is seen as applied to a specific operation as distinct from fatigue which has a more general, non-specific effect.
4. Time Pressure may be imposed by: -
    a. Explicit instructions
    b. Implied messages in management systems.
    c. By personal pressure and beliefs.
5. Time pressure may be countered by: -
    a. Changing the industry structure.
    b. Shipowner managing the application of time pressure.
    c. Developing skills onboard to deal with the consequences of time pressure.