WHITE PAPER

Utilising vessel data monitoring to improve crew safety

Or
“Why bother using data monitoring”

Issued: 10-05-2019

Contents

Dyena Ltd
OVIC Building, Ocean Way,
Southampton, SO14 3JZ, UK

+44 (0) 2380 231 991
info@dyena.com
www.dyena.com

Utilising vessel data monitoring to improve crew safety

In recent years there has been growing acceptance of the need to protect maritime crew from the shocks and impacts received during open water transits. This is evident in the explosion of shock mitigating seating products available and the associated press articles, conferences, and government contracts all based around the subject.

Scientists have been utilising acceleration data logging for many years to research the magnitude of the forces imparted upon the vessel, equipment and occupants. But is it now relevant for vessel operators to use data monitoring?

If it ain't broke, why fix it?

Traditionally vessels are built to withstand their operational environment, based upon previous experience of the conditions they will encounter and the limits the human occupants can withstand.

However, with the latest shock mitigation technology we can now drive vessels harder and faster. In the past, an impact of 5g (five times the Earth's gravity) may have caused the crew to slow down, but now with suspension seats they may feel comfortable to travel whilst the vessel is receiving impacts of 10g.

As well as the obvious increased stress on the hull, this now means that anything fitted within the vessel is facing double the impact loads. Engine mounts that previously supported the weight of the powertrain, may no longer absorb the load placed on them and damage the engine.

Benefits of using data recording

Monitoring speed and impact forces on the vessel and its occupants can enable an operator to protect their investment and better forewarn the crew if they are approaching safe operational limits. The data can be used in real-time as a live display or recorded to memory to be studied later. Some companies follow a proactive approach, planning better operations based upon the results, whilst others may only look at the data following an incident to understand the cause and learn for the future.

Informing the crew?

Whilst having a display showing that severity of each shock seems an obvious solution, this is often not the best tactic. The people onboard the boat already know about the last impact; as they felt it. Travelling on water always includes a risk of encountering an unexpected wave or wake from a passing boat. To slow down or cease operations because of a singular event is not practical.

A better solution is to alert the crew when the frequency of large impacts increases. If the vessel is encountering repeated high forces then the conditions may have changed and slowing down may be more relevant.

For example, if the boat receives 10 impacts over 5g in 10 minutes, then an amber warning light can be raised. However, if 4 impacts of 8g in 1 minute are encountered, then a red warning can be shown to require an immediate reduction in speed.

This also discourages the user from “driving to the lights”, using the display as indication of acceptable performance. They attempt to keep the vessel as close to the limit as possible, placing the crew at increased risk.

Seat monitoring

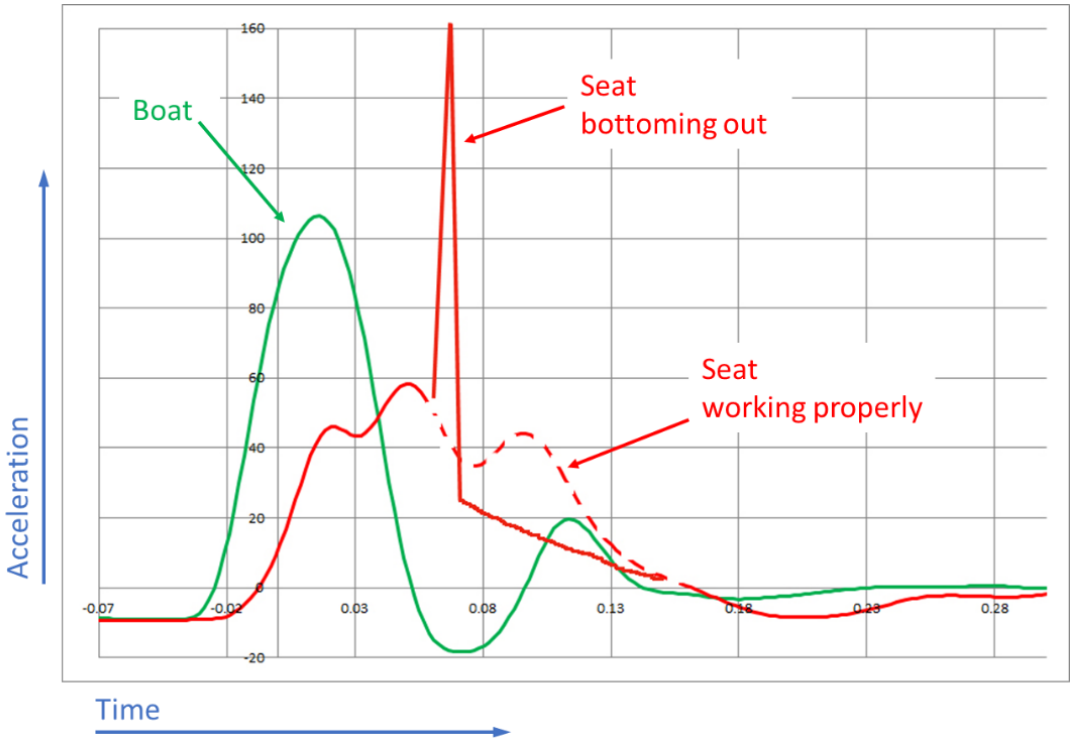
Shock mitigating seats bring an immediate benefit in protecting the crew, but they need to be setup correctly and serviced. There are many different versions of seats on the market, some suitable for slow speed recreational use, others designed for the most extreme SAR vessels. Some designs have features to protect from side impacts, some are designed to better absorb longitudinal impacts when stuffing the bow into a wave.

The common factor in all designs is the importance of never “bottoming out” the suspension system. This is when the displacement of the seat during motion reaches the physical limits of its design. This can be the shock absorber becoming fully compressed, the mechanical linkage jamming or maybe the seat colliding with the structure of the boat.

It's not the fall that hurts

All shock mitigation technologies work by expanding the time over which energy is applied to the body, and in doing so reducing the maximum force received. Bottoming out causes the motion of the seat to come to a sudden stop, causing a large increase in the deceleration of person in the seat. To steal an old phrase, "It's not the fall that hurts, but the sudden stop."

When a seat bottoms out, all the remaining energy is transmitted into the body in single instance, potentially to the level that they would have been safer if sitting on the solid deck of the boat without any seats.



Are my seats working?

The performance of seats can be monitored in two principles ways.

Firstly, measuring the accelerations received by the occupants. This allows the operator to monitor the actual impacts received by the crew to ensure that they are properly protected. By comparing these impacts against those of the boat deck it also shows the reduction in shock exposure the seats provide.

Secondly, the displacement of the seat can be monitored, and by knowing the maximum travel in the suspension linkage, used to determine if an occupant is at risk of bottoming out. By comparing the accelerations measured on the seat against the displacement, the condition of the suspension can be determined.

The accelerations and displacement can be used in live display to inform if a crew member is receiving harmful impacts or is close to the limit of travel for their seat. If the coxswain is in a more comfortable position within the vessel, or has a better seat setup, they may not realise the discomfort or danger experienced by others.

Employer Responsibility

There is a distinct line of responsibility between the MAIB, MCA and HSE, but it would be shaky ground for an employer to claim that the HSE requirements are not valid because their staff were placed at risk when onboard a vessel beyond the confines of the marina wall.

> **"**It is an employer's duty to protect the health, safety and welfare of their employees and other people who might be affected by their business.
>
> Employers must do whatever is reasonably practicable to achieve this."
>
> **Health and Safety Executive**

What is a thrill to a young coxswain may be considered an unnecessary risk to his fellow crew or passengers. On land, monitoring of company vehicles is becoming increasingly standard to ensure that they are driven appropriately, and this will surely soon filter into the marine environment.

Monitoring the speeds, driving style and accelerations onboard the vessel can help distinguish between legitimate wear and tear from rougher weather or inappropriate driving with increased fuel costs and stress on components.

It's not all about shocks, impacts and WBV

Data monitoring is more than just recording who got hit the hardest; other inputs can bring additional benefits. GSM and satellite communications can be added to provide live or regular updates. For example, fishery authorities can monitor the position of their fleet, ensuring they are not fishing in prohibited areas.

For wind farm operators, sensors can measure the vertical displacement of the bow to inform the skipper if it is safe for crew to transfer to the offshore pylon. The push-on force can be measured to ensure that there is adequate friction between the bow and the pylon; reducing the need to keep engines on full power.

Crew tracking can be incorporated to keep a record of who was on the boat for each voyage. Advanced systems can also record which seat they were using. This will then allow an organisation to retrieve the relevant data for that employee across all the vessels they have used to produce a singular record of the impact exposure during their career.

If a solo fisherman falls overboard, a MOB facility will recognise that they are no longer within range of the boat, sending a distress signal with the last known coordinates. This will also work with pets, children and, if you wish, marital partners.

A picture is worth a thousand words

A video camera used in conjunction with the monitoring solution provides valuable information when evaluating the facts of an incident. A view showing the helm and the water in the same shot will allow you to discern the sequence of events. For example, did a wave strike the boat first? Did the coxswain turn into the wave in time? Were the engines throttled up or down?

© GoPro

You do not need a camera network connected to a video recorder. These days a cheap camera on a bracket mounted to the vessel and pointed in the correct direction will provide hours of HD quality footage. Many cameras now come with options to only record when motion is detected and continuously recycle the memory to always capture the latest incidents.

Correlating the video camera with the vessel data when trialling equipment can be very useful. For example, if testing engine mounts a synchronised video will demonstrate the deformation of the mount at different vertical accelerations. If there is a breakage, the exact impact force that caused it can be determined.

Don’t over complicate

A distinction can be drawn between the data logging requirements of scientist tests versus those of long-term monitoring. As a naval architect I would want multiple sensors collecting raw data at a high frequency so that all events are captured in minute detail allowing me to filter or analyse the data in many ways.

This would be expensive, need a trained technician to install, and the duration of data storage would be limited. The data would need to be downloaded daily, prepared and then analysed.

The users whom this article is aimed at do not need this level of detail. Their priorities are an extended recording duration, clarity on the peak impacts and sufficient information to investigate the circumstances surrounding any incidents.

Suitable data monitoring products measure the accelerations on the vessel at a minimum of 500 times a second, filtering and processing the results on-the-fly to store the peak values at least once per second. This provides useful data whilst pushing the recording duration to over a year, allowing the operator plenty of time to download information.

It may pay for itself

As already discussed, shock mitigating technology is allowing boats to go faster and harder, increasing stress and risk of accident. The fast boat builders are now fitting impact monitoring systems to protect themselves from future warranty claims caused by the vessel being driven beyond the structural limits or the skipper's skill level.

In the event of an incident the data can be used to distinguish between genuine claims or damage caused by inappropriate driving, or by overlaying the course on a chart, perhaps a collision with a fixed object.

This is not a new clandestine tactic. For many years, car manufacturers have been recording data within the ECU to protect themselves from dishonest customers who may claim the gearbox "just fell apart at the traffic lights" but omitted the fact they had changed from 6th gear to 2nd gear on the motorway.

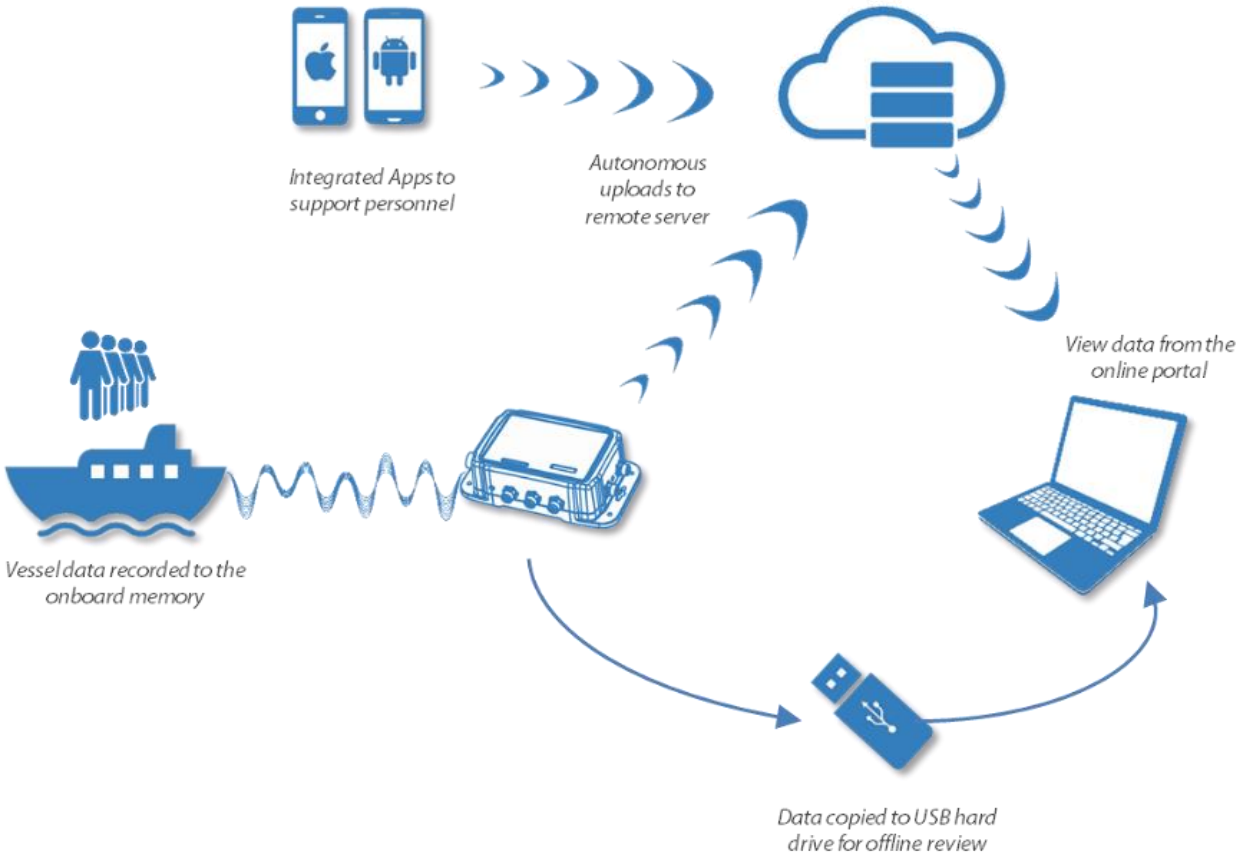
Hands free

Data logging for race teams or scientists is simple. Have your dedicated technician install and setup the equipment, download the data after every transit and prepare it for review.

In the real world this isn't going to work. For long term data monitoring to be practical, it needs to operate autonomously, require minimal input to setup or view data, and not have any daily requirements from the, already busy, crew.

Systems are now available that, alongside the afore mentioned vessel and seat data, will automatically record the crew onboard the vessel for each transit and which seat they in, uploading all data to a remote server for review from anywhere in the world, without any interaction from the crew.

With a smartphone app, the crew can provide routine feedback on their health and fitness, fill in incident reports, inform the HQ of any damage and order spare parts, all whilst working remotely away from a line manager.



Where to start

Marinised solutions are available to suit different requirements and budgets. Some incorporate all the features mentioned above, others may provide data in different resolutions or require more human intervention. There are entry level systems that just need power to begin operating and can be upgraded later if the organisation wants to add more beneficial features.

For further information, contact James Glover, Managing Director at Dyena, which specialise in maritime monitoring systems.

About the Author

James Glover - Managing Director, Dyena Ltd

A naval architect and design engineer with over 20 years experience in automotive, motorsport and high speed marine craft design with technical skills focused around mechanical, hydraulic and electrical system design.

Before forming Dyena, James was Head of Engineering Design for a high performance powerboat company, focusing on defence and commercial high speed craft design.

Since releasing its original device in 2012, Dyena has continued to advance its vessel monitoring systems, alongside the likes of the RNLI, and whose clients include government agencies including the Royal Navy, US Navy, and commercial wind farm operators such as EON and RWE.

Contact details:

jamesglover@dyena.com

www.dyena.com