22nd November 2019

Berth Utilisation and Cargo Characteristics

Planning Phase

MVP Description

The purpose of this MVP is to explore technology and process enhancements to the planning phase of the vessel arrival experience at a UK port.

The 2050 Innovation Hub is seeking early working concepts / prototype solutions to assist with the streamlining and automation of the planning phase of the operational process, which commences approximately 10 days prior to vessel arrival.

This MVP requirement assumes the requirements for all previous operational phases have been satisfied and focuses purely on the resource planning aspects of the process.

We are looking to advance the current 'state of the art' for the Maritime Industry as a whole, not to simply procure existing technology as it stands.

The 2050 Innovation Hub is keen to explore innovation opportunities around:

- Apps
- AI & Machine Learning
- Robotic Process Automation (RPA)
- Big Data
- IoT
- Robotics
- Environmental and Safety Sensors
- Location and Proximity Detectors
- Augmented & Virtual Reality
- Data Process Flow Improvements

Current State

The key to the planning phase is the vessel's **Estimated Time of Arrival** (ETA). Once this is confirmed planning commences with regard to the servicing of the visit. The key factors are per below:

- **Labour** - based on the contractual load as advised in the enquiry stage and the agreed contractual discharge rate
- **Berth location** - based on the most efficient berth for the cargo
- **Equipment** - based on availability and cargo requirements. Different cargoes can require a different configuration of plant and machinery

Other factors such as weather, tide, ad hoc vessel requirements and marine services will also need to be taken into account.

Costs are continually monitored, but being able to include these other factors mentioned above would realise cost reductions and saving on demurrage charges.

Demurrage is the charge payable to the owner of a chartered ship on failure to load or discharge the ship within the time agreed.

The planning process is primarily manual, requiring human interaction with numerous systems (Appendix 3) and a dependency on manual paperwork and spreadsheets. Due to low levels of system integration and departmental segregation, information is frequently entered multiple times into different systems or document sets leading to potential keying errors and a dilution of information, meaning there is not one single version of the truth.

Information from the enquiry phase (Appendix 1) is a requirement of the process, as information such as vessel size, dimensions, tonnage and discharge rates are fundamental to the planning.

Additional information is then required at the planning phase, (Appendix 2) and built into the information previously received from the enquiry phase (Appendix 1) to provide a full view of the vessel requirements and how best to service them effectively.

Plant and equipment availability is held separately, and although internal discussions take place prior to vessel arrival, availability lists are still provided manually, (Appendix 3).

The late arrival of vessels due to factors beyond the destination ports control leads to issues with labour planning and resourcing. Often staff are not allocated confirmed shift patterns until 24 hours before the unloading of the vessel is due to start. Additional staffing can be brought in by using either agency labour or overtime for existing staff, both of which are costly. Any reduction in these areas would be a cost benefit to the port.

While the planning phase commences approximately 10 days prior to scheduled arrival, vessels are only confirmed as arriving at the destination port 12-14 hours before berthing.

Cost estimates are provided to the customer prior to the planning phase, but it is only once the planning phase has been completed and the vessel has departed that a true cost of the vessel visit can be determined.

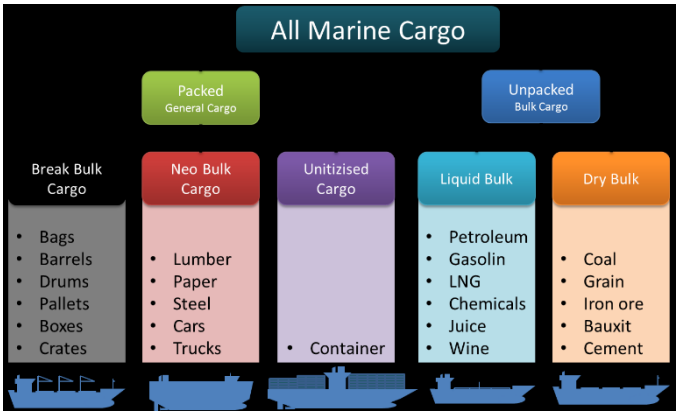
It is fundamental that the planning phase is undertaken correctly using all available data. This will ultimately safeguard the contractual obligations agreed between port and customer and avoid demurrage costs.

Ports are required to handle a wide range of cargo types and volumes all with a unique set of challenges and data variables.

For example:

Cargo characteristics:

- Density stowage factor
- Health and safety
- Environment
- Weather
- Berth availability
- Labour and Resource Planning



Target State

The aim of this MVP is to streamline and automate the processes and data inputs used throughout the planning stages of a vessel's arrival for its loading or unloading at the destination port. Additionally the MVP should highlight any potential opportunity for vessel lay time, during quiet periods, which is when a vessel may utilise a berth without loading or unloading to resupply or undertake repairs.

The system should be of benefit to all parties and allow visibility of (non-commercial) data throughout the process. The MVP needs to consider all of the factors from the enquiry and planning phases including expected load rates to give the port the most efficient configuration of labour, machinery and berth utilisation. The system also needs to be flexible to take into account changes in vessel arrivals due to external factors.

The vision is to develop a system which will be able to automate the planning process from start to finish and extract data from multiple sources to assist with resource planning and billing. The system needs to be accessible to multiple stakeholders across the business and to external customers who will have visibility of the information and data applicable to them throughout the process.

Ideally the system will be able to self-learn through usage to improve decision making and operational practices.

The target benefits of such a system are as follows:

- **Efficiencies for Ports:** Cost saving, streamlining of the processes and better informed decision making amongst others
- **Safety:** This system should allow ports to share safety information between each other on cargo characteristics, handling requirements, potential issues with vessels or cargoes and highlight any environmental concerns
- **Information Sharing:** The system should act as an information portal for stakeholders such as: Local authority, Local community, port Users, UK Boarder Force (UKBF), Customers, Agents, HMRC, MCA
- **External:** Beneficial for external agencies to see what a port is handling at any one time to help their planning (UKBF resource planning as an example)

- **Learning:** Data could be made available to assist future research projects or academic advancement

The output of the MVP should make significant improvements to the planning process and should include the features below:

- Planning for berth, labour and equipment availability and optimum usage of resources
- Access to and use of historical data for customer insights and trends
- A visual representation of the berth to include current position and planned bookings
- To be a berthing prediction, realisation and optimisation tool to assist the port in the delivery of maximum % utilisation of resource to the benefit of the customer and the business
- Efficiency usage of berth capacity, labour resource and equipment availability
    - Labour planning to include vessel requirements, staff availability, skillset, sickness, legislation and ad-hoc requirements such as number of first aiders or supervisors per gang
- Cross functional tool to advise Marine, Engineering and Operational departments on current and long term planning requirements
- Link seamlessly with other aspects of the enquiry to delivery process – (MVP scope also issued for the enquiry phase)

MVP Features

It is envisaged that the MVP features could capture some, if not all, of the detailed list below:

Must Have:

- User friendly, responsive, visual dashboard functionality – single view of the operation
    - Browser based user interface
    - Customer account access
- Cost estimate (from enquiry and contractual phases) versus the true cost comparisons and lessons learnt
- Accurate and complete information from integrated data sources
- Links to vessel identification information and cargo details
    - Vessel dimension to quay dimension representation (number of vessels on berth)
- Integration with staff and skills matrix to enable planning of resource against available hours
    - Ability to make staffing decisions/recommendation based on best cost options to reduce overtime or agency requirement
- Visibility of resource requirements, usage and availability to all relevant parties
- Capability to handle requirements around loading and unloading of vessels
- Adaptability to be able to accommodate cargoes and timings from a few days to 12 months in advance
- Alerting functionality for any berthing restrictions due to vessel dimensions, tidal, weather or other
- Planned resource usage verses actual resource used comparisons and lessons learnt
- Automated KPI reporting and pricing

Nice to Have:

- Cargo identification integration
- Predictive modelling and scenario planning functionality to deal with “what if” queries

- Ability to work through multiple discharge options for number of gangs, and equipment levels
- Scope to handle multiple hatch discharges as per vessel master requirements
- Long term visibility of staff working requirements
- Marine requirements – tugs, pilots
- Vessel requirements – water, electricity, repairs, lay time and other ad-hoc (chargeable) requests
- Commercial pricing breakdown for port management to assess
- Links to storage or stock pile availability (if required) to assist with discharge decision making
- Visibility of historical visits
- Machine learning to provide cost saving measure on staffing and plant utilisation based on previous visits and operations

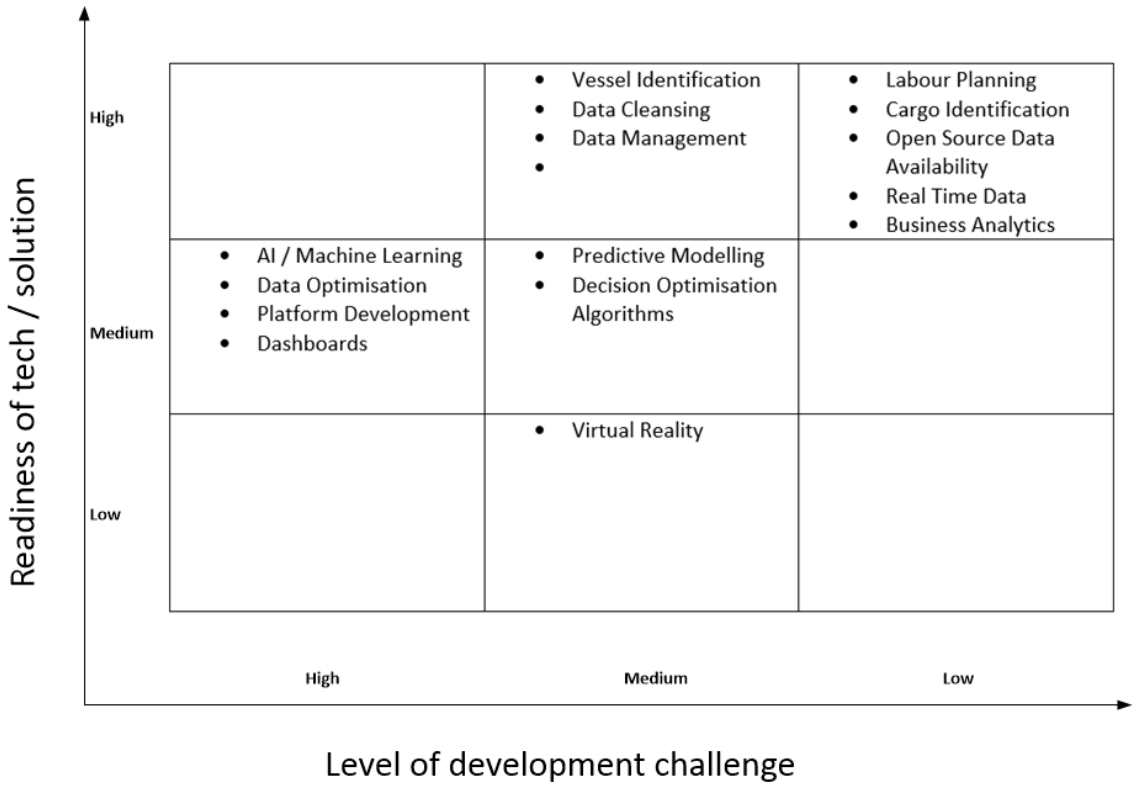
Avoid:

- Issues around working hours
- Over complexity of vessel discharge options
- Customs issues around cargo types
- Border Force requirements
- Vessel crew interactions
- Hazardous cargoes and precautions associated with the loading/unloading of such
- Decisions on storage and data location (On premise verses Cloud)

Advancing the Current State of the Art

The matrix below shows currently available technology and solutions and plots their readiness for use against the development challenge based on the outputs from our previous innovation sprints. The matrix inputs were generated by delegates at our MVP innovation sprint on 30th October 2019.

As an example, *Labour Planning* systems are commonplace and have low development overheads so would be plotted in the top right segment of the grid. On the other hand, although the technology for virtual reality is available, it's not ready to be adopted straight out of the box for this solution and is likely to need some development. Therefore virtual reality is plotted to the lower-centre area of the grid.



Data Sources

The following data will be provided at the hackathon.

Source	Description	Format
Vessel Management System	Management system used by Marine Department to track vessel arrivals, movements and sailings.	SQL Database
Bulk Management System	Management system used by operations department to	SQL Database
Staff Shift Planning	Staff rotas and vessel gang requirements.	Excel Spreadsheet
Historic Enquiry Details	Details relating to previous vessel visits to the Tyne.	Excel Spreadsheet / paper based forms
Plant Availability	Plant Maintenance Systems	SQL Database / paper based forms
Weather Stations	Real time data relating to wind speed and direction (potentially not relevant at the enquiry phase)	Raw data
Tidal Data	Information relating to tidal levels	Raw Data (port owned tide gauge) and online tidal data sheets

Data Sources – External

Please note there are numerous sources of shipping information in a variety of formats. The below are all online sources utilised by the Port of Tyne. They are all primarily subscription based.

Access to these systems will not be provided by the 2050 Innovation Hub during the Hackathon, they are intended for information purposes only to demonstrate the type of resources consulted through the full operational process.

Source	Description	Comment
AIS	Vessel Tracking	Positional information of vessels
Lloyds Register of Ships	Worldwide Shipping database holding all relevant vessel information	The ports VTS System imports Lloyd's details upon estimated arrivals information being entered.
RightShip	Marine safety and environmental management system.	Utilised for reviewing any historical issues with vessels worldwide.
Weather Forecasting	Details relating to previous vessel visits to the Tyne.	Online sources available.

Intellectual Property

Innovation Hub "hackathon" terms

The Port of Tyne Authority ("**we**" or "**us**") are delighted to host the 2050 Innovation Hub "hackathon" event on 22nd November 2019 (the "**Event**").

The purpose of the Event is discuss and develop innovative ideas in the area of maritime and logistics technology, with the aim of creating streamlined, efficient and environmentally friendly ways of working in the sector, for the benefit of all participants.

In registering for the Event, you are indicating your acceptance of the below terms of your participation in the Event:

1. The Event is open to people who are over eighteen years of age and who are invited by us or our partners in the Innovation Hub (a list of our partners can be found at https://www.portoftyne.co.uk/about-us/2050-innovation-hub/partners).

2. The Event will take place on our Tyne Dock site, at the 2050 Innovation Hub building. Tyne Dock is a security controlled site and you agree to register with our security office, and to abide by all health and safety and security rules whilst on site, and any reasonable instructions that our staff might give you.

3. You agree to us collecting and processing your personal data for the purpose of running and administering the Event, and for issuing follow-up communications related to the Event.

4. The event will include photography and videos, and you consent to us and our partners in the Innovation Hub using and publishing those images and videos, in which you might feature, for the purposes of promoting and documenting the Event and the Innovation Hub more generally.

5. All participants in the Event agree to collaborate with each other in good faith and respectfully during the event. If we feel your behaviour is causing disruption to the Event or upsetting other participants, we may ask you to leave.

6. You agree that any ideas and suggestions you contribute to the Event will be your own ideas, or ideas which you are permitted to share by the person that owns them.

7. You acknowledge that sharing any idea at the Event makes it public and might have a detrimental impact on your ability to later apply for formal protection of that idea (for example to apply for a patent).

8. You agree that any ideas or suggestions you raise or contribute during the Event will be free to be utilised by other participants, including us, in the future. Any project or ideas that are developed by any party based on those ideas outside of or after the Event will be owned by the person that developed it, not by the person that first raised the idea at the Event. In that way, all ideas or points raised or developed at the Event are "open property" and any participants are free to exploit them or develop them separately for their own purposes.

9. We may decide to change or cancel the Event at any time. If we do, we will tell you about any changes as soon as practical using the contact information you gave during registration.

Appendix 1 – Enquiry Phase

Information required	Where from	Description	Why we need this information
What is the cargo	Customer		So we can make sure we have the capability to handle the cargo
Size of shipment			Helps with planning and costing
Stowage factor		In shipping, the stowage factor indicates how many cubic metres of space one metric tonne of a particular type of cargo occupies in a hold of a cargo	Allows us to calculate the size of storage area required and how efficiently we would be able to grab a cargo.
Density	Customer/on line		Allows us to calculate equipment suitability
Weather constraints	Customer		Not all cargo can be loaded unloaded in the rain, wind etc.
COSHH requirements	HSE	• PPE • Exposure limits • Explosive levels	Health and safety requirements
Storage requirements		• Dry storage • Surface it can be stored on	Some cargo needs particular storage requirements e.g. Grain
Angle of repose if a bulk cargo		The angle of repose, or critical angle of repose, of a granular material is the steepest angle of descent or dip relative to the horizontal plane to which a material can be piled without slumping. At this angle, the material on the slope face is on the verge of sliding.	Helps us understand how the cargo will behave in storage and loading.
Equipment required for loading unloading	Customer	• Crane • Ship loader • Shovel • Lifting equipment • Grabs	Ports may not have all the equipment required for handling a particular cargo.
Environmental implications	• Customer • Environment agency • Local authority	• License and regulatory requirements • Noise • Dust • Impact on local area • Contaminate other products	

Appendix 2 – Planning Phase

10-7 Day Requirements

Plan	Data required	Description	Considerations
Equipment	Equipment availability/ cargo type	Needs to tie in with maintenance program/ grab changes suitability	
Labour	Labour time sheet/ training matrix records	Allocate the correct amount of labour for this cargo with the correct training.	
Vessel updates	Updated ETA	We need this because continues to change, therefor labour allocation and berth availability are changing	Location of storage area for efficient discharge
Allocation of berth	Berth planner	ETA of vessel and vessel	Other vessel on berth, due to arrive
Weather	7 day weather forecast	Weather impacts on cargo operations and vessel arrivals.	

24-12 hours Requirements

Plan	Data required	Description	Considerations
Equipment movement	Cargo been handled allocated equipment	Any equipment required for handling the cargo is checked and moved in place for the cargo.	Weather, discharge rates, servicing requirements.
Berth instructions issued	Vessel length Depth ETA	A detailed set of instructions are issued to the marine department stating where vessel needs to be berthed	Location of storage areas.
Labour	Daily time sheet job allocation	Labour is formally allocated the day before	
Marine department?	Berth instructions, official booking from vessel agent	Harbour office will arrange tugs, pilot,	

Appendix 3 – Data Sources

Plant and Equipment

Labour Planning

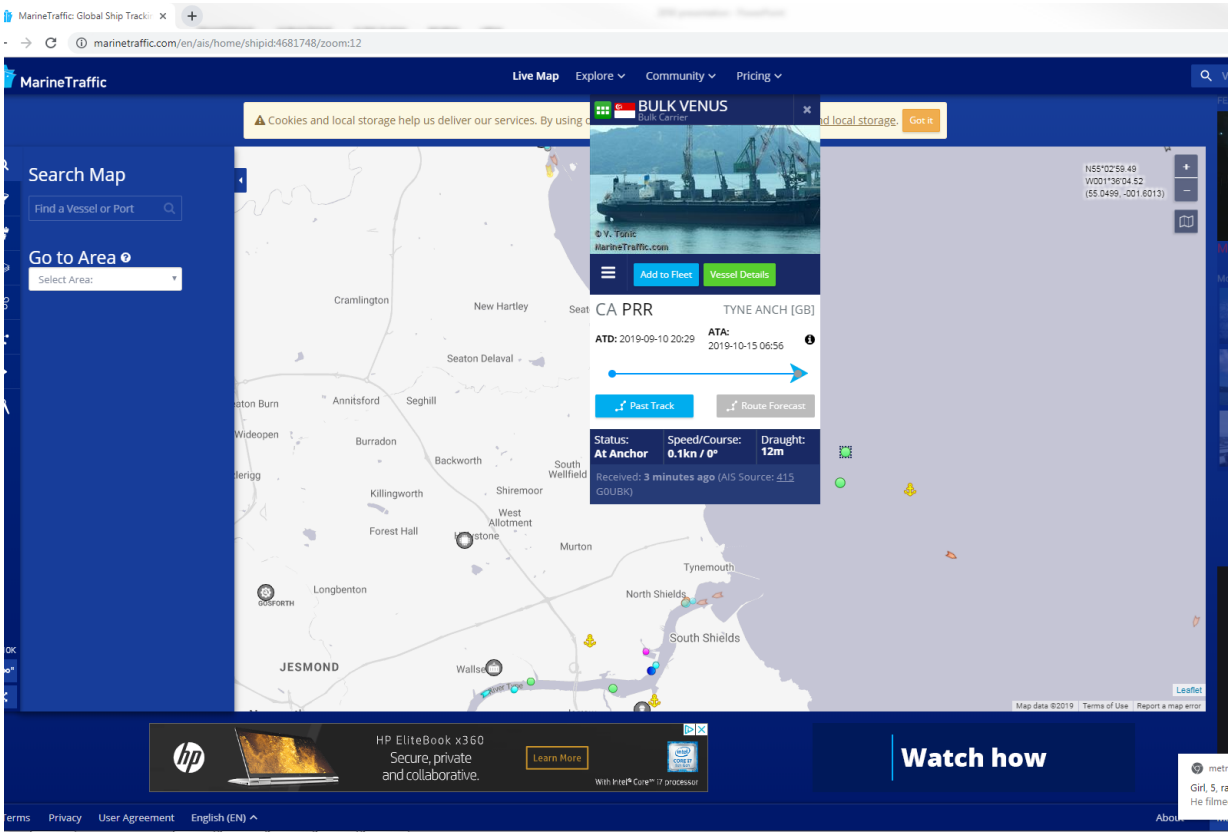
Group A Period Wk No, Period 4, Week 2
Group B Period Wk No, Period 4, Week 6

PORT SERVICES SHIFT ROTA AND PERIOD HOURS

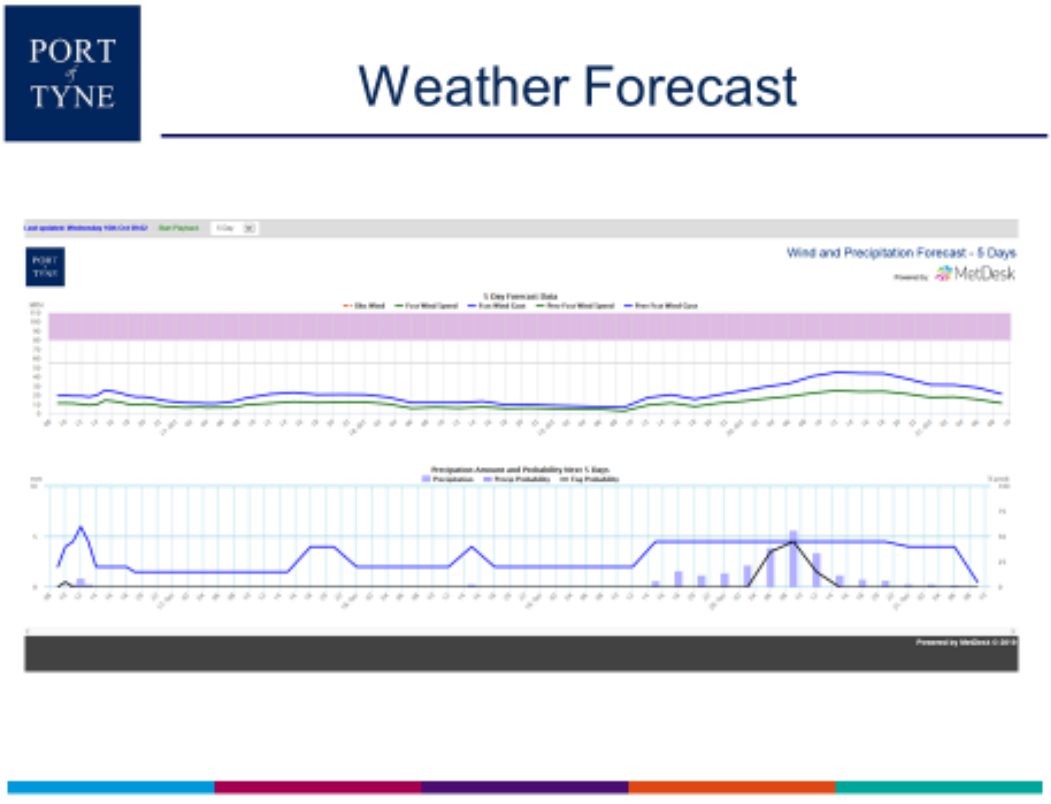
Shift Pattern
wk 11

Period Group	Rota Group	Payroll No.	Name	Period Hours	Hours Worked	Period Hours Remaining	Weekly Average	Calendar Week	WEEK 48 2018							
								Group A Week	Period 4, WEEK 10							
								Group B Week	Period 1, Week 1							
								Date	24-Nov	25-Nov	26-Nov	27-Nov	28-Nov	29-Nov	30-Nov	
									Sat	Sun	Mon	Tue	Wed	Thu	Fri	WEEKLY TOTAL
A	6	[redacted]		546	126.5	419.5	63.3	Shift	D	D	R	R	D	D	D	0
								Hrs	11.5	11.5	0	0	11.5	8.5	11.5	54.5
				OT Hours	0			O/T Hrs								0
A	6			546	123.8	422.2	61.9	Shift	DH	DH	R	R	DH	DH	DH	0
								Hrs	8.4	8.4	0	0	8.4	8.4	8.4	42
				OT Hours	0			O/T Hrs								0

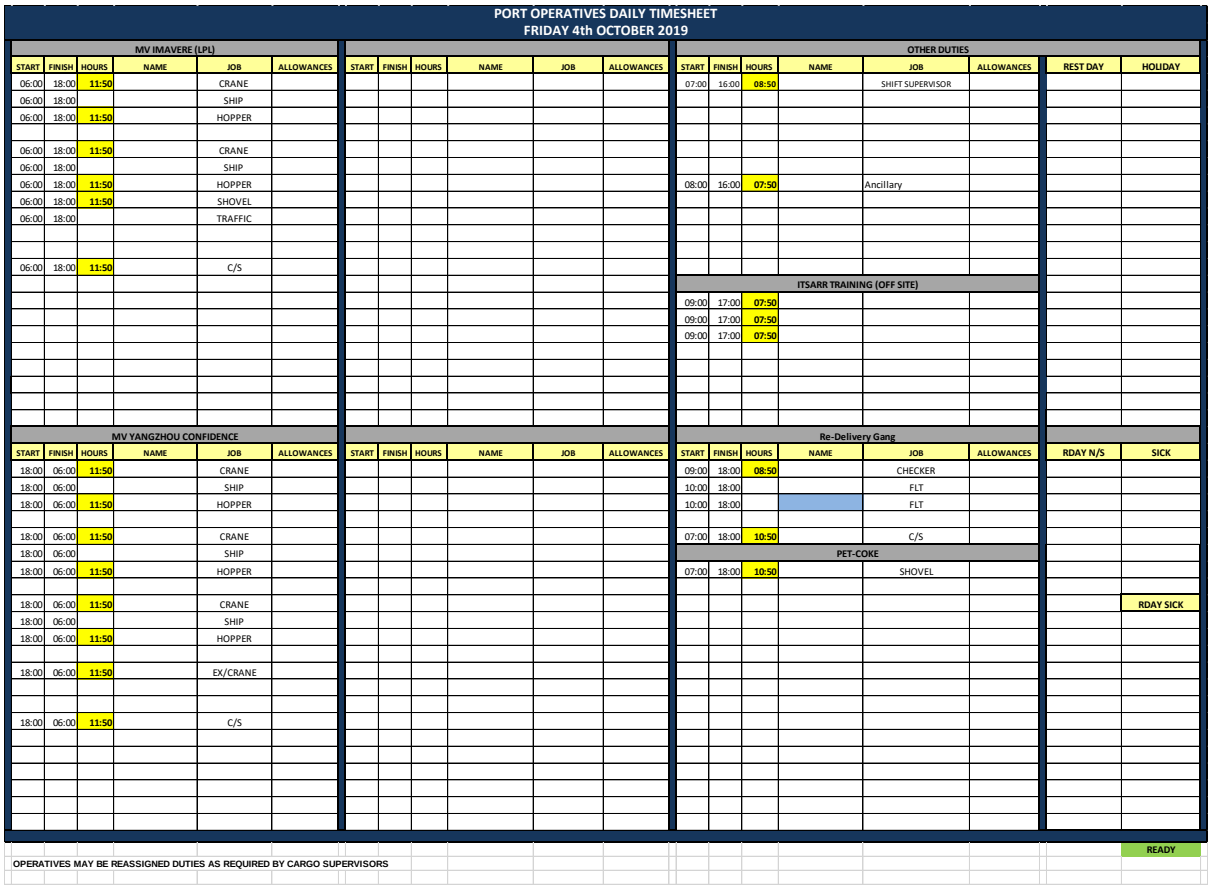
AIS (external system) Vessel Tracking



7 Day Weather Forecasting



Job Allocation Sheets



PORT OPERATIVES DAILY TIMESHEET
FRIDAY 4th OCTOBER 2019

MV IMAVERE (LPL)

START	FINISH	HOURS	NAME	JOB	ALLOWANCES
06:00	18:00	11:50		CRANE	
06:00	18:00			SHIP	
06:00	18:00	11:50		HOPPER	
06:00	18:00	11:50		CRANE	
06:00	18:00			SHIP	
06:00	18:00	11:50		HOPPER	
06:00	18:00	11:50		SHOVEL	
06:00	18:00			TRAFFIC	
06:00	18:00	11:50		C/S	

OTHER DUTIES

START	FINISH	HOURS	NAME	JOB	ALLOWANCES	REST DAY	HOLIDAY
07:00	16:00	08:50		SHIFT SUPERVISOR			
08:00	16:00	07:50		Ancillary			

ITSARR TRAINING (OFF SITE)

09:00	17:00	07:50			
09:00	17:00	07:50			
09:00	17:00	07:50			

MV YANGZHOU CONFIDENCE

START	FINISH	HOURS	NAME	JOB	ALLOWANCES
18:00	06:00	11:50		CRANE	
18:00	06:00			SHIP	
18:00	06:00	11:50		HOPPER	
18:00	06:00	11:50		CRANE	
18:00	06:00			SHIP	
18:00	06:00	11:50		HOPPER	
18:00	06:00	11:50		CRANE	
18:00	06:00			SHIP	
18:00	06:00	11:50		HOPPER	
18:00	06:00	11:50		EX/CRANE	
18:00	06:00	11:50		C/S	

Re-Delivery Gang

START	FINISH	HOURS	NAME	JOB	ALLOWANCES	RDAY N/S	SICK
09:00	18:00	08:50		CHECKER			
10:00	18:00			FLT			
10:00	18:00			FLT			
07:00	18:00	10:50		C/S			

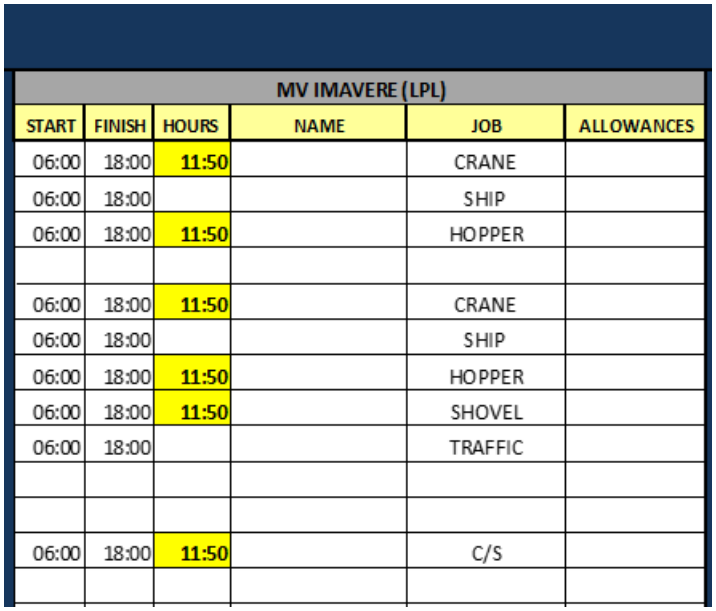
PET-COKE

07:00	18:00	10:50		SHOVEL		

RDAY SICK

READY

OPERATIVES MAY BE REASSIGNED DUTIES AS REQUIRED BY CARGO SUPERVISORS



MV IMAVERE (LPL)

START	FINISH	HOURS	NAME	JOB	ALLOWANCES
06:00	18:00	11:50		CRANE	
06:00	18:00			SHIP	
06:00	18:00	11:50		HOPPER	
06:00	18:00	11:50		CRANE	
06:00	18:00			SHIP	
06:00	18:00	11:50		HOPPER	
06:00	18:00	11:50		SHOVEL	
06:00	18:00			TRAFFIC	
06:00	18:00	11:50		C/S	

Berthing Requirements

HF 509-BERTHING ARRANGEMENTS

Vessel	Tampa Bay	Agent	Caspers	LOA	170m
Date of form			07/10/19	Revision	1

Berth			PST	SST	ANY	Must	Preferred	No preferenc
RSQe			X	☐	☐	X	☐	☐
Bow	C13		Bollard			X		☐
Stern	C2/3		Bollard			X		☐
Headlines	C14	C15	Bollard(s)*			☐	X	☐
Sternlines	C2	C1	Bollard(s)*			☐	X	☐

** Vessels less than 120m in LOA may not require two bollards for headlines and sternlines. Vessels of 120m LOA and greater should be allocated two bollards for each.*

Further comments
Expected arrival draught 9.5m

Duty Operations Person	Joe Wardle