



# Planning for Weather Downtime

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Dr David Lambkin

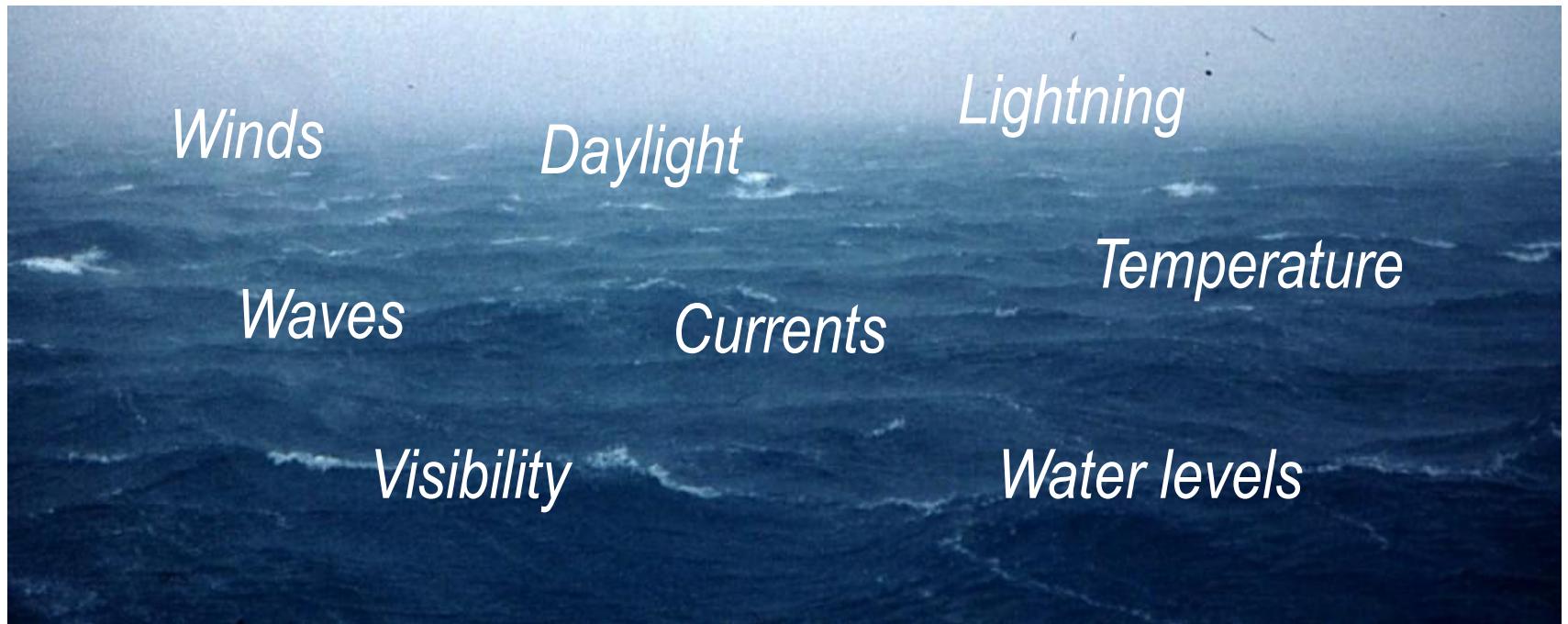
SOREC: Winds of Change  
National Oceanography Centre, Southampton.



# Planning for Weather Downtime

Working in the marine environment can be challenging at times.

The risk of dangerous situations arising is often managed by setting working limits for relevant environmental factors.



Limits will be specific to the task, the vessel or equipment, and the operational methods being used.

# Planning for Weather Downtime

- **Weather downtime (WDT) occurs when** one or more working limits are, or are expected to be, exceeded in the time required to complete a task, causing work to stop until the actual or forecasted conditions are suitable.

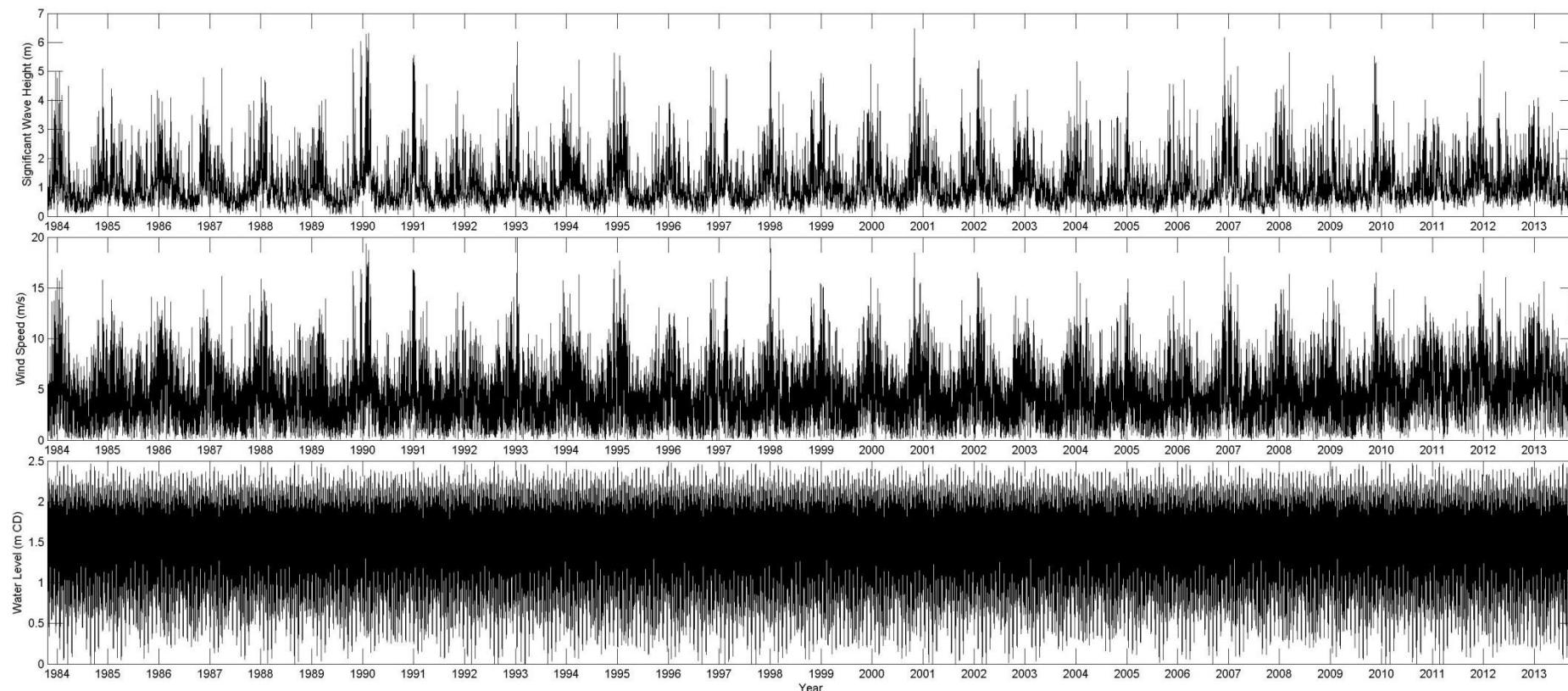


- **WDT extends programme** by delaying the start time of subsequent tasks.



- **WDT costs money** (e.g. vessel and equipment hire, personnel, insurance, mooring, penalties).
- **The risk of WDT (cost and time)** can be estimated and managed in the planning stages of a project.

To quantify WDT, we use **location specific historical weather patterns** to estimate how long it would have taken to do the job (including WDT) in the past.



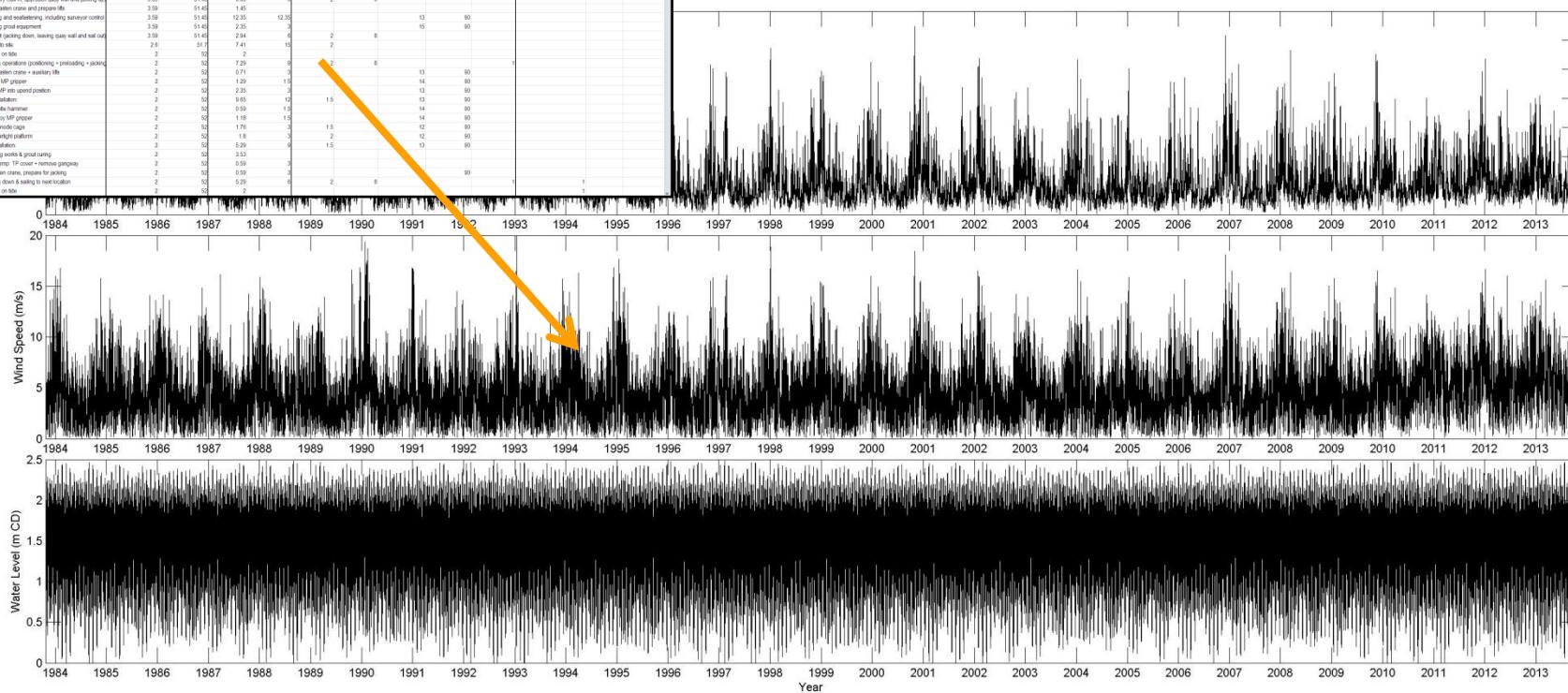
e.g. from ABPmer SEASTATES [www.seastates.net](http://www.seastates.net) 31+yr hourly hindcast of winds and waves.  
Other parameters also available (water levels, daylight, etc).

**A detailed task list, of all of the things you need to do, in the order in which they need to happen, with associated durations and thresholds.**

	A	B	C	D	E	F	G	H	I	J	K	L	M	
1														
2	Operation Name:	Example Operation 1			Get results for repeating this task list									
3	Version:	1.0												
4														
5	Net cycle time (excluding weather down time)													
6		167.14 hrs												
7		6.96 days												
8														
9														
10	<b>Tasks</b>	<b>Location</b>		<b>Durations</b>			<b>Thresholds (not to be exceeded whilst working)</b>				<b>Other working criteria</b>			
11	Task name	Location of task		Task duration	Weather window		Wave height	Wave period	Wind speed	at height	Current speed	Group with following task (flag=1)	Daylight only (flag=1)	Not on falling tide (flag=1)
12		Longitude	Latitude	(hrs)	(hrs)		(m)	(s)	(m/s)	(m)	(m/s)			
13	Port entry (sail in, approach quay wall and jacking up)	3.59	51.45	5.88	6		2	8						
14	Unseafasten crane and prepare lifts	3.59	51.45	1.45										
15	Loading and seafastening, including surveyor control	3.59	51.45	12.35	12.35					13	90			
16	Loading grout equipment	3.59	51.45	2.35	3					15	90			
17	Port exit (jacking down, leaving quay wall and sail out)	3.59	51.45	2.94	6		2	8						
18	Sailing to site	2	52	7.41	15		2							
19	Waiting on tide	2	52	2										
20	Jacking operations (positioning + preloading + jacking)	2	52	7.29	9		2	8				1		
21	Unseafasten crane + auxiliary lifts	2	52	0.71	3					13	90			
22	Deploy MP gripper	2	52	1.29	1.5					14	90			
23	Move MP into upend position	2	52	2.35	3					13	90			
24	MP installation	2	52	9.65	12	1.5				13	90			
25	Dismantle hammer	2	52	0.59	1.5					14	90			
26	Undeploy MP gripper	2	52	1.18	1.5					14	90			
27	Install anode cage	2	52	1.76	3	1.5				12	90			
28	Install airtight platform	2	52	1.8	3	2				12	90			
29	TP installation:	2	52	5.29	9	1.5				13	90			
30	Grouting works & grout curing	2	52	3.53										
31	Install temp. TP cover + remove gangway	2	52	0.59	3									
32	Seafasten crane, prepare for jacking	2	52	0.59	3				13	90				
33	Jacking down & sailing to next location	2	52	5.29	6		2	8				1		1
34	Waiting on tide	2	52	2								1		

Operation Name: Example Operation 1		Get results for repeating this task list:											
		1 times.											
<b>Net cycle time (excluding weather down time)</b>													
187.14 hrs													
6.98 days													
<b>Tasks</b>	<b>Location</b>	<b>Durations</b>	<b>Thresholds (not to be exceeded whilst working)</b>				<b>Other working criteria</b>						
Task name	Location	Task duration (hrs)	Wave height (m)	Wave period (s)	Wind speed (m/s)	At height (m)	Current speed (m/s)						
Latitude	Longitude		(m)	(s)	(m/s)	(m)	(m/s)						
13. Port entry, ballast in, approach quay wall and jacking up	3.59	51.46	5.88	6	2	4							
14. Unswathable crane and prepare off	3.59	51.46	1.45										
15. Jacking up, ballasting, holding, berthing, berthing control	3.59	51.46	12.25										
16. Loading grout equipment	3.59	51.46	2.35	3		13	60						
17. Port exit & jacking down, leaving quay wall and sail out	3.59	51.46	2.94	6	2	8	60						
18. Ballast out	2	52	2.16	5.1	15	2							
19. Walking on site	2	52	2										
20. Jacking operations (postponing + preloading + jacking)	2	52	7.29	9	2	8	1						
21. Cleaning operations + auxiliary life	2	52	0.71	3									
22. Dock MP prepare	2	52	1.29	1.5		13	60						
23. Move MP into stand position	2	52	2.35	3		14	60						
24. MP installation	2	52	9.65	15		13	60						
25. Diving hammer	2	52	0.90	1.5		14	60						
26. Undock MP recover	2	52	1.18	1.5		14	60						
27. Install anode cage	2	52	1.76	3	1.5	12	60						
28. Ballast out platform	2	52	1.16	3	2	12	60						
29. TP evolution	2	52	5.29	6	1.5	13	60						
30. Grouting works & grout curing	2	52	3.52										
31. Jacking down & sailing to next location	2	52	2.59	3									
32. Features crane, prepare for jacking	2	52	0.59	3									
33. Jacking down & sailing to next location	2	52	5.29	6	2	8	1						
34. Walking on site	2	52	2										

The task list is simulated many times within the timeseries data, pausing the start of a task if any of the threshold conditions will be exceeded during the required weather window.

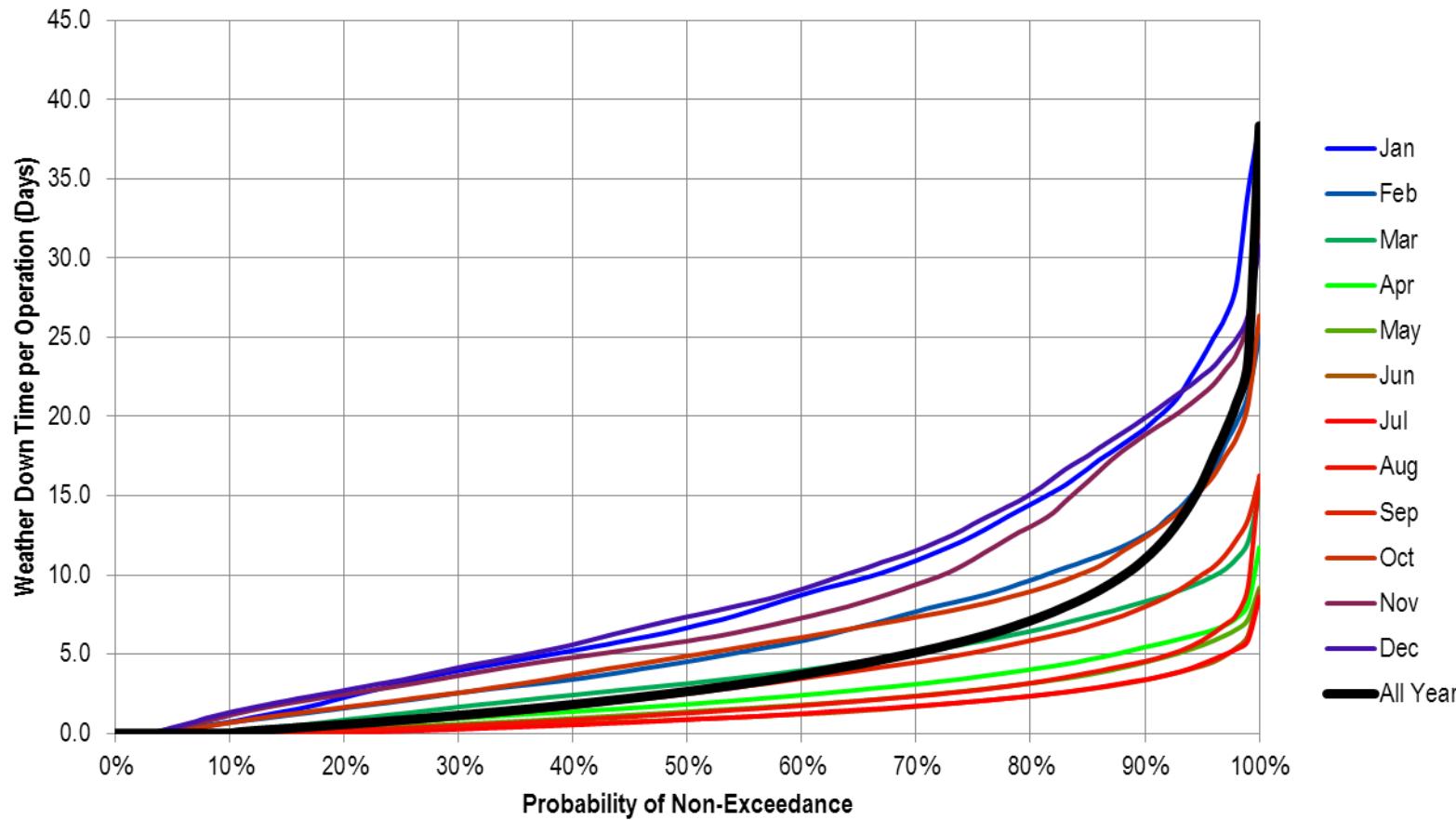


We simulate the whole operation 271,752 times (starting on every hour of a 31 year, hourly hindcast). The results are the statistics of all the individual simulations.

The proportion of time spent working and in **WDT** is then analysed and can be reported by start date (month), by task, or by groups of tasks if needed. Results are provided for a range of probabilities of occurrence.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	A
1																												
	For All Tasks in the Operation (see the [Task List] Tab)																											
2	Operation Net Duration (Hours)	0% = Minimum value in analysis																										
3	167.14	100% = Maximum value in analysis																										
4	Operation Net Duration (Days)	0% = Minimum value in analysis																										
5	6.96	100% = Maximum value in analysis																										
6	Weather Down Time per Operation (Days)																											
7	Result in Days	For All Tasks in the Operation (see the [Task List] Tab)																										
8		0% = Minimum value in analysis																										
9		100% = Maximum value in analysis																										
10	Probability of Non-Exceedance	Weather Down Time per Operation (Days)																										
71	60%	9	6	4	2	2	1	1	2	3	6	7	9	4	16	13	11	9	9	8	8	9	10	13	14	16	11	
72	61%	9	6	4	2	2	1	1	2	4	6	7	9	4	16	13	11	9	9	8	8	9	11	13	14	16	11	
73	62%	9	6	4	3	2	1	1	2	4	6	8	10	4	16	13	11	9	9	8	8	9	11	13	15	17	11	
74	63%	9	6	4	3	2	1	1	2	4	6	8	10	4	16	13	11	10	9	8	8	9	11	13	15	17	11	
75	64%	10	7	4	3	2	1	1	2	4	7	8	10	4	16	13	11	10	9	8	8	9	11	14	15	17	11	
76	65%	10	7	4	3	2	1	1	2	4	7	8	10	4	17	14	11	10	9	8	8	9	11	14	15	17	11	
77	66%	10	7	5	3	2	1	2	2	4	7	8	11	5	17	14	12	10	9	8	8	9	11	14	15	17	11	
78	67%	10	7	5	3	2	2	2	2	4	7	9	11	5	17	14	12	10	9	8	9	9	11	14	16	18	12	
79	68%	10	7	5	3	2	2	2	2	4	7	9	11	5	17	14	12	10	9	9	9	9	11	14	16	18	12	
80	69%	11	7	5	3	2	2	2	2	4	7	9	11	5	18	14	12	10	9	9	9	9	11	14	16	18	12	
81	70%	11	8	5	3	2	2	2	2	4	7	9	12	5	18	15	12	10	9	9	9	9	11	14	16	18	12	
82	71%	11	8	5	3	2	2	2	2	5	7	10	12	5	18	15	12	10	9	9	9	9	12	14	17	19	12	
83	72%	11	8	5	3	3	2	2	2	5	8	10	12	5	18	15	12	10	9	9	9	9	12	15	17	19	12	
84	73%	12	8	5	3	3	2	2	3	5	8	10	12	6	19	15	12	10	10	9	9	10	12	15	17	19	13	
85	74%	12	8	6	3	3	2	2	3	5	8	11	13	6	19	15	13	10	10	9	9	10	12	15	18	20	13	
86	75%	12	9	6	4	3	2	2	3	5	8	11	13	6	19	16	13	10	10	9	9	10	12	15	18	20	13	
87	76%	13	9	6	4	3	2	2	3	5	8	11	14	6	20	16	13	11	10	9	9	10	12	15	18	21	13	
88	77%	13	9	6	4	3	2	2	3	5	8	12	14	6	20	16	13	11	10	9	9	10	12	15	19	21	13	
89	78%	14	9	6	4	3	2	2	3	6	9	12	14	7	21	16	13	11	10	9	9	10	13	16	19	21	14	
90	79%	14	9	6	4	3	2	2	3	6	9	13	15	7	21	16	13	11	10	9	9	10	13	16	20	22	14	
91	80%	14	10	6	4	3	2	2	3	6	9	13	15	7	21	17	13	11	10	9	9	10	13	16	20	22	14	
92	81%	15	10	7	4	3	2	2	3	6	9	13	16	7	22	17	14	11	10	9	9	10	13	16	20	23	14	
93	82%	15	10	7	4	3	3	3	3	6	9	14	16	8	22	17	14	11	10	9	9	10	13	16	21	23	15	
94	83%	16	10	7	4	3	3	3	4	6	10	15	17	8	23	17	14	11	10	10	10	13	17	22	24	15		
95	84%	16	11	7	4	4	3	3	4	7	10	15	17	8	23	18	14	11	11	10	10	11	13	17	22	24	15	
96	85%	17	11	7	5	4	3	3	4	7	10	16	18	9	24	18	14	12	11	10	10	11	14	17	23	24	16	
97	86%	17	11	8	5	4	3	3	4	7	11	17	18	9	24	18	14	12	11	10	10	11	14	18	24	25	16	
98	87%	18	11	8	5	4	3	3	4	7	11	17	18	9	25	18	15	12	11	10	10	11	14	18	24	25	16	
99	88%	18	12	8	5	4	3	3	4	7	11	18	19	10	25	19	15	12	11	10	10	11	14	18	25	26	17	
100	89%	19	12	8	5	4	3	3	4	8	12	18	19	10	26	19	15	12	11	10	10	11	15	19	25	26	17	
101	90%	19	13	8	5	4	3	3	5	8	12	19	20	11	26	19	15	12	11	10	10	12	15	19	26	27	18	
102	91%	20	13	9	6	5	4	4	5	8	13	19	20	12	27	20	15	13	12	10	10	12	15	20	26	27	19	
103	92%	21	14	9	6	5	4	4	5	9	13	20	21	12	27	21	16	13	12	11	11	12	16	20	27	28	19	
104	93%	21	14	9	6	5	4	4	5	9	14	20	21	13	28	21	16	13	12	11	11	12	16	21	27	28	20	

The proportion of time spent working and in WDT is then analysed and can be reported by start date (month), by task, or by groups of tasks if needed. Results are provided for a range of probabilities of occurrence.

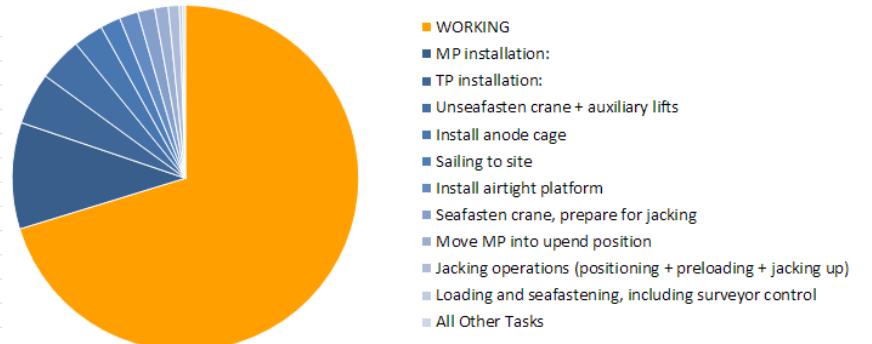


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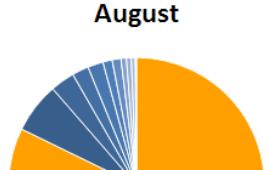
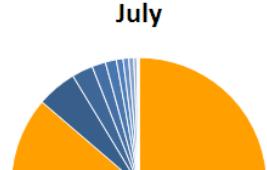
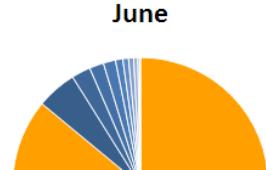
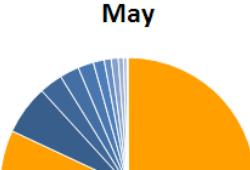
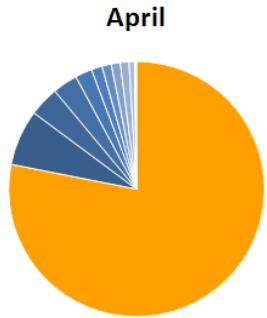
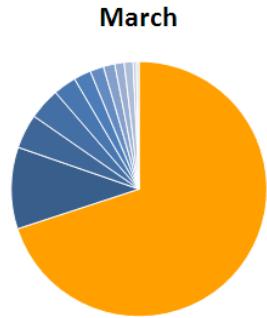
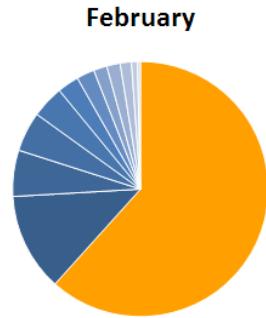
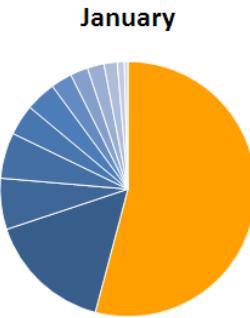
## Top 10 Tasks Contributing to Mean WDT

### All Year

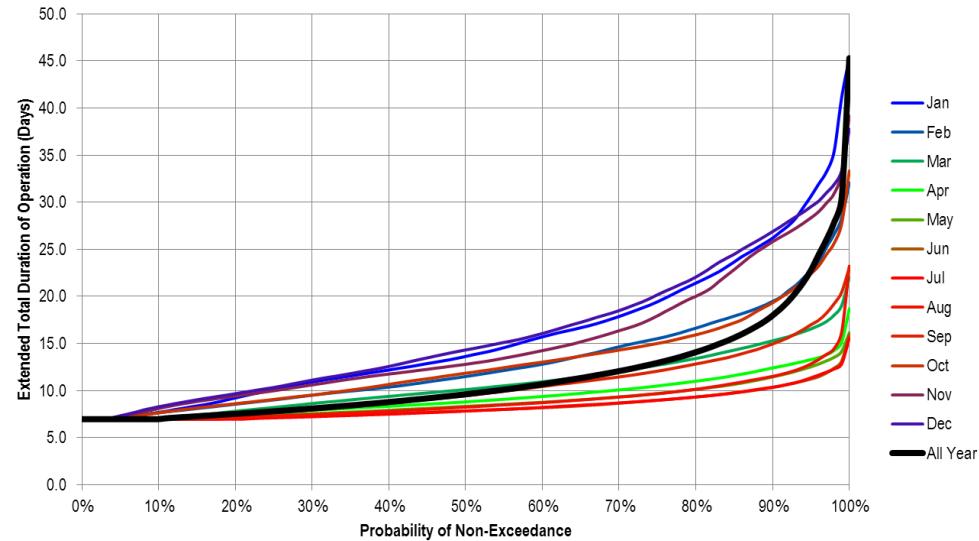
WORKING	70.2%
MP installation:	10.0%
TP installation:	4.8%
Unseafasten crane + auxiliary lifts	4.1%
Install anode cage	2.8%
Sailing to site	1.9%
Install airtight platform	1.7%
Seafasten crane, prepare for jacking	1.6%
Move MP into upend position	1.3%
Jacking operations (positioning + preloading + jacking up)	1.0%
Loading and seafastening, including surveyor control	0.3%
All Other Tasks	0.2%



### By Month



- Planning of future operations **can then account for the additional time and cost likely to be associated with WDT**, for various probabilities of occurrence.
- The same process can be used to **optimise programme and/or cost** by repeating the analysis for alternative vessel / tool / method options.



Consideration of WDT can be beneficial for... e.g.

- **Developers** (to forecast and optimise programme and cost)
- **Vessel and equipment suppliers** (to design/promote more cost effective solutions for clients)
- **Vessel and equipment operators** (to quantify the risk associated with a potential job)



## Thank you for your attention

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