

# Subsea Cables The Ultimate Guide

Discover all about cable manufacturing requirements, the latest trends and making your subsea project a success

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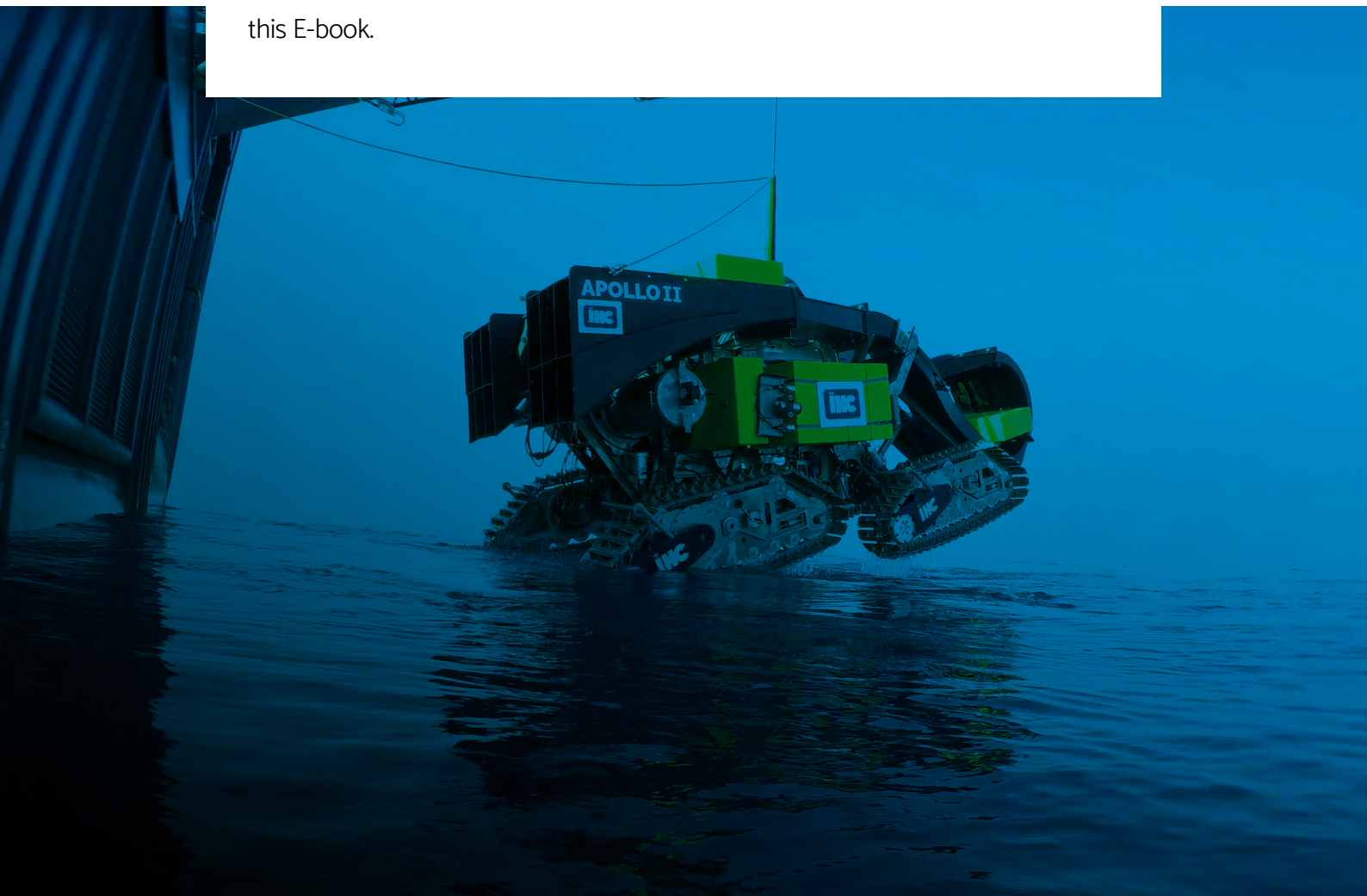
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# A deep dive into everything there is to know about subsea cables

Your subsea system consists of many different components. That's why success depends on a lot of factors within your projects. For example, in the Remotely Operated Vehicle (ROV) world, the cable is only one part of the entire system, but buying an ROV cable that's too short or can't lift the necessary weight, will be fatal to your subsea project. That's how important one component can be.

But how do you find the perfect cable for your project? To help you in this process, you'll find information about every aspect of your subsea project in this E-book.



From the latest developments in the subsea cable market to the the connection between system and cable; with the knowledge you gain, you'll be prepared for every challenge you encounter in your project.

Please note you don't have to overcome these challenges alone. Early Supplier Involvement and co-creation are important assets that make your project easier. You'll read more about those in Chapter 5 of this E-book.

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Enjoy the read and **feel free to reach out with any questions or remarks!**

# 1

## Subsea Cable Trends

### (and their impact on the cable)

The world is developing rapidly, and the same is true for subsea cables. The latest trends and developments might be of great importance for your project.

Which cable matches which type of subsea project? What does this mean for the life expectancy and the risks of downtime? How does sustainability affect the use of subsea

cables? And what about depth?

Subsea solutions exist in all shapes and sizes, but it is important to know what fits your project best. In this chapter, we will zoom in on some of the most important trends and developments, affecting your subsea cable choices.

## Going into deeper water

Mankind is increasingly entering deeper waters in search of resources. Exploring deeper water means that equipment has to adapt and longer subsea cables are necessary.

Longer subsea cables entail a new challenge: for example, for ROVs, because the cable itself is heavier, a stronger cable is necessary for lifting the ROV. In fact, from 4000 meters depth, standard steel becomes far too heavy and other materials are required to support the ROV. However, lightweight materials are more brittle and do not conduct heat as well as steel. As a result, going deeper makes cable design more complicated; careful consideration must be given to the specifications and which material is most suitable for the subsea project in question.



## Less Downtime, Longer Lifespan

Both money and risks can be saved if we are able to tell exactly when a subsea cable is due for replacement. To help us do this, extensive knowledge of materials is crucial. For steel wires, this knowledge already exists, which enables accurate estimates through proven inspection methods. For the less familiar synthetic fibers, global research is being conducted to gain more knowledge and experience. How can we measure when such cables reach the end of their life cycle? Fiber optic cables can be a viable solution. Such optical fibers are already being used in measuring the impact of aircraft landings.

Groundbreaking inventions as self-healing materials and other trends might increase the lifespan of subsea cables drastically.

By keeping a close eye on these developments, DeRegt can implement them directly in custom solutions for your specific challenges.

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# The Sustainability Trend

Independence from fossil fuels is more realistic than ever, thanks to modern developments.

That's why the demand for Renewable Energy is increasing sharply every year. This trend has implications for the subsea cable business.

Wind farms are being placed further and further from the coast, where they take up less coast space. These “floating wind farms” demand dynamic subsea cables, as wind turbines are exposed to swaying waves and the most extreme weather conditions. This relates to an interesting development in sustainability: thanks to **Ocean Power Technology (OPT)**, cables can extract energy from wave action.

Cables that are used far from the coast must also have a long lifespan. Products that last longer have less environmental impact and are more sustainable. There are many developments in this area too, as described in Chapter 1.2.

# 2 Subsea Cable Construction

Each subsea project is different and the same is true for the corresponding cable construction. After all, subseacables are used for a broad range of purposes. Which type of cable is best for your subsea project? To answer the question

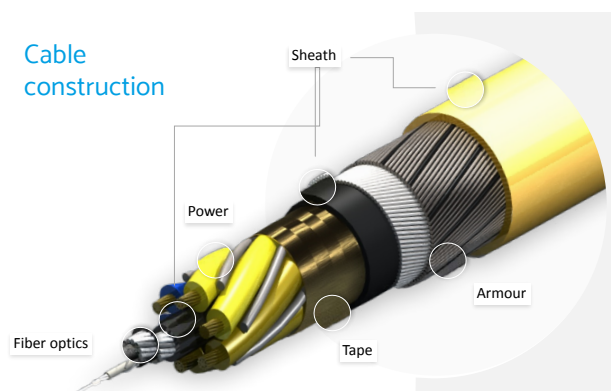
of which cable suits your subsea project best, it is important to know how a cable is built. Which elements determine the geometry of a cable? And which cable specifications are important for your project?



## An example of Cable Construction

As each purpose requires a different cable construction, there is no such thing as a catalog; your requirements must be translated into fit-for-purpose designs.

In the example below, components are laid up in helices with extruded plastic sheets and tapes separating the layers. The electrical and optical components are laid up in the core. Around the core, a strength member is wrapped. In this case a steel armor with 2 layers. Another common material used as a strength member in deepsea cables is aramid fiber, which is much lighter.



## Conducting electricity and data

Electrical conductors are usually made of copper with thermoplastic insulation. Data is often sent via optical fibers these days. Fragile components like optical fibers are placed towards the center for crush resistance. The helical structure makes it possible to bend and stretch the cable construction without permanently deforming or breaking the components.



## Weight and Elongation

Subsea cables are designed in a way that the load is transferred through the strength member instead of the electrical and optical components. This is done by applying a smaller lay angle for the strength member than for the components. In deeper waters, the number of heavy materials should be limited as the cable should be able to lift its own weight.

Another important aspect is to design cables so that they do not stretch more than 0,6% at the maximum workload. Further stretching should be limited, in order to prevent the copper from deforming and/or creating an overlength of copper in the cable.

**For more aspects of Cable Construction, (re)  
view our Webinar On-Demand here**

[Watch our Webinar](#)

What determines the cable design for your specific subsea project? Should the cable be able to transfer a certain amount of power? Is the cable going to be used in deep waters?

Steel is often too heavy for deep-water operations, which is why aramid fibers or other lightweight materials are a better option in such cases. Selecting an extra-long cable in deeper waters “just to be safe” is a common mistake. This means that large pieces of cable remain on deck when not using its full length - resulting in a cable that can get too hot.

This shows how important fit-for-purpose is. Not only length is very important; weight and conductivity also play a major role. Think carefully about the application of your cable and what specifications fit this purpose!

In the next chapter, we'll focus more on fit-for-purpose and how System Requirements are translated into subsea cable.



# 3 System VS Cable Requirements Fit-for-purpose

it is vital to determine the function of the subseasystem. After all, the system requirements largely impacts the cable requirements and fit-for-purpose design. In the table below, the various system requirements and cable requirements are listed.

System Requirements	Cable Requirements
Function	Diameter
Deployment	Weight
Depth	Flexibility
Downtime	Geometry
Power	Strength
Design life	Crush resistance
Budget	Repairability

There are 7 important system requirements that can impact your cable design. The link between system requirements, cable requirements and cable design is crucial for a successful subsea project.

## Function & Deployment

Supplying power, sending control instructions and sending/receiving data are common functions of an subsea cable.

The function determines the geometry of the cable to a large extent. The same is true for the maximum working load, defined as the load necessary to stretch the cable by 0,6%. Further stretching can cause permanent deformation of copper conductors and quickly result in failure.

The deployment/retrieval also impacts the cable requirements, which is why insight on how the cable will be launched and deployed is important. For example, the diameter determines the minimum bend radius, which directly impacts the size of the handling system. Crush resistance is also often a key design criterion. Because steel has a superior crush resistance compared to synthetic fibers, it is often preferred for subsea applications where crush resistance is a necessity.

## Depth

The required length and diameter of the cable are directly related to the operating depth.

There is also a limitation on length when using steel armoring and the deeper you go, the greater the voltage drop. Additionally, the pressure on the cable will be bigger. How do you design a subsea cable that can deal with these challenges of depth?

System Requirements play a big role in this.

To overcome challenges, you must first know what these challenges will be. That's why one must know how deep the cable will go and what weight must be pulled from these depths. For example, working at depths deeper than 6 km requires the cable to be completely air-void-free.

Hydrostatic pressure can also have an impact on the cable's weight in water. Foam may be used to reduce the cable's weight in water, but pressure can change the properties of the foam.

Developments to better deal with deepsea challenges are ongoing. Of course, we will keep you informed of the latest developments at DeRegt.



## Power

Power is a big driver for the diameter, weight and geometry of the cable. It has a direct impact on the size of the conductors and the thickness of your insulation. The size of the conductors is either determined by **current** or **voltage drop**.

For **current**, heat is often the limiting factor. The cable is usually water-cooled, but deployment in shallow water could be a problem with lots of layers on the winch. Thermal analyses help us to prevent heat issues from happening. The voltage drop can also be a driving factor for the size of the conductors. For the electrical circuit of the system, the **voltage drop** mustn't be too high. Normally, the maximum allowed voltage drop is 10%.

A third factor is **electrical stress**. When voltage stress is too high, air can ionize and generate discharges. This will eventually burn up your plastic insulation. Air voids might increase electrical stress, which is why it is important to fill the void in your cables.





# Crucial Design Considerations for subsea Cables

How do these system and cable requirements impact each other in practice? And when should you bring certain manufacturers to the table in order to make the best choices for your offshore project?

(Re)watch our Webinar On-Demand and see how our R&D Manager answers all these questions and more!

[Download your recording here](#)

# 4 Downtime & Life Expectancy

As stated above, it is very important to determine early on how the cable will be used exactly. Most problems occur when cables are used for other functions or on other devices. Using the cable differently on the ship has a direct impact on downtime and life expectancy.

## Downtime and how to prevent it

Downtime is a common yet preventable issue. Compared to other structures on board, the cable is quite a fragile component. One way to minimize downtime is by using extra optical fibers in the cable. This way, there are always spare fibers present. Secondly, fragile components can be placed towards the inner core of the cable, to avoid crushing.

Another important aspect is the fatigue life of steel. Making the steel armored cable strong enough to stay under its fatigue limit can be considered. Aramid cables work differently: they fail because of internal abrasion, which happens especially at low bend radii.

It may be necessary to **repair a cable in the field**. Steel armored cables are much easier to re-terminate than aramid cables, which require special tooling. Taking this into consideration might save complications later.



## Life Expectancy and how to prolong it

Downtime is directly related to another important factor of subsea cables: life expectancy. How long should the cable last?

The so-called fatigue life of the cable can be considered by designing steel armored cables in a way that the strength member fails first. Besides direct strength, the stresses in bending are important as well. Bend stress can be reduced by making the cable more flexible. When the helix length is increased, the cable will become stronger in tension, but less flexible - and vice versa. The balance between those two is crucial for the life expectancy of a cable.

With a fatigue model, the cable life for different operating scenarios can be determined - which answers the most important question: does the strength member meet the requirements on the design life?

## Consequences for your Budget

The last important factor for your subsea cable is your budget. Downtime can be reduced by not buying the cheapest cable, but cheap choices might turn into expensive consequences. A large part of the cable cost is determined by the number of required lay-up operations, which comes in three options.

### **Unilay**

Twisting all components up at the same time is called unilay. This is the most compact construction, with often the smallest diameter achievable. Because everything is twisted together in one go, production costs are lower. A disadvantage is the build-up of torsion by laying up the components in one pass.



### **Concentric Lay**

Another construction is concentric lay. Each layer is laid-up separately, making it more expensive. The advantage is that the components in each layer can be laid up without generating torsion.

### **Group Lay Construction**

A cable can also be composed by laying up a set of subcables, with each subcable composed of its individual laid-up components. This so-called group lay construction is often the most flexible construction, but also the most expensive.

With all these different lay-up operations, there are plenty of options to minimize the cable cost. However, costs should never be leading in a subsea project. The quality of the cable and the suitability for your specific application should always be the most important consideration.

# 5

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## Cable Manufacturer as Strategic Partner

To make sure your offshore project is as successful as possible, every component must be exactly right. Each component is a small part of the bigger whole, but they're all important.

That's why early supplier involvement, co-creation and strategic partners are very important. By ensuring that all components are properly taken care of by experts, you will have less to worry about in terms of the big picture.

The cable forms the connection between a ship or shore and your offshore or subsea equipment, which makes it a component with multiple functions (like conducting data and lifting weight). To make sure everything works properly and fix damage or downtime as quickly as possible, you need cable experts that know everything

about project requirements and the corresponding cable.

DeRegt likes to take this in-house expertise one step further, by expanding it outdoors.

Thanks to our Field Service, our cable experts and engineers are able to help on location if any assistance is needed.

With their knowledge of multiple systems and cable requirements, they'll help your crew find issues and fix them, in order to minimize downtime as much as possible.

We do this because we believe in the power of collaboration. By supporting engineers through the entire process, we create long-lasting relationships and projects that are built for success. But what is the difference between a simple Cable Manufacturer and a true Strategic Partner? Three ingredients are important:

### **Early Supplier Involvement**

Ideally, you know who your supplier will be for each component as early as possible from each component. With Early Supplier Involvement, you allow suppliers to become more than just a supplier. After all, strategic partners are much more useful!

### **Thinking along**

A strategic partner thinks along with you about the final solution. A supplier delivers what you ask for. Quite often, you don't know exactly what is needed for success. Take the cable, for example. By choosing a cable supplier who thinks along with you as a strategic partner, you know for sure that you will receive the cable that best suits your application.

### **Co-creation**

The result is co-creation: together you create the final solution that ensures that your system operates optimally. With strategic partners, you can also solve challenges together, each thinking from his own expertise. Cooperation is key!



# Recap

## Everything about deepsea Cables

The success of your deepsea project depends on many factors. The cable is only one part of the entire system, but buying a subsea cable that's too short or can't lift the necessary weight, will be fatal to your project. Components like cables exist in all shapes and sizes, but it is important to know what fits your project best.

For example, new developments might impact your specific project. Whether these trends (Chapter 1) impact your specific project, depends on the circumstances. Each subsea project is different and the same is true for cable construction. To answer the question of which cable suits your project best, it is important to know how a cable is built.

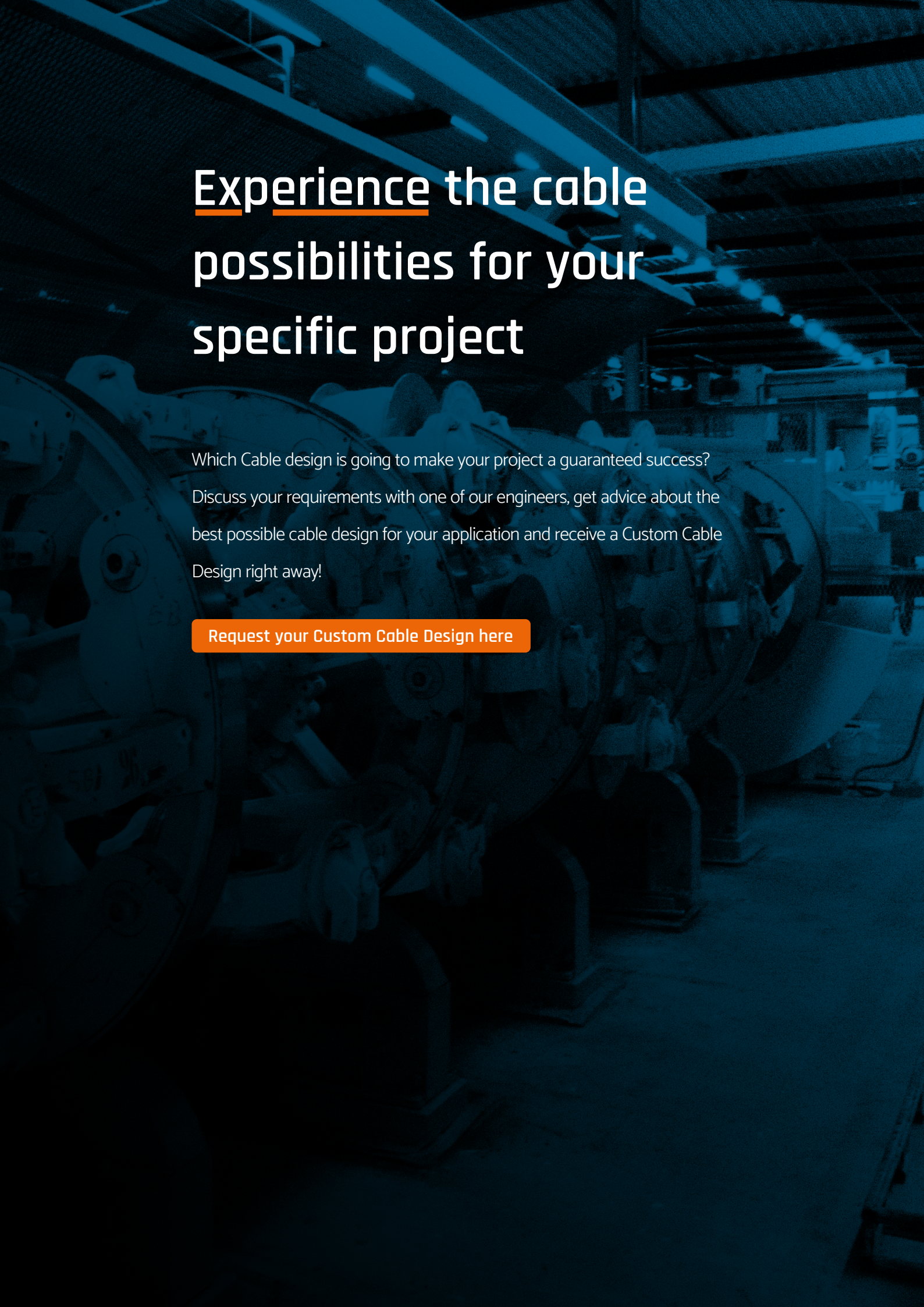
With Function, Deployment, Depth, Downtime, Power, Lifetime and Budget, system requirements can impact your Cable Design. The link between system requirements and cable requirements (Chapter 3) is crucial for a successful subsea project.

Function largely impacts the geometry and the working load of the cable and greater depths require different lengths and diameters. The size of the conductors is determined by current and voltage drop.

To prolong life expectancy, the balance between tension and flexibility is crucial. Downtime can be minimized by using extra optical fibers in the cable or by placing fragile components towards the inner core of the cable. Downtime can also be reduced by not buying the cheapest cable, but cheap choices might turn into expensive consequences.

In short, each component is a small part of the bigger whole, but they all contribute to the success of your project. By ensuring that all components are properly taken care of by experts, you will have less to worry about in terms of the big picture. How can our cable experts help you?





# Experience the cable possibilities for your specific project

Which Cable design is going to make your project a guaranteed success? Discuss your requirements with one of our engineers, get advice about the best possible cable design for your application and receive a Custom Cable Design right away!

[Request your Custom Cable Design here](#)





# About DeRegt

Ever since 1912, De Regt Cables has built its success on three pillars: quality, craftsmanship and innovation. These pillars still allow us to deliver new and innovative cable solutions for years to come. We also believe in the power of collaboration: together we can challenge the status quo. Our future lies where you take us, as well as where we guide you.

Ongoing support through the entire process is what our cable experts promise. Recognizing the specific needs of our clients is of great importance for this purpose. That's why our solutions are always custom-made: our project focuses entirely on your challenge. What is yours?

Discuss your challenges with our experts:

[Request a Custom Cable Design](#)