BOSTON CONSULTING GROUP

Reducing discharge of nutrients at ports

2020-10-30

RACE FOR THE BALTIC

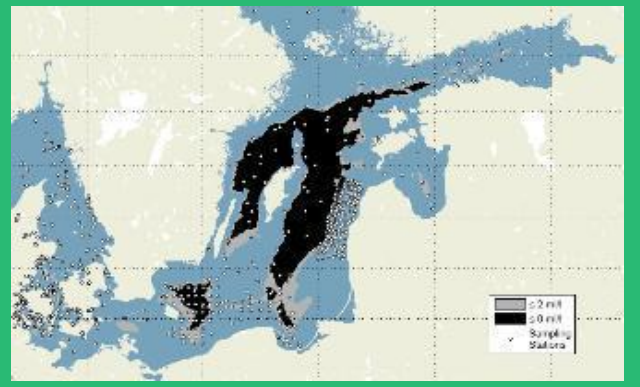
The Baltic Sea - One of the world's most polluted Seas

The Baltic Sea is one of the world's most polluted seas and has a dead zone twice the size of Denmark

More than 80 000 km² suffer from hypoxia or anoxia, making it arguably the largest environmental problem in the region

Of the various environmental pressures on the Baltic Sea, eutrophication (caused by an excess of nitrogen and phosphorus) has by far the largest impact on the Baltic Sea ecosystem

Increased algae blooms in the Baltic Sea, 2010 (BBC)



Large dead zones in the Baltic Sea, 2018 (SMHI)

Source: SMHI; European Space Agency; BBC; Greenpeace International, "The Baltic Sea, A Roadmap to Recovery"; Baltic Sea Impact Index, Naturvårdsverket "Eutrophication of Swedish Seas"

Poor handling/transport of dry bulk mineral fertilizers could contribute subsantially to the eutrophication of the Baltic Sea

More than 45 million tons of fertilizer pass through the ports of the Baltic Sea annually...

Ports in the Baltic Sea shipping fertilizers

Relative volume of fertilizer shipping per harbor

..and even if a small percentage of the dry bulk cargo is lost, this could have large impact on the surrounding environment

5,000t

phosphorus fertilizer in one shipment

2.5 t (0.05% of cargo)

of spillage produces

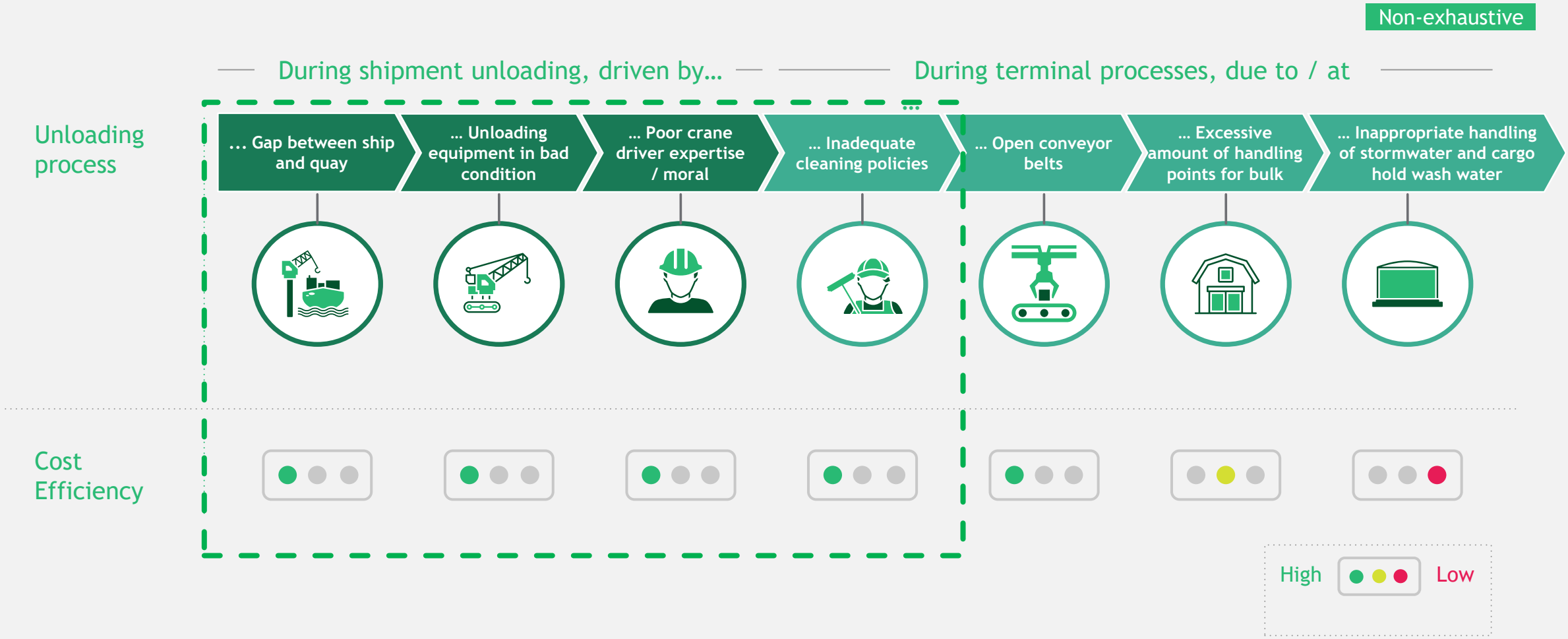
125 t

of algea blooms to grow

Note: Report (Dry bulk cargo shipping — An overlooked threat to the marine environment?) indicates that a spillage of 0,05% of the dry bulk cargo can be lost when transported at sea. This would equal 2.5 tons of fertilizer for a 5000 ton ship. Assuming the P content of fertilizer is 5%, this means that 125kg of phosphorus is lost. If it ends up in the sea, this is enough to generate 125 ton of algae.

The magnitude and effects of fertilizer spillage into the sea is mainly driven by shipment unloading activities

Non-exhaustive

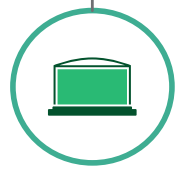


Source: Industry interviews

Luckily there are ways to avoid / minimize spillage

During shipment

During terminal

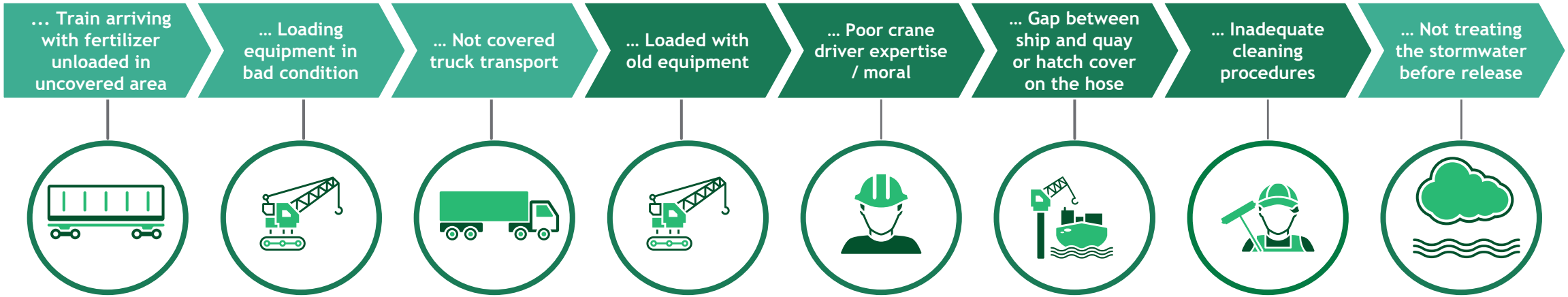
… Gap between ship and quay	… Unloading equipment in bad condition	… Poor crane driver expertise / moral	… Inadequate cleaning policies	… Open conveyor belts	… Excessive amount of handling points for the bulk	… Inappropriate handling of stormwater and cargo hold wash water
						
Minimize gap between ship & quay and / or **protect gap** to avoid spillage into the water	Ensure clamshell bucket **equipment is in good condition** (by investing in high-quality equipment & ensuring proper maintenance) to avoid spillage. Alternatively investing in a completely closed system (e.g. bucket chain unloader, vertical screw unloader)	Crane operator has to be **well trained in how to operate the crane** (e.g. understanding of maximum load & distance from clamshell to hopper at discharge) and have adequate information about the conditions.	Ensure that staff is trained and has the **adequate equipment and facilities** to collect residues[1] .	Make conveyor belts as **short** as possible, ensure **correct slope** of belts, **minimize number of switching points,** and **regularly changing dust filters**. Shorter belts also imply lower electricity costs[3]	**Minimize bulk handling** (i.e. ensure early bagging) due to higher amounts of spillage. Delivering & handling bulk at farm level is in total also more costly than delivering bags	Ensure that you have a PRF to store the cargo hold wash water before this is sent to a treatment facility. For the stormwater, this needs to be treated in the same way, alternatively add filters in the outlets to catch P and N.

Port example of up to 65% spillage reduction[2]

1. For example, larger terminals might rent a sweeper after unloading and for smaller terminals, an employee can take care of it continuously
2. Assuming that the unloading equipment was already in a good condition.
3. Source: Industry interviews

There is also a significant spillage at loading ports driven by a number of factors...

Non-exhaustive



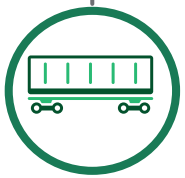
During shipment loading

During terminal process

Source: Industry interviews

There is also a significant spillage at loading ports driven by a number of factors...

Non-exhaustive

… Train arriving with fertilizer unloaded in uncovered area	… Loading equipment in bad condition	… Not covered truck transport	… Loaded with old equipment	… Poor crane driver expertise / moral	… Gap between ship and quay or hatch cover on the hose	… Inadequate cleaning procedures	… Not treating the stormwater before release
							
Make sure that the train wagon is unloaded in a closed system with dust control.	Ensure clamshell bucket **equipment is in good condition** (by investing in high-quality equipment & ensuring proper maintenance) to avoid spillage.	Cover the truck transports with tarpaulins to avoid dusting. Alternatively invest in covered conveyor belts transporting the fertilizer.	Invest in a telescoping loading chute, screw-type loader or aeroslide loader (i.e. a closed ship loader instead of a grab crane).	Crane operator has to be **well trained in how to operate the crane** (e.g. understanding of maximum load & distance from clamshell to ship) and have adequate information about the conditions.	**Minimize gap** between ship & quay and / or **protect gap** to avoid spillage into the water. If a loading chute: put a hatch cover on the hose opening (also enables loading in rainy weather).	Ensure that staff is trained and has the **adequate equipment and facilities** to collect spillage[1]	Filter systems in the wells/outlets for the stormwater. Alternatively collecting it in a tank and delivering it to a third party.

1. For example, larger terminals might rent a sweeper after unloading and for smaller terminals, an employee can take care of it continuously 2. Conveyor belts are tilted at the start 3. For example, one port reduced their electricity costs by 80% by shortening the conveyor belt from 2000m to 250m. Source: Industry interviews

During shipment loading | During terminal process

4 main areas to focus on to reduce spillage

Gap between ship and quay

Minimize the gap between ship and quay to reduce leakage

Unloading equipment in bad condition

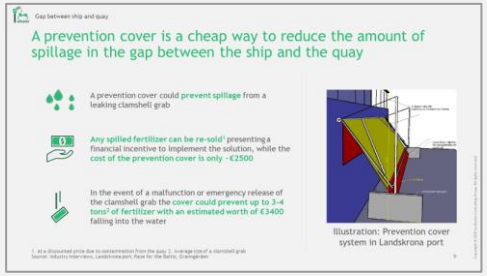
Make sure unloading equipment is upgraded regularly

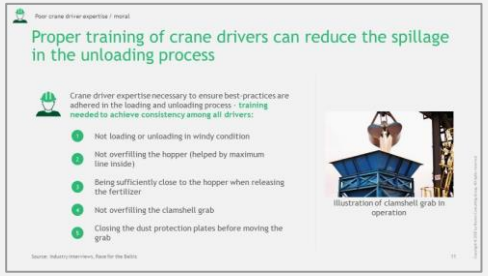
Poor crane driver expertise / moral

Require sufficient training or crane drivers

Inadequate cleaning policies

Make sure to enforce stricter cleaning procedures



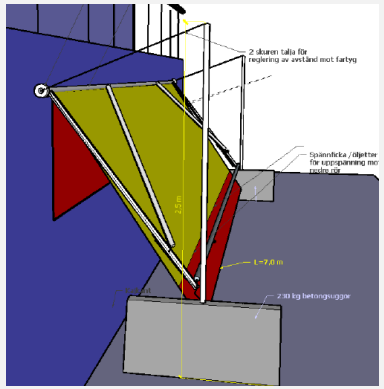


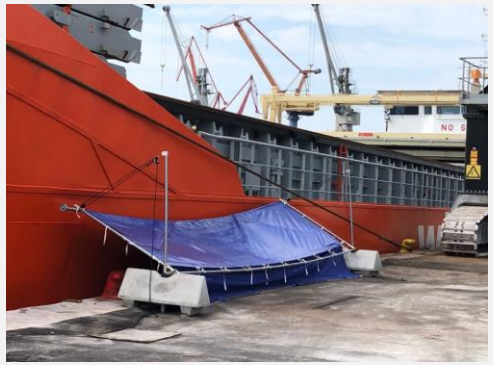
A prevention cover is a cheap way to reduce the amount of spillage between the ship and the quay

A prevention cover could **prevent spillage** from a leaking clamshell grab

Any spilled fertilizer can be re-sold[1] presenting a financial incentive to implement the solution, while the **cost of the prevention cover is small**

In the event of a malfunction or emergency release of the clamshell grab the **cover could prevent up to 3-4 tons**[2] **of fertilizer with an estimated worth of €600-800**[3] falling into the water





Efforts have to be followed by adequate cleaning policies

1. At a discounted price due to contamination from the quay 2. Average size of a clamshell grab in a smaller unloading fertilizer port in the Baltic Sea 3. At original price of €200/ton
Source: Industry interviews, Race For The Baltic; Granngården

Updating the clamshell grab can results in a 7x higher effectiveness

Spillage can amount to ~350 kg if clamshell bucket is in bad condition, compared to a maximum of ~50 kg if equipment is in good condition, implying a **~7x higher effectiveness**

Repairing or changing the clamshell grab can **cost between €5000 and €40000**

Additional updates to consider are **dust protection plates** that can close the open top part of the clamshells to reduce spillage (~€5000)

Changing and sharpening the outer metal part of the clamshells can make the grab close more tightly (~€6000)

Old clamshell grab

New clamshell grab

Source: Industry interviews, Race For The Baltic

Proper training of crane drivers can reduce the spillage in the unloading process

Crane driver expertise necessary to ensure best-practices are adhered in the loading and unloading process - **training needed to achieve consistency among all drivers:**

1. Not loading or unloading in windy condition
2. Not overfilling the hopper (helped by maximum line inside)
3. Being sufficiently close to the hopper when releasing the fertilizer
4. Not overfilling the clamshell grab
5. Closing the dust protection plates before moving the grab

Illustration of clamshell grab in use

Source: Industry interviews, Race For The Baltic

Simple cleaning routines with considerable positive effects

- Ensure that the **wells/outlets in the port for stormwater are covered** when unloading and loading or remove if possible
- **Do not use water** in the cleaning and **use a machine with a vacuum function**
- Make the surface as smooth as possible, **remove rail tracks** if they are no longer in use
- **Avoid driving vehicles in the area** during loading/unloading to avoid spreading the dry bulk fertilizer
- **Clean on a regular basis** – several times during the loading/unloading
- Very important to **clean prior to rains**

Illustration of cleaning machine

Source: Industry interviews, Race For The Baltic

There are plenty of effective solutions in the market today

1

Many cheap solutions such as **regular cleaning, prevention covers and ensuring adequately informed operator** can have a great impact on reducing spillage in the ports

2

More costly investments such as **changing to a new clamshell grab, maintenance of the grab or upgrading to a closed system** are also easy to justify thanks to their short pay-back time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