

TOWARDS THE MOST SUSTAINABLE DREDGING FLEET IN THE WORLD

Detailed Proposal for the WACA Call for Innovation:
Development of West Africa's ports and coastal areas

Thematic Challenge 3





ROYAL IHC

P.O. Box 1, 2960 AA Kinderdijk
6, Smitweg, 2961 AW Kinderdijk

www.royalihc.com

World Bank Group
WACA West Africa Coastal Areas Management Program

DATE **REFERENCE**
30 August 2020

SUBJECT
Sustainable African Dredging Capacity

To whom it may concern,

With great honour we noted that our expression of interest has been longlisted. We see this as a confirmation of our African business strategy, we do not just want to be an equipment supplier, but we want to make a difference by making a substantial contribution to the sustainable development of local capacity.

As we emphasized in our earlier proposal, dredging will play a vital role in laying the foundation for the development of West Africa. Port maintenance is important and the sustainable development of coastal protection is vital. Dredging plays an essential role in both.

The relatively old dredging fleet (operated mainly by international contractors) offers great opportunities. We see a future in which this fleet will be replaced by vessels with higher efficiencies, for instance by using our Low Emission Adaptive Fuel (LEAF) technology, managed and operated by local West African contractors. These vessels are designed for minimal energy consumption and are adaptable to clean types of fuel. This will make a significant contribution to the reduction of CO₂ footprint in West Africa.

We believe this is the only way forward for both the development of sustainable local dredging capacity and a profitable future for IHC in West Africa. Therefore we are highly enthusiastic and excited to put energy into making sure that, through lease and operate models, the LEAF technology will be available in such a way that this will be a great stimulus for the development of local capacity.

We appreciate this opportunity to continue demonstrating our thoughts and sharing our knowledge with the World Bank and Africa.

Yours faithfully,
IHC Holland B.V.

A handwritten signature in blue ink, appearing to be 'Gerben Eggink', is written over a horizontal line.

Gerben Eggink - Chief Executive Officer
Royal IHC



DESCRIPTION OF THE APPLICANT

Name of lead organization

Name: **Royal IHC**
Street: Smitweg 6
Postal code: 2961 AW
City: Kinderdijk
Country: The Netherlands

Contact details

Name: Bas Kockmann
Function: Sales Manager Africa
Call Work: +31880153862
Call Mobile: +31622867264
Email: b.kockmann@royalihc.com



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1 TOWARDS THE MOST SUSTAINABLE DREDGING FLEET IN THE WORLD

This detailed proposal consists of five chapters. In Chapter 1, as follows below, a short recap is given of the application document as send from Royal IHC to the World Bank on June 30th, 2020. Chapter 2 gives an overview of different types of dredging works. A situation analysis of actual dredging activities in West Africa is given in Chapter 3. This is followed by Chapter 4, in which the LEAF-Hopper concept is described in more detail. The final chapter, Chapter 5, gives detailed information of the Lease and Operate model.

Introduction

Royal IHC would like to promote a new lease and operate business model as a basis to upgrade the Dredging Fleet of West Africa to the most green and sustainable fleet in the world. West African Ports, Investors and Authorities currently rely on an aging and polluting dredging fleet for maritime developments, port and access channel maintenance, and coastal protection. The only other alternative is to contract international Dredging Contractors, which means that money is not invested in the national economy.

The LEAF-Hopper concept

In the Research & Development program of IHC for trailing suction hopper dredgers (TSHD's), optimizing cost-efficiency and minimizing environmental impact has been the focus for many years. Currently, the concept of Low Energy Adaptive Fuel (LEAF) hopper is being developed. These vessels are designed for minimal energy consumption and are adaptable to clean future fuels. With actual bunker infrastructure in West Africa being set for a general overhaul, we foresee that West Africa can leapfrog into the transition to green fuels.

Lease and Operate model

Although TSHD's require a large investment, the capital investment can be made accessible by a new business model replacing the classic employer-contractor model with a lease and operate model. A consortium of public private parties invest in the acquisition of new equipment through a Special Purpose Vehicle. Several Investors such as Operators and Equipment Suppliers can join forces and share the capital investment.

Conclusion

Through Lease and Operate models, the acquisition of the cleanest generation of TSHD's can be made accessible for the Western African region. The local dredging fleet is upgraded and expanded to the greenest and most sustainable fleet in the world. The region will save costs by becoming less dependent on International Contractors and drastically reduce its environmental footprint.



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2 INFLUENCE AND IMPACT OF DREDGING WORKS IN WEST AFRICA

2.1 DREDGING FOR PROSPERITY

As part of coastal infrastructural improvements, dredging contributes greatly to the development of the economy of many countries. By opening access channels and maintaining waterways and ports, it opens countries both internally and externally. It is also essential in countering erosion of coastlines and by building sea defenses that shelter and protect population and economic activity. There is an increasing need for dredging in many applications, both large and small, in either capital or maintenance works in order to comply with development demands. In this respect, we can conclude that dredging is vital for economic growth of the West African region.

Port Development

Growing global trade has led to an increase in maritime transport. In order to accommodate this growth in international shipping and ever larger vessels, new ports are being constructed around the world and existing port infrastructure is being expanded. Dredging activities for port construction and expansion include the creation of access channels, berthing places and turning basins, reclaiming land for yard and terminal activities, and the deepening and widening of existing waterways.

Land reclamation

The overall growth in the global population and the trend of migration towards coastal areas has led to a huge rise in the number of land reclamation projects. Industrial sites, residential areas, ports and airports are increasingly expanding in the direction of the coast and water. The dredging process uses sand, clay or rock from the seabed to create new land. Many land reclamation activities are combined with projects for deepening of ports and access channels, since the reuse of the dredged materials for adjacent jobs may reduce the total costs.

Maintenance Dredging

Ports and estuaries are continuously exposed to siltation. Tidal movements deposit sand and silt in port basins and waterways. Rivers also carry sediment in their flow, which tends to settle in the deltas. Due to this natural phenomena, the water depth gradually decreases. In order to safeguard a constant navigable depth, maintenance dredging is required.

Coastal protection

Coastal protection is an essential process to provide a defense against flooding and the erosion of land caused by waves, tides, currents and wind. The trend of migration towards coastal areas, rising sea levels and climate change will further increase the need for coastal defense. Beach re-nourishment and dike construction are some examples of coastal protection works. Both require the recovery and transportation of large volumes of sand.

Aggregate dredging

Aggregate dredging is deployed to collect sand or gravel from onshore or offshore locations. These marine aggregates are the raw ingredients for building materials such as concrete. The specific sand and gravel types used for concrete production can be found in rivers and offshore deposits. With the increase in the global population, the demand for construction aggregates is also increasing.



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3 ACTUAL DREDGING ACTIVITIES IN WEST AFRICA

In the following paragraphs, insight will be given in the actual impact of dredging activities in West Africa. This will then allow us to present the environmental and societal gains that can be achieved by developing capacity at local Port Authorities and Contractors through Lease and Operate models.

3.1 RECENT DREDGING PROJECTS

Over the last decade we have seen a rapid development of population and economic activity along the West African Coast. The need for coastal improvement works has never been as high in order to keep up with this growth. Simultaneously, sea level rise and erosion pose an increasing threat making coastal interventions unabatingly urgent. We see this reflected in the number of dredging works in the region. Since 2009, IHC has recorded about 77 completed dredging works in West Africa. The future outlook remains high with 18 ongoing projects and 12 planned works. The information is represented in Figure 3.1 below, whereas the number within the circles represents the total number of dredging projects (per country). More detailed information with respect to coastal protection works in the WACA target countries, can be found in Appendix A.

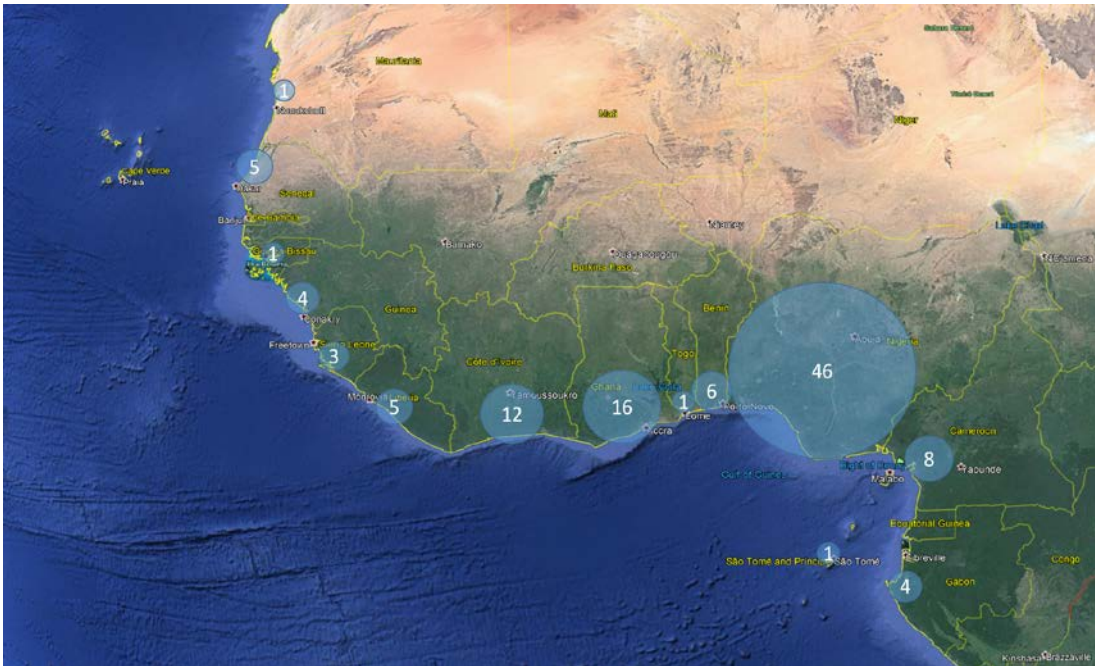


Figure 3.1: Number of dredging related projects per country in West-Africa since 2009

We see that the projects relate to land reclamation, beach nourishment, shoreline protection and coastline care. These works are vital to protect populated areas from flooding and erosion as well as sea level rise.

An illustrative project showing how dredging brings back life to a community is the ongoing restoration project of the beaches of Saly, Senegal (more details can be found in Appendix A). This World Bank funded project started in 2017. Due to erosion the beaches almost completely disappeared at Saly. This severely hampered the fishing industry and affected the tourism industry. With the beaches being restored in their former state, the local community can pick-up their livelihood again as fishing activity and tourism will return to the region in the coming years.

3.2 WEST AFRICAN DREDGING FLEET

In Table 3.1, an overview is given of the top 10 most active dredgers in the first half of 2020. The vessels are sorted by time active. We roughly see the same vessel activity in 2019 along the West African coast.

What strikes is the age of the vessels. With an average of 27 years, the ten most active dredgers in West Africa are old. We even see that 3 dredgers, of the 10 most active vessels in the first six months of 2020, are even over 40 years old. Moreover, these vessels are very energy inefficient and have a large environmental footprint.



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Table 3.1: Overview of the 10 most active vessels in West Africa in the first six months of 2020

	Vessel Name	Company	Volume [m ³]	Installed power [kW]	Age [years]	International / Local
1	Poseidon I	Ekohidrotechnika Latvia SIA	4,696	7,513	47	International
2	S.D. Gumel	Nigerian Ports Authority (NPA)	2,500	2,871	23	Local
3	Sea Lion	Nigerian Ports Authority (NPA)	4,000	600	45	Local
4	River Chalawa	Nigerian Ports Authority (NPA)	750	1,370	24	Local
5	Hang Jun 4012	CCCC Dredging	4,200	10,571	14	International
6	James Ensor	Jan de Nul	3,600	7,349	40	International
7	Marieke	DEME	5,600	6,776	15	International
8	Kaishuu	Jan de Nul	16,500	24,300	18	International
9	Breughel	DEME	11,650	10,890	9	International
10	Dravo Costa Dorada	Van Oord	2,548	4,271	33	International
		Average:	5,604	7,651	26.8	

African contractors and African Port Authorities have difficulties to obtain the funds required for investing in upgrading their dredging fleet. Despite the healthy prospects for ‘local players’ given the steady high need for marine works in the region, without being able to make the investment, there is no business model. The alternative, unfortunately, is either to use less efficient (second-hand) equipment or hire, at a high cost, dredging capacity from international dredging companies and consequently seeing money leave the country.

Fortunately, the investment in these new vessels can be made accessible by a different model replacing the classic employer-contractor model by a Lease and Operate model. This finance solution practically converts CAPEX into OPEX for the operator. We will detail this model further in Chapter 5.

3.3 ENVIRONMENTAL FOOTPRINT OF DREDGING WORKS AND ACTIVE VESSELS

In the past years, many improvements has been implemented in the efficiency of (dredging) vessels. Based on our experience the efficiency increase is estimated to be up to 20% in the past 20 years. In the next 20 years, a further efficiency increase of 20% to 30% is expected, see Chapter 4. An increase in efficiency results in a decrease in fuel consumption. When less fuel is consumed, less pollutants are emitted in the atmosphere.

Besides the energy saving improvements and cleaner engines, insight through digitalization has proven to be of added value in dredging processes. Dredging cycles can be analyzed and conclusions can be drawn on its performances. With this data, crew and operators can learn how to improve their dredging strategy and find the most optimal working method, which in turn leads to another substantial improvement in efficiency. Training of the crew, which is part of the Lease and Operate model, provides added value to this (see Chapter 5).



4 A NEW GENERATION OF DREDGING VESSELS

Together with the Dutch government (Rijkswaterstaat) IHC established an innovation partnership focused on the reduction of emissions of coastal protection works, while maintaining cost-efficient price levels. For this program, IHC developed the concept of the Low Energy Adaptive Fuel (LEAF) hopper. This concept represents a new generation of dredging vessels that will be able to perform dredging operations with significant lower emissions. The main goal is to perform coastal protection works with the lowest emissions possible and in a cost-effective way. This is seen as a valuable solution for West Africa.

4.1 THE LEAF-HOPPER CONCEPT

As a starting point, the LEAF-Hopper concept is designed in such a way that energy consumption, and therefore emissions, of the ship are reduced and minimized as much as possible. The goal is to minimize the energy consumption per volume of sand (kWh/m³) significantly. All sorts of cost effective energy saving measures are taken to reach this goal. A life cycle performance assessment helps to get insight in the environmental impact of a trailing suction hopper dredger in its life cycle.

4.1.1 Life Cycle Performance Assessment

Royal IHC was part of the EU-funded JOULES project which resulted in the development of, amongst other, the Life Cycle Performance Assessment tool (LCPA-tool)¹. It can evaluate the environmental performance of different designs of trailing suction hopper dredgers in an early stage. The LCPA-tool calculates six key performance indicators:

- Global warming potential
- Acidification potential
- Aerosol formation potential
- Cumulative energy demand
- Eutrophication potential
- Net present value

These KPI's can be calculated over the life time of the LEAF-Hopper concept, which gives insight in the environmental performance. An example of a life cycle analysis² of a trailing suction hopper dredger is given in Figure 4.3, where it can be seen that fuel consumption contributes 99% to the total impact. In the phase of 'usage', the biggest reduction in terms of environmental impact can be made. Minimizing the energy consumption relates directly to this, which is one of the design approaches of the LEAF-Hopper, as explained in the following.

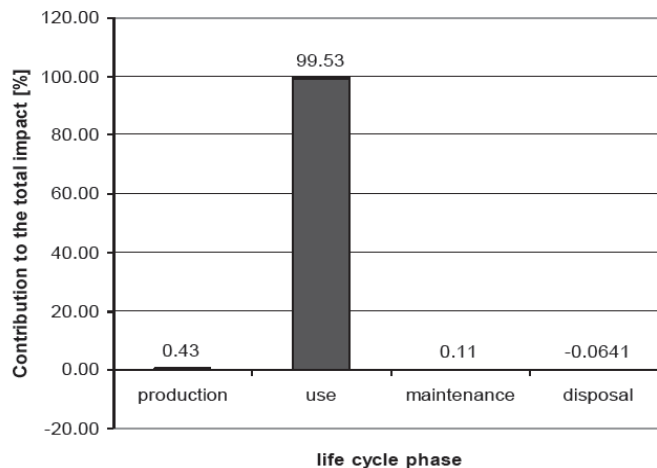


Figure 4.1: Environmental impact of the life cycle of a trailing suction hopper dredger

¹ *Designing the zero emission vessels of the future: Technologic, economic and environmental aspects* [B. Mestemaker, et al., International Shipbuilding Progress 67 (2020) 5-31 DOI 10.3233/ISP-190276, IOS Press]

² *Using Life cycle analysis methodology to assess the sustainability of dredging equipment and its manufacturing processes* [M.B.G. Castro, et al., CEDA Dredging Days 2011: Dredging and Beyond, Rotterdam, the Netherlands – Proceedings]



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4.1.2 Design approach

First, the energy consumption of a trailing suction hopper dredger in its working environment should be analyzed. Four different stages in a hopper cycle can be considered, being; loading, sailing full, offloading and sailing empty. When the time of each stage in the cycle and the amount of energy consumed are known, an optimization can be made towards minimal energy consumption. This could either be done in variation on the installation (capacity) or the usage of new equipment. An impression of the (first) design is given in Figure 4.1.

The LEAF-Hopper will initially rely on diesel fuelled internal combustion engines. Due to less installed power, the fuel consumption and thus the environmental footprint will be reduced significantly. Additionally, the latest available energy saving technologies (see Figure 4.2) are implemented. We like to call this state of the art vessel the Low Energy Hopper (LE Hopper). It is ready for fabrication today. In the next stage, the vessel is made ready for using clean alternative future fuels and so reduce the emissions and environmental footprint even further. With its adaptive power source, the vessel is now the Low Energy Adaptive Fuel Hopper (LEAF Hopper).



Figure 4.2: Impression of the design of the Low Energy Hopper

4.1.3 Energy saving measures

In order to reach the lowest energy consumption per volume of sand (kWh/m³) several energy saving measures are taken. An overview of possible energy saving measures can be seen in Figure 4.3.

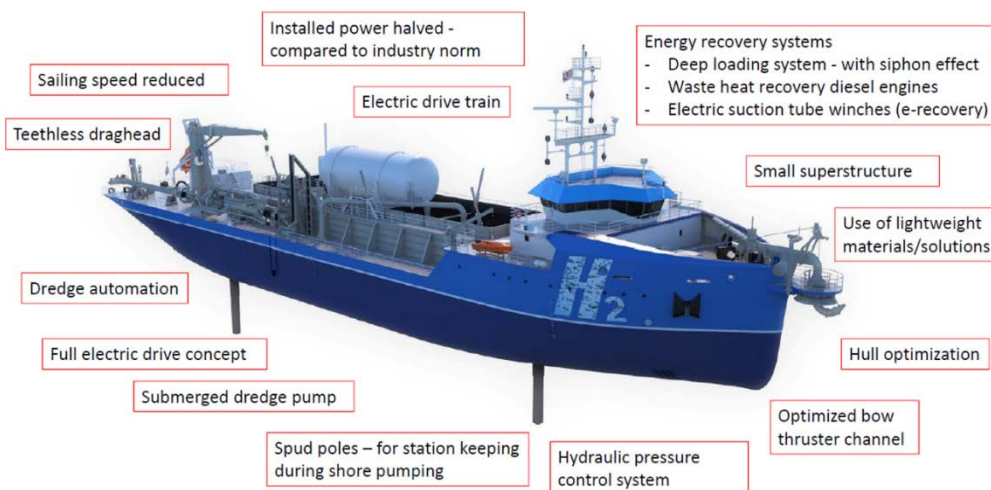


Figure 4.3: Energy saving measures of the LEAF-Hopper concept



4.1.4 Adaptability to a green future fuel

The LEAF-Hopper concept is made adaptable to different types of fuel. Fossil diesels, like Heavy Fuel Oil or Marine Diesel Oil, are the current standard fuels in the maritime industry. These fuels emit harmful exhaust gases, like sulphur and nitrogen emissions, and contribute heavily to Green House Gas emissions. Alternative fuels like LNG or biofuels are becoming available more widely. These fuels provide a cleaner alternative compared to fossil diesel, both in reduction of harmful emissions as well as green house gas emissions. In the future much cleaner fuels will emerge. Hydrogen is a zero emission fuel, when produced with renewable electricity. IHC closely follows the development of suitable alternative fuels³.

The LEAF-Hopper design is developed in such a way that different types of fuels can be used. With dual-fuel LNG engines the vessel can operate diesel, LNG and biodiesel. The combination of LNG and biodiesel will already lead to a significant reduction of harmful emissions and green house gas emissions and the drive components needed for this are already proven technology⁴. In 2016/2017, IHC launched the world's first LNG trailing suction hopper dredgers 'Minerva' and 'Scheldt River'. Details of this can be found in Appendix B. This was followed by the 'Bonny River', 'Meuse River' and Cutter Suction Dredger 'Spartacus'.

Further reduction of emissions will be possible with the introduction of hydrogen. Although the technology needed for this is not available right now and the availability of green hydrogen is still very limited, the expectation is that this will change in the future. Several options for the LEAF-Hopper concept have been explored, ranging from dual-fuel applications (using a combination of hydrogen and diesel fuel) or completely fuelled hydrogen vessels with the implementation of fuel cells.

4.2 CONCLUSION

With the new generation of dredging vessels that Royal IHC is developing, it is possible to reduce the environmental footprint and CO₂ emissions significantly. This is possible through a focus on minimizing energy consumption during dredging operations on one hand and a focus on using alternative fuels on the other hand. A very large reduction can already be made with technology that is available today. In the long term, the development of a LEAF-Hopper running on green future fuel could eventually lead to a zero emission solution.

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³ <https://www.royalihc.com/en/blog/fuels-and-the-transition-to-zero-emission-vessels>

⁴ https://www.youtube.com/watch?time_continue=77&v=l-qvjNDUrHc&feature=emb_title



5 FINANCING (LEASE AND OPERATE MODEL)

5.1 INTRODUCTION

Many ports around the world, also in West Africa, find themselves in the position that they are depending on commercial dredging parties for port maintenance dredging projects and coastal protection dredging works. The capital investment for new dredging vessels is too high to consider building their own dredging fleet. To tackle this, Royal IHC developed a lease, maintain and operate model for dredging vessels. This concept can be tailored to specific requirements of clients, with local conditions and specific operational circumstances taken into account.

5.2 BUILDING LOCAL DREDGING CAPABILITIES

Essential is the selection of the right equipment. Production calculations will be made based on requirements and local dredging parameters. Typically, the main input for the calculations are type of material (e.g. silt), dredging depth (e.g. 20m) and discharge method (e.g. dumping or through floating pipeline).

After the equipment selection process, building of local dredging capabilities will be ensured by taking the following steps:

1. **IHC Lease and Operate finance model**
 - Establish SPV (Special Purpose Vehicle) as a shipping company
 - Establish operations and fleet management team
2. **Training and (local) development program**
 - Draw up crewing, training and development plan
 - Draw up succession plan
 - Objective is to increase skilled local (for example West African) capacity to for instance 80% over a period of 5 years

5.2.1 Lease and Operate finance model – Hopper Dredgers

In the classic approach, a hopper dredger is bought and financed by the dredging company (operator) itself. A down payment to the shipyard is made at contract and the remaining amount is paid in milestones by the buyer, either from his own means or through disbursements from a credit facility. This puts a significant strain on the financial strength of the buyer, especially during construction and the early years of exploitation of the vessel. This is not a problem for companies who have sufficient resources or can easily attract financing, but it can be much more challenging for smaller companies or companies starting in the dredging industry.

Most African contractors or African Port Authorities have to deal with both challenges. They face difficulty obtaining the funds required for a hopper dredger. Despite the healthy prospects of the business model for 'local players', without being able to make the investment, there is no business model. Their alternative, unfortunately, is either to use less efficient (second-hand) equipment or hire, at a high cost, state-of-art dredging capacity from international dredging companies.

Fortunately, the investment in these new vessels can be made accessible by a different model, replacing the classic employer-contractor model by a finance solution that practically converts CAPEX into OPEX for the operator, assuring healthy cash flows on dredging projects and facilitating ease of doing business for the operator.

The new model focuses on the operational expenditure of the client, differentiating in two types of costs. First there is the cost of the hopper dredger, in the form of a charter, second there are the costs to operate the vessel (personnel, fuel, logistics, etc.).

5.2.2 Lease costs

Instead of repaying the vessel, the operator pays a charter fee on the actual usage to a Special Purpose Vehicle (SPV) that owns the vessel which it has financed with a maximized debt and equity.

The debt part, approx. 80% of the shipbuilding contract value, will be financed via banks/financial institutions under ECA (Export Credit Agency) cover. The (predominant) State risk character of the loan represents an



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attractive risk for financial parties to support through loans and/or equity. As a result, financing for the CAPEX is much easier obtained against better conditions.

The required equity could come from one or multiple public/private parties, which become owner of the SPV and therewith the vessel. Lease revenues will be assigned to service, residual margin could at some point be used to invest in additional dredging equipment and/or paid out as dividend to the owners.

5.2.3 Operational Costs

The second part of the model is related to the operation of the (LEAF) hopper dredger. The operator will hire IHC- and local capacity for operational and technical management related to the dredging operation. Main scope consists of the following activities:

- Execute dredging works
- Technical management
- Maintenance management and control maintenance program
- Execute or outsource Repair and Maintenance Jobs
- Vessel flag + classification management
- Spare part management and storage
- Procurement and logistics
- Management and supply of crew
- Perform training (local) program
- Determine annual and monthly budget requirements

Separating the lease from the services should enable financial parties to base the financing risk on the former only, as the ownership of the vessel is with the SPV. Through the service contract, IHC helps reducing the operational risk by warranting smooth operational performance. Clear separation and addressing of risks makes it easier to find the financial support required for the investment.

This model enables the operator to reap the fruits of a local players’ business model by using a state-of-art vessel, rather than having to own and finance a vessel, or needing to in-source expensive international capacity. Instead, the focus can be set on a developing a smooth dredging operation whilst growing local dredging capacity.

5.3 TRAINING AND (LOCAL) DEVELOPMENT PLAN

There are several strategical considerations for having local dredge equipment. Ports are more in control, they do not depend on third parties for dredging equipment, it is directly available. Furthermore, having local dredge capacity saves costs regarding the (de)mobilization of equipment, no dependence on commercial market prices and a decrease of OPEX for many years. Besides that, the local economy can benefit from the presence of local dredge equipment. Also, regional production of liquid hydrogen is a boost for the local economy.

An operations and fleet management team, which consists of functional groups for the complete dredging organization, will be appointed. For a single vessel, the functional areas can be clustered by assigning responsibilities. The team will be a combination of personnel provided by IHC, a local (West African) partner and/or a local crewing agency. The focus will be on training and development of personnel locally in the operation and management of the functional areas.

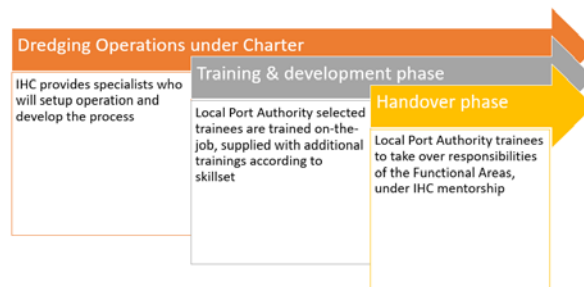


Figure 5.1: Lease and Operate finance model



5.4 TYPICAL BUSINESS CASE

A business case can be constructed based on the following parameters:

- *Market volume*
The market volume is based on the type and volume of dredging needed (capital/maintenance)
- *Determination of the production costs*
The ratio between the total costs and total production costs
- *Determination of the total costs*
Costs related to capital costs, maintenance and repair, wear and tear, fuel costs, etc.
- *Cost price of the market in comparison with the in-house cost price*
Return on investment based on cost savings

We did so based on reference numbers and assumptions (i.e. a dredging volume of 4,000,000 m³ per year and a cost price of 6 €/m³) and represented the cumulative cost savings graphically (figure 5.2) for a typical business case. The graph below, Figure 5.2, indicates the cost savings that can be achieved with a lease & operate model. In this graph, revenue is actually generated, as the ports will not have to pay a cost price per cubic meter of dredged soil (e.g. sand) to a commercial dredging company. Instead, the assumed expenses, in the form of operational costs and lease/charter fees, will result in cost savings. These costs savings are plotted against the number of years that an operator (for example a Port Authorities) would use our dredging vessel.

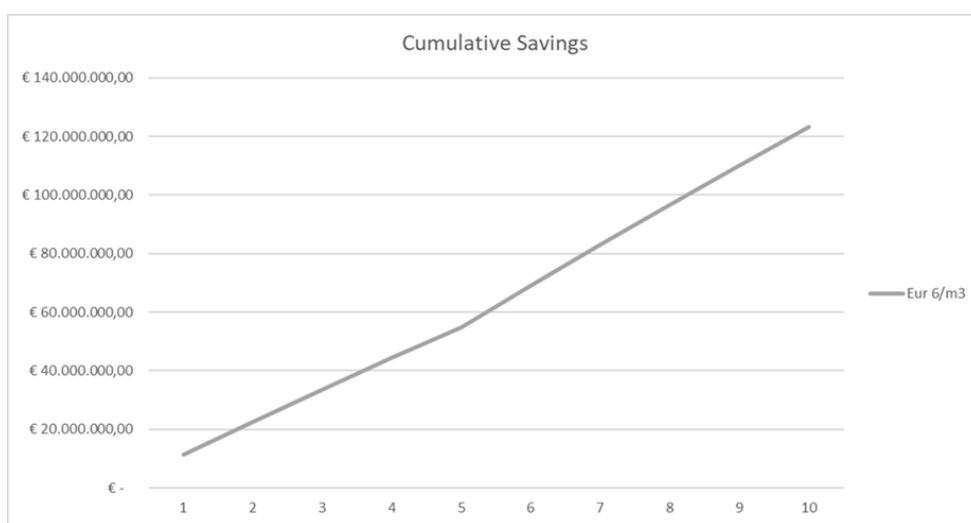


Figure 5.2: Cumulative savings versus (operational) years

5.5 CONCLUSION – BENEFITS FOR THE (LOCAL) COMMUNITY

With the successful implementation of the proposed concepts and financing construction by the World Bank and Royal IHC, a port will be able to significantly reduce their costs for maintenance dredging. Due to the Lease and Operate model both a direct as well as a long term decrease of OPEX can be seen without the necessity of a large capital investment. Besides the reduction of costs, the client is now more in control; they are not dependent on third parties and the dredging capacity is available throughout the whole year. Another benefit for the client is the de-risking of operations. The full fleet management is outsourced, knowledge to run a dredging operation is accessible (the local crew is trained by Royal IHC) and the operational risks are manageable.

Besides the benefits for port authorities, there are also many benefits for the local community. We saw the improvement works on the beaches of Saly (Senegal) in Chapter 3, which is bringing back tourism and the fishing industry. Moreover, another benefit to the local community could be the production of green future fuels locally. This could perhaps include the production of liquid hydrogen, powered by solar energy. This brings a lot of jobs to the local community and local people can be involved in this.



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APPENDIX A – KEY DREDGING PROJECTS PER COUNTRY

IHC has looked into the dredging projects in each of the target countries of the WACA program. Please find below a list per country of key coastal protection dredging projects.

Benin

We have information on 6 dredging projects in Benin. Two of those projects are directly related to coastal protection. The projects are summarized as follows:

1. Benin Coast: dredging and beach nourishment to protect the coast east of Cotonou

- a. Project size: 2,000,000 m³
- b. Project duration: 2 years (2017 – 2019)
- c. Contractor: DEME (International contractor)
- d. Equipment: Trailing Suction Hopper Dredger (name: Orwell)
- e. Source: <https://www.offshore-energy.biz/deme-cotonou-coastal-protection-works-in-benin-move-ahead/>

2. Ouidah: submerged dike for coastal protection near the villages Avlekete and Djegbadji

- a. Project size: 1,775,000 m³
- b. Project duration: Ongoing (2018 – now)
- c. Contractor: Jan de Nul (International contractor)
- d. Equipment: Trailing Suction Hopper Dredger (name: Pompei)
- e. Source: <https://www.afrik21.africa/en/benin-coastal-protection-project-2-progressing-at-high-speed/>

Côte d'Ivoire

Côte d'Ivoire has invested heavily in its coastal infrastructure and we see this reflected in a total of 12 dredging related projects. Two of those projects, which were all executed done using trailing suction hopper dredgers, are summarized here:

1. Port of San Pedro: dredging access channel and land reclamation works for a new terminal

- a. Project size:
- b. Project duration: Ongoing (2019 – now)
- c. Contractor: DEME (International contractor)
- d. Equipment: Trailing Suction Hopper Dredger (names: Marieke, Orwell)
- e. Source: https://www.deme-group.com/sites/default/files/2020-05/Activity_report_DEME_2019.pdf

Mauritania

A large dredging project is currently being executed in the Port of Nouadhiad. The project can be summarized as follows:

1. Port of Nouadhibou: deepening and widening access channel of the SNIM mineral terminal over 25 km

- a. Project size: 22,000,000 m³
- b. Project duration: Ongoing (2019 – 2030 (planned))
- c. Contractor: Jan de Nul (International contractor) in combination with Van Oord (International contractor)
- d. Equipment: Trailing Suction Hopper Dredger (name: Leiv Eiriksson)*
Trailing Suction Hopper Dredger (name: HAM 318)*
- e. Source: <https://www.offshore-energy.biz/mauritania-port-of-nouadhibou-readies-for-larger-ships/>

*These vessels are named, but not yet on the project.



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São Tomé and Príncipe

CCCC (China Harbour Engineering) recently completed dredging for the new deep sea Port of São Tomé. This project can be summarized as follows:

1. Port of São Tomé: new deep sea transshipment port located in the oil-rich Gulf of Guinea

- a. Project size: Unknown
- b. Project duration: 2015 – 2019
- c. Contractor: China Harbour Engineering Co. (CCCC) (International contractor)
- d. Equipment: TSHD (name: not mentioned)
- e. Source: <https://www.marineinsight.com/shipping-news/sao-tome-signs-memorandum-with-china-on-deep-sea-port/>

Senegal

Senegal has seen a number of marine infrastructure improvements over the last years. We have records on 5 dredging projects in Senegal. One of those projects is the ongoing restoration of the beaches in Saly. This project is a good example of how dredging brings back economic activity (tourism, fishing) that had been literally washed away by erosion and sea level rise. We invite the reader to follow the below hyperlink for a nice video on this project showing how dredging brings back life to a community. This project can be summarized as follows:

1. Beaches of Saly: restoration and protection of the beaches in Saly

- a. Project size: 550,000 m³
- b. Project duration: ongoing (2017 – now)
- c. Contractor: Van Oord (International contractor)
- d. Equipment: Trailing Suction Hopper Dredger (name: Dravo Costa Dorada)
- e. Source: <https://www.vanoord.com/activities/riviera-senegal-safe-again>

Togo

We would like to highlight the dredging works executed for the Port of Lomé in 2012 and 2013 as another example of dredging for economic development in West Africa. The project can be summarized as follows:

1. Port of Lomé: new container terminal in Togo, West Africa

- a. Project size: 1,900,000 m³
- b. Project duration: 1 year (2012 – 2013)
- c. Contractor: ABEKO Marine BV, VINCI (Soletanche Bachy, Sogea-Satom and EMCC) (International)
- d. Equipment: Backhoe Dredger
- e. Source: <https://www.dredgingtoday.com/2012/02/29/togo-vinci-wins-port-of-lome-contract/>



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APPENDIX B – WORLD'S FIRST LNG HOPPERS

The world's first LNG hoppers are the 'Minerva' (launched December 2016) and the 'Scheldt River' (launched January 2017). In Figure B.1 a schematic overview is given of the LNG-installation inside the 'Scheldt River'. A picture of both of the vessels at the shipyard of Royal IHC can be seen in Figure B.2.

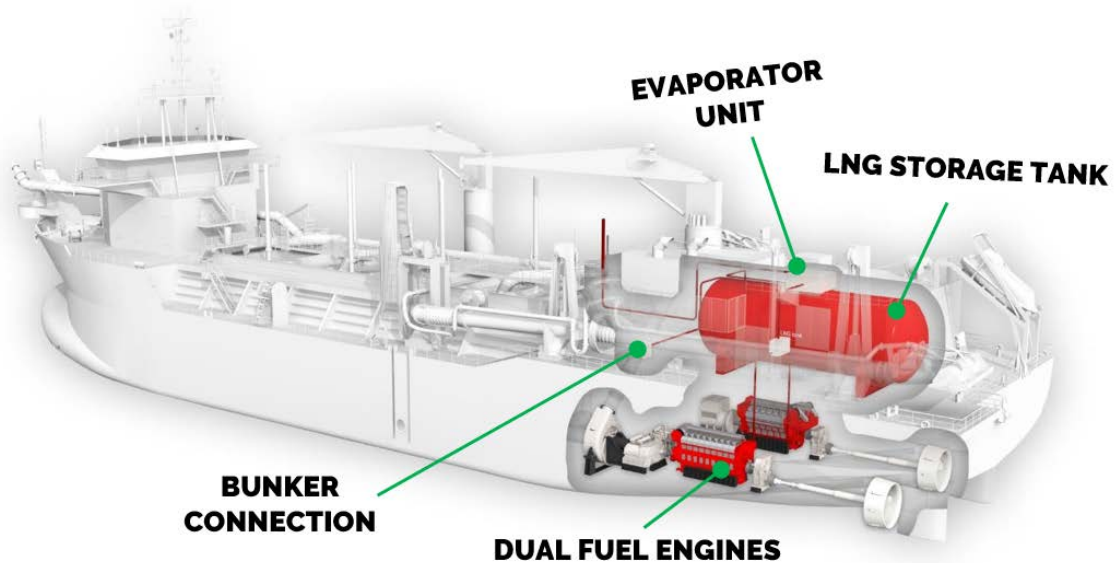


Figure B.1: Schematic overview of the LNG-installation of the TSHD 'Scheldt River'



Figure B.2: World's first LNG hoppers 'Minerva' (front) and 'Scheldt River' at the shipyard of Royal IHC in 2017



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Press release – 3 December 2016

World's first LNG-powered hopper dredger launched

The launch ceremony of DEME's 3,500m³ LNG-powered trailing suction hopper dredger (TSHD) MINERVA took place on 3 December at Royal IHC's shipyard in Kinderdijk, The Netherlands. The official name giving and christening ceremony will take place in the spring of 2017 in Zeebrugge, Belgium.

"The launch of this vessel is an important milestone for the dredging industry," says IHC's Executive Director Shipbuilding, Arjan Klijnsoorn. "IHC had already started to investigate the integration of LNG into dredging vessels in 2012, enabling us to understand the challenges of this green solution. This gave us a solid basis to work from when DEME started its tender process, and helped us to materialise DEME's preliminary design for two LNG-powered TSHDs. We are proud to have made a huge step forward in dredger design and to be able to limit the environmental impact of DEME's vessels. We want to thank DEME for their close cooperation and for giving us the opportunity to build the world's first LNG-powered hopper dredger."

Alain Bernard, Director and CEO DEME Group: *"DEME's multi-year fleet expansion programme is focused on increasing efficiency, both in terms of productivity and environmental performance. The design of our new vessels is inspired by a drive to continuously innovate from an ecological and efficiency perspective. As such, DEME continues to be at the forefront of the industry and significantly reduces the environmental impact of its operations."*

Increased deployability and availability

The dual-fuel (diesel and LNG) dredger has a 'Green Passport' and a 'Clean Design' notation, complying and exceeding with the strictest international emission requirements.

The availability of the vessel has also been increased since it meets the requirements for the extended dry-docking system. Ships under this special programme get a maximum dry-dock interval of 7.5 years (instead of 5 years) by replacing certain dry-dockings with in-water surveys.

Award-winning dredger design

IHC and DEME are delighted that this game-changing design has been officially recognised by the industry. On 10 November, both companies were awarded a DPC Innovation Award for the new concept.

Additional information

Name	MINERVA
Type	Trailing suction hopper dredger
Customer	DEME
Builder	Royal IHC
Length overall	83.5m
Breadth	18m
Depth	6.8m
Design draught	5.0m
Hopper capacity	3,500m ³
Dredging depth	30m
Speed	12 knots
Accommodation	14 people



Note for the editors, not for publication:

For more information please contact:

Ms Kitty de Hey

Strategy & Communications Director

T + 31 88 015 29 51

M + 31 6 52 03 10 23

c.dehey@royalihc.com

Profile Royal IHC

In an ever-changing political and economic landscape, Royal IHC enables its customers to execute complex projects from sea level to ocean floor in the most challenging of maritime environments. We are a reliable supplier of innovative and efficient equipment, vessels and services for the offshore, dredging and wet mining markets.

With a history steeped in Dutch shipbuilding since the mid-17th Century, we have in-depth knowledge and expertise of engineering and manufacturing high-performance integrated vessels and equipment, and providing sustainable services.

From our head office in The Netherlands and with 3,100 employees working from sites and offices on a global basis, we are able to ensure a local presence and support on every continent.

Dredging operators, oil and gas corporations, offshore contractors, mining houses and government authorities all over the world benefit from IHC's high-quality solutions and services. With our commitment to technological innovation, in which sustainability and safety are key, we strive to continuously meet the specific needs of each customer in a rapidly evolving world.

Royal IHC. The technology innovator.

For more information on Royal IHC, visit <http://www.royalihc.com>

Press release