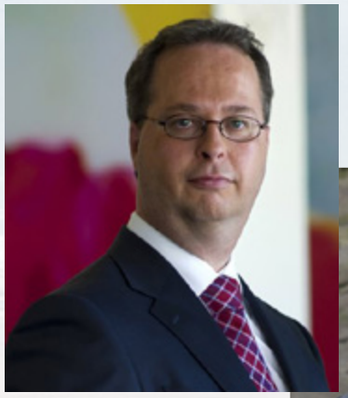
The story of the Sand Engine

The turbulent process of an innovation within water management from various perspectives

July 2016

Preface



The Sand Engine is an innovative solution for coastal reinforcement and a valid source of national pride. This form of coastal maintenance offers safety while giving space to nature and recreational possibilities in our province. The innovative project started four years ago and now enjoys the interest of other countries in low-altitude and densely populated delta areas. They want to see if they can develop their coast naturally too, studying to see if the successful Dutch Sand Engine can be translated into a solution for their specific situation.

The process that resulted in decision-making and realisation of the Sand Engine is innovative. Contrary to the traditional ways, market parties were involved via the Ecoshape foundations in a very early stage of development. This allowed for leveraging the market knowledge and expertise from the very start. The excellent collaboration between Rijkswaterstaat (the Directorate-General for Public Works and Water Management) and the Province of South Holland was instrumental in delivering this project within budget, both in terms of time and cost. We bridged some cultural gaps between the organisations, and demonstrated that we are able to complete such projects together. A great exercise for future projects, combining safety and spatial quality.

The Sand Engine is now four years old, and was constructed in the time when Mrs. Dwarshuis, a former Province delegate, was responsible for coastal reinforcement. She ensured the realisation of the Sand Engine with great passion and commitment. The past 4 years were characterised by further development, management and monitoring. Meanwhile, the Sand Engine is a well-known phenomenon along the Dutch coast.

In the coming years, we will assess whether or not the Sand Engine actually fulfilled the very high expectations. This will enable us to answer the frequently asked question if this form of coastal management could be applied elsewhere.

The process of the past few years offers many lessons learned that can be applied in future projects. This booklet describes the process prior to the construction of the Sand Engine. Based on interviews with key players in the decision-making process of the project, we paint a picture of the arguments and visions applicable at the time. This offers some interesting learning points that can be applied in realising future innovations.

More than ever before, the coast of South Holland offers something for everyone. Beautiful, expansive beaches for walking and sunning, many possibilities for water sports fans and expanding dune zones with special birds and plants. And the key point: a safe place to live!

With this innovation - building with nature - the Netherlands added a new dimension to its reputation as a country of dike builders and dredging companies.

We hope you enjoy the read and gain inspiration.

Han Weber, member of the Provincial Executive Committee of South Holland, portfolio Coast (2011 – May 2015)
Rik Janssen, member of the Provincial Executive Committee of South Holland, portfolio Coast (from May 2015)

Contents

And suddenly, there was the Sand Engine...

Jan Baltissen,
writer / editor

As Leading professional Water Governance with Royal HaskoningDHV, I am involved in many water-related projects and developments in water management. My passion is bringing persons and parties together to collaborate on flood protection and supply of sufficient and clean water.

I was first introduced to the Sand Engine at the 2008 World Exhibition in Zaragoza, Spain. Our King, then Crown Prince Willem Alexander, had just opened its presentation and the Sand Engine captivated me instantly. In 2009 South-Holland Province awarded Royal HaskoningDHV with the assignment to make the technical design of the Sand Engine and for the assessment of its environmental impact.

In the context of this assignment, I supported the then Province project manager Edith van Dam, in the decision-making process within the Province. Very soon, the complex process to create the Sand Engine fascinated me with its wide range of interests, visions and opinions that all played a role.

I looked back on this complex period in 2014 with Koen Oome, who was in various roles involved in creating the Sand Engine since 2003. This is when we got the idea to write down the 'story of the Sand Engine'. How did the decision to create the Sand Engine come about and which were the key factors? At a later stage, we involved Carrie de Wilde in this initiative. She is Rijkswaterstaat's communication advisor and since 2010 she has managed communications related to the Sand Engine. Koen and Carrie helped me write down this 'Story of the Sand Engine'. They provided key contributions as soundboards and advisors.

Walking across the dunes near Kijkduin, just south of The Hague, you will see an expansive range of sand bars and channels. Depending on weather and season, dozens of colourful kite-surf sails, sunbathers and people strolling along with playful dogs enhance this image. When the weather is worse, a lot of sand is suspended in the air, but the happy dogs are always there. The Sand Engine is being used! Not just by people enjoying their leisure, but also by researchers and authorities. There is probably not a single stretch of beach anywhere on the planet that is so intensively studied. Many researchers and authorities are continually working on and around the Sand Engine.
The Argus mast in the middle records all developments 24/7. Groups of interested parties from all around the world are often given a tour.

Dealing with dynamics
Late 2011, the construction started and was completed in a short time. One could walk over the Sand Engine for the first time in the summer of 2012. It became immediately clear that the Sand Engine is dynamic, the more so in the first phase. Subject to wind and waves, the sand started moving immediately, showing ever-shifting patterns of channels and sand bars. This was entirely as expected, although it still took the operational authorities some time to get used to it and deal with it.

Short - very short
The construction period was very short. Looking back, the entire planning and decision-making period was actually also very short. The formal Environmental Impact Assessment procedure started in 2009 and in 2011 the contractor started with the construction. For such an innovative project, requiring a significant investment, this was an extremely short period.

Fascinating
This was also the period in which I was involved in the Sand Engine. At the request of the South-Holland Province, I consulted with the stakeholders.
Together with the project manager Edith van Dam, the project, I prepared the decision-making documents.
The consultative meetings fascinated me or more accurately, the discussions at the time. These were mainly about all sorts of risks. Almost all parties at the table saw all kinds of dangers and between the lines, you could clearly read: 'We don't see the point, we see no benefits, just risks of general losses'. Only the Member of the Provincial Executive Committee continued to reiterate the goals, making an effort to come to a decision.

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Factors for success

Now, almost five years later, I am still fascinated by the decision-making process that preceded the construction of the Sand Engine. I wonder what the final push really was? Which factors were instrumental in the decision to realise the Sand Engine? And, in that line of thinking: what can we learn from the Sand Engine when we are doing something innovative within water management (or other policy areas). In brief, what are the factors for success that can be derived from the Sand Engine decision-making process?

The story of the Sand Engine, told by the key persons

I started looking for the factors relevant in the planning and decision-making process of the Sand Engine.
For this reason, I listed the key persons playing a role in the decision-making process. I asked these persons for their goals, considerations and arguments. For their personal story of the Sand Engine. Would they do the same thing again?
I also asked some experts to clarify essential knowledge issues.

Step by step, I gained an impression of the processes, visions, strategies, ambitions and beliefs that played a role.
Below, I reported about these interviews. There is no such thing as 'the' story. Each key player has a different coherent and water-tight substantiation of his choices. The compilation of their stories creates 'The story of the Sand Engine', supplemented with the explanations of the experts. After these reports, the last section of this booklet sets out some of my conclusions of the key factors that played a role and the lessons learned that can be applied in other innovations.

Jan Baltissen

Allow me to present: the Sand Engine

The Sand Engine consists of about 20 million cubic metres of sand just along the coast of South Holland, a peninsula between Ter Heijde and Kijkduin. This large amount of sand is to be deposited by the waves, currents and wind, allowing the coast to grow naturally. The sand is added to the coastal foundation, gaining a buffer against the rising sea level. The expectation is that supplementary sand deposits will not be necessary in the coming two decades. This implies long-term coastal safety. Coastal development also provides room for nature and recreation. The principle of the Sand Engine has not yet been applied in practice on this scale. This is why the construction of the Sand Engine has the character of a pilot. The construction project allows for gaining knowledge of coastal development based on the principle 'Building with nature', exploring new methods for anticipating the sea level rise.

Sand Engine

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

- 21.5 million cubic metres of sand
- Surface upon delivery 128 hectares. Eventually, this will result in 35 hectares of new beach and dune surface.

Principal:	Rijkswaterstaat *Ministerie van Infrastructuur en Milieu*	**Rijkswaterstaat** *(Dutch Directorate-General for Public Works and Water Management)*
Financing:	provincie ZUID HOLLAND; Rijkswaterstaat *Ministerie van Infrastructuur en Milieu*	**Province of South Holland and Rijkswaterstaat**
Cost:		**€ 70 mln.**
Design and EIA:	Royal HaskoningDHV *Enhancing Society Together*; Deltares Enabling Delta Life	**Royal HaskoningDHV and Deltares**
Realisation:	Van Oord; Boskalis	**contractor combination Van Oord-Boskalis**

Decision-making procedure

Decision-making: Plan study and realisation

2008

December

Provincial Executive Committee (PEC) adopts the Start Memorandum

2009

November

PEC adopts EIA

National government agrees to financial contribution

December

Provincial Council (PC) makes decision on financial contribution in February 2010

Steering group approves of implementation

2010

February- September

PC adopts the follow-up process for realisation; preparing construction plan
Acceptability assessment EIA Authorised Supervisor
Publication / available for viewing of EIA and permits
Agreement relating to monitoring and management
Concluding management agreement with Landscape of South Holland

May - September

European tender for implementation

Oktober

Permit NB Act (Nature Conservation Act): sand extraction and construction Sand Engine (LNV - Min. Agriculture)

December

Contract work

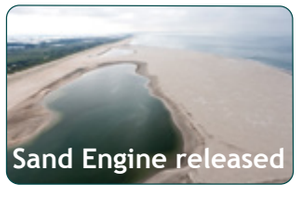
2011

March - November

Construction Sand Engine

November

Sand Engine ready



Legend
GS - PEC = Provincial Executive Committee of South Holland
PS - PC = Provincial Council of South Holland

Network of parties

One thing was very clear when being involved in the Sand Engine: the Sand Engine is a lot more than a heap of sand that forms a way of reinforcing the coast. Everyone you talk to has their own opinion and vision. The Sand Engine is also a major network of a range of parties and persons collaborating and joining forces to shape the management, research and promotion of the Sand Engine. Above, this field of players is represented in a diagram of who were involved at the time of the decision-making process in 2009.

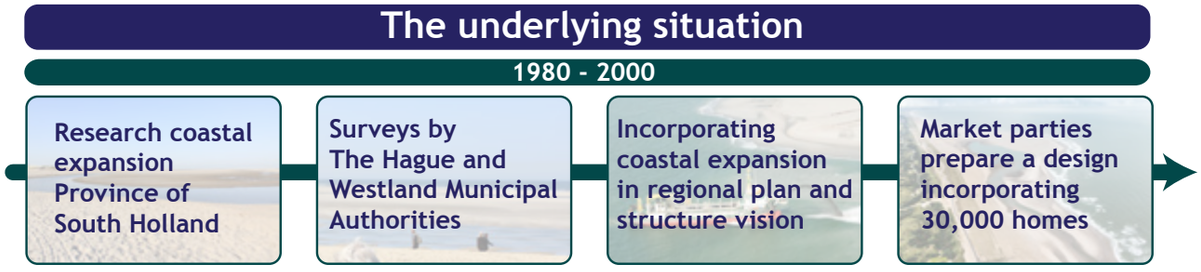
The decision-making process: a summary

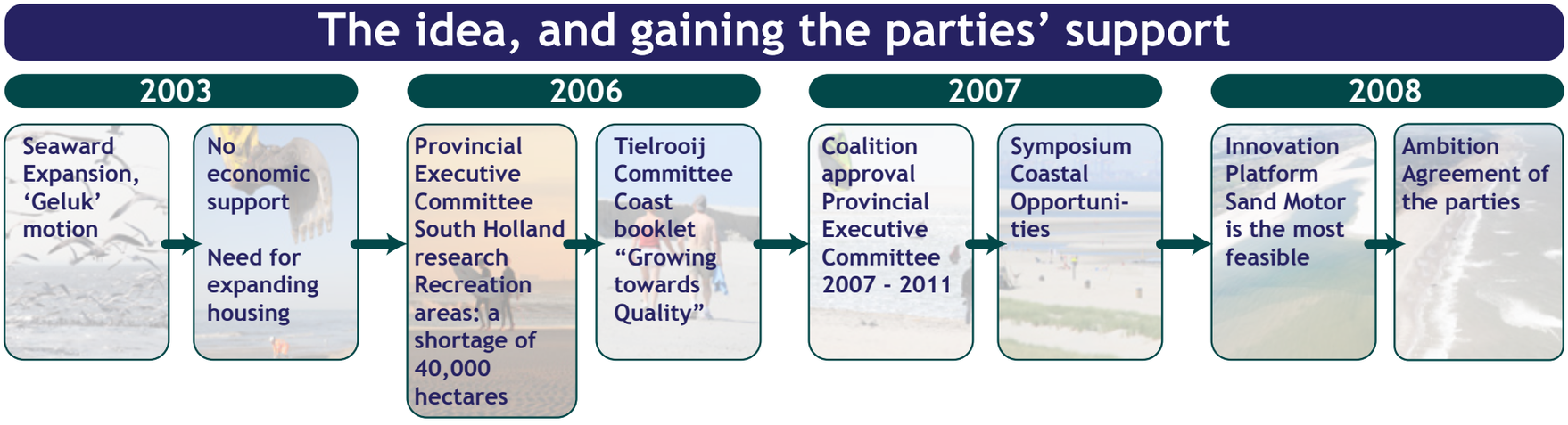
The underlying situation

The story of the Sand Engine is not an isolated story. The concept did not simply appear one day. In the early 1980's, the Province of South Holland researched possible ways to enhance the coast.
Ronald Waterman specified the Building with Nature concept in a plan for coastal expansion, incorporating a lot of nature and water. This was referred to as the Waterman plan. In 1995, a consortium prepared a plan to realise coastal expansion with a number of market parties, building a large number of homes and greenhouses. This plan caused both social and political commotion to such an extent that it was withdrawn.

The idea, and gaining the parties' support

The first building brick for the current Sand Engine was laid in 2003 with the 'Geluk' motion (in the House of Representatives) and Waterman/Hieltjes (in the Provincial Council of South Holland), proposing the preparation of an exploration into integral, multi-functional, sustainable and phased coastal expansion. The Province and the Ministry of Housing, Spatial Planning and the Environment then explored what coastal expansion would involve in terms of nature and recreation.
This exploration resulted in the conclusion that the 'South Wing' had a shortage of about 40,000 hectares of nature and recreation, and that coastal expansion would be a welcome solution to fill some of that shortage. In 2004, the Provincial Executive Council of South Hol- >>





land appointed the 'Advisory Committee for the South Holland Coast' for 'Growing towards Quality', with the instruction: 'expand the Delfland coast in accordance with the principle 'Building with Nature', by constructing a 'Sand Engine'.

Subsequently, the Province appointed the Sand Engine steering group to specify the format and content of the advice. In February 2008, the steering group presented its plan, the Sand Engine Pilot Project, to the Innovation Platform (chaired by then Prime Minister J.P. Balkenende). The plan was well-received. The Innovation platform gave the Sand Engine a high priority on the agenda as an example to put Dutch hydraulic engineering back on the international map.

Plan study

On 23 April 2008, the Ambition Agreement Pilot Project Delfland Coast was signed by the Province of South Holland, the Ministry of Transport, Public Works and Water Management, the City of The Hague, the Municipal Authorities of Westland, the Delfland District Water Control Board and the South Holland Environmental Federation. In this agreement, the above-mentioned parties set out the ambition to start up a pilot project before the Delfland coast, studying and preparing the implementation of a Sand Engine.
In early 2009, the plan survey started, preparing the EIA and determining the location and shape of the Sand Engine. After the decision-making process in the Province and Rijkswaterstaat, the preparations for implementation started in 2010.

Reporting the search

Lenie Dwarshuis

Report of a meeting with Ms. Lenie Dwarshuis, former member of the Provincial Executive Committee of South Holland.

Lenie Dwarshuis was a member of the Provincial Executive Committee from April 2003 through April 2011, with Water and other subjects in her portfolio. She was the administration contact and the face of the Sand Engine, directing and driving the decision-making process relating to the Sand Engine.

When did the story of the Sand Engine start?

We must go back in time to the early 1990's. The Province of South Holland had an urgent need for housing. Coastal expansion was then seen as a great opportunity for building a large number of homes. The preparations were started. There was a discussion for years. Until the day when celebrity comedian Wim de Bie, the last of the 'local Mohicans', stood on a dune in front of a batch of cameras, and spoke passionately about the importance of the continued integrity of the current coast line. 'Hands off our coast' was his message. And it hit home. The administrative and social discussions were soon cut off, under pressure of public opinion.

From the start of my period as a PEC member, I knew that the coast was a very sensitive subject for many. If you want to get anything done here, you must work on gaining support from the very start. Not just in the political arena, but also at all social levels.

Did you think then, this is something I am going to get done?

Yes. A light bulb came on in my head, we were dealing with something special here. I had not expressed that yet, but I had personally decided to continue with this plan: 'This is what we should want'. A new concept with a future.

We had an idea for coastal expansion with three objectives: 1. Water safety, 2. Nature and recreation, and 3. Innovation. Another method for the necessary regular sand supplements, fulfilling the calculated requirement for recreation and nature areas in the province, and contributing to innovations within water management.

Extensive preliminary work - and now it was your move?

I started to prepare the specification of the concept in terms of procedure. By then it was 2005. I ordered a task force, a committee to be appointed, with the assignment:

'Devise a way to expand the Delfland coast for nature and recreation, without residential construction.' This committee included representatives of the key parties involved as well as people who were, in principle, not supporting the idea. My strategy was: create maximum support by involving everyone and allowing everyone's views at an early stage.

No lack of vision. How about political support?

I was able to start working on the political parties once the Coast Booklet was there. Thanks to Ronald Waterman's lobby work, the VVD Parliamentary Group submitted a motion to the House of Representatives when processing the Spatial Planning Memorandum. This expressed support for coastal expansion in South Holland. The next political momentum was initiated by the coalition accord of the Province of South Holland in May 2007.

The Sand Engine concept now received sufficient political support to continue.

Sounds driven - did it work?

In political terms, we were heading the right way.

In particular when Prime Minister Balkenende wanted to present appealing proposals in an Innovation Platform in 2008. He requested the Province of South Holland to come up with a plan within one year. That's when our momentum started.

Ever thought 'this is not going to work'?

Innovation also means incurring a risk. You get off the well-trodden path and you start doing something new.

We came out fine. In particular thanks to the crucial support of the DG Water of the Ministry of Transport, Public Works and Water Management.

However, in political terms, we had not crossed the finish line yet. We had a major financial gap.

Parliamentary groups felt that the € 12 million earmarked for the Sand Engine could be used for other things. I had to get all hands on deck and it really could have gone one way or the other. The Sand Engine reserve was maintained and I had increased political support.

What were the pivotal factors in seeing this through?

Many factors played a role. The commitment of a small core group of persons from various parties that continued to believe in it from the start until the finish, was the driving force making it happen.
I often felt and called myself a trade representative. Continually I was talking about the Sand Engine concept, putting it on the agendas, giving presentations and explanations. To ensure the success of such an innovation, you need an amazing commitment to build support.
And make the right products of course, without people being able to shoot holes in it.
I could count on excellent administrative support with a few employees who really went the extra mile.

The Sand Engine is there - what's next?

My first item: making sure we learn a lot from it. Intensive monitoring of safety, recreation and nature development and the spin-off of the innovation. It is important to indicate in specific terms what we achieved and what we want to achieve in the future. Have we achieved the targets and objectives? How many? My second item: we have to look forward again. Can the Sand Engine concept be applied elsewhere, within the Netherlands and in other parts of the world? The time has come to more specifically define the spin-off.

Looking back, what are you most proud of?

In 2003 we started the plan, and from 2011 you were able to walk across it and the first dunes started forming. Nothing slow about the government in this case. This project was realised very quickly. In less than eight years' time the first idea was developed into a vision, the implementation was planned and the concept was realised!

Let's not stop thinking.

Let's make opportunities and possibilities visible.

You can do much more with it!

Increase the user value

Benno Wiersma and Jan Zegering Hadders

Jan Zegering Hadders is the former Chairman of the New Holland foundation.
He had many positions within the banking sector. He was the Chairman of the Group Executive Board of ING the Netherlands from 2000 through 2007.

Benno Wiersma was a fellow founder and the Secretary of the New Holland Foundation.
Benno is an entrepreneur and mainly involved in sustainability projects.

A world exhibition?

Yes, that was part of our ambition. In 1992, when we started the New Holland Foundation, we saw it as a great opportunity to put the Netherlands on the map.
We lobbied for organising a world exhibition on a coastal expansion in front of the South Holland coast line. Presenting the Netherlands as the epicentre of construction and other works to do with wind, water, energy, coast and sand.

A plan with just nature and also homes?

We are entrepreneurs. We realised the plan could be realised only if we could find investors. Coastal expansion of the Waterman Plan scale based on nature only was impossible to finance back then. In those days, the need for homes was urgent. In the spirit of the time, we thought we could cover the funding needs by building homes.

But you met resistance

That's right. A plan with lots of red zones was financially feasible, but did not gain any social support. No more red zones, the primary goal had to be blue and green only.
So we went back to the essence of the Waterman Plan, with a substantial natural area.

And you managed to get a feasible plan?

Yes, Ms. Lenie Dwarshuis, who then became a member of the Provincial Executive Committee of South Holland, became passionate about it, and then the whole idea of the Sand Engine was born. This fitted very well in our vision of 'stringing beads'.
One step on the way towards a complete system. An opportunity to experiment and get creative developments going.
The Sand Engine is an excellent starting point for initiating further coastal development.

Could this expansion of nature be financed?

Initially, no. Rijkswaterstaat was not willing to finance it all. Then the Province made a contribution. And us, the Foundation, went to the dredging companies with the request of working at a maximum fixed price, ensuring the Sand Engine cost could never exceed the maximum. They agreed under conditions.

The Sand Engine is there now

We can do more with it! Let's try and increase the user value. For example, organising a major event for young people between age 20 and 35. The Sand Engine is naturally great for science and researchers. Also, we should review the possibilities that the Sand Engine offers in terms of further development. Let's not stop thinking. Let's make opportunities and possibilities visible.

What should be happening?

The Sand Engine is dynamic. Maybe we should maintain it, or even increase it, when we fill it up again. I see the Sand Engine mainly as the first start of 'stringing beads'. Let's now figure out how we can make that happen. To us, it is important for coastal development to fit into a broader range of issues. We advocate preparing a Masterplan. A plan specifying and adding to opportunities and possibilities of the entire region.

Where will we be in 20 years time? Will the world exhibition become reality?

We are still going for it, it is still a unique option for profiling the Netherlands.
In 10 years' time, further coastal expansion is possible between Hoek van Holland and Scheveningen. If the governments are prepared to issue a 30 or 40 year concession to parties for further expansion of the area, it will certainly happen.

Hans Kleij

Report of a meeting with Programme Director Coastal Development Province of South Holland.

He was the Programme Director Coastal Development for the Province of South Holland from 2003 through 2006, and responsible for Coastal Development and the Sand Engine.

If we had to do it again?

"... At the beginning, make very specific agreements with the national authorities, rather than 50 meetings!" The Sand Engine is the result of a long process, and we, as the Province, have had to pull the ropes very hard to get the other parties to take action. At the start, not many thought it was a good idea. There was no immediate drive to change anything. It took a while before everyone realised the meaning and impact of the Sand Engine.

Now everyone is enthusiastic

Certainly, everyone loves it now. The opposition have become the supporters. I am proud of the Sand Engine being there now. If you fly in with an aircraft, you know you are home when you spot the Sand Engine.

Quite a dramatic change in a few years' time. What happened?

Many factors played a role.
Lenie Dwarshuis was vital, of course. Her power and drive were crucial. If I look back, I see a long process with a few key cohesive strategic actions. It all starts with a good story. We never specifically presented the Sand Engine on its own; rather, it was always part of the bigger picture.
We made the Sand Engine part of a broader vision on the future of the South Wing. The South Wing was not doing well. An OECD report spelled this out.
The economy was down, the infrastructure had plenty of room for improvement, and in particular relating to recreation and nature, we had major gaps.
We then went on to frame this, comparing it to the Ruhr area in Germany, to London and Paris. We started presenting this story everywhere.

Great story, grand design, but how did this lead to the Sand Engine?

The core of our story was: nature and recreation can no longer be realised in the densely urbanised areas. Instead, we should use the coastal region. A coastal expansion in the form of the Sand Engine. A fantastic opportunity for realising areas for nature and recreation. Very close to major cities such as The Hague and Rotterdam.

Did this convince Rijkswaterstaat to enthusiastically join in?

No, not at that point. The national authorities were divided on the issue. Rijkswaterstaat's policy remained: we are bringing the coast in order as usual.
We continued to developed the strategy and started filling the organisation. We also spent a lot of time and attention to informing and managing the surrounding residents and environment.

I don't hear anything about 'Balkenende's Tulip'?

This was Balkenende's idea, to develop a symbol of the Netherlands in the form of a tulip-shaped island at the coast, and it certainly played a role. I called it 'outboard engining'.
For the process to be successful, it is important to tell the story to others outside your own circle. The ambition to innovate was the driving factor. Balkenende was the Chairman of the Innovation Platform, and together with the dredging companies and the New Holland Foundation, we created a broad plea for innovation.

The Sand Engine is there. It works - what's next?

We are on the verge of great coastal development, here in South Holland, and also elsewhere. The coast is safer, nature is developing, people walk, swim and surf, and extensive research is being conducted. Another result of the Sand Engine process is that we created more support and involvement in the coastal issues, compared to when we started in 2003. We have a better starting point for new developments.

Sand Engine Management

Contributed by Ben Girwar

Project leader Sand Engine Management, Province of South Holland (from September 2013)

Who were involved in the operational management of the Sand Engine?

Rijkswaterstaat (the Directorate-General of Public Works and Water Management), the Province of South Holland, the Delfland District Water Control Board and the Municipal Authorities West and the City of The Hague have agreed and allocated the operational tasks between them.
Following up on the management agreements, specific agreements on tasks and authorisation were made for the Province. This is full-circle supervision and monitoring.

What does the management consist of?

Supervising and applying the management agreement.
The management agreement sets out that the Province is responsible for management in enforcing the operational management agreements. The municipal authorities and Rijkswaterstaat also perform operational management components.
Daily operational management tasks are a shared responsibility. A management protocol sets out a wide range of 'unforeseen' circumstances, with appropriate measures to resolve them. This allows for quick intervention without having to complete a full consultation and decision-making process. This works very well in reality, as all parties involved understand who does what and when. In special conditions, the protocol is always applied in consultation, with people from the different bodies seeing each other as direct co-workers. That allows for smooth collaboration, switching quickly and helping each other.

What do you mainly focus on as a project leader?

Consultation with all parties, leading excursions, answering questions from the Provincial authorities, ensuring that monitoring is performed for policy components that are relevant specifically to the Province. This includes nature development, recreation and fulfilling obligations pursuant to legal requirements and permits.

How about recreation?

The recreation objectives of the Sand Engine have worked out very well ever since it was opened. The key questions are: is it an attractive area, do people make frequent and different use of it, and how do people experience it. We conducted a baseline measurement with a follow-up measurement in the first year after completion.
This was very critically monitored when making the plans and during construction of the Sand Engine. Now I hear many enthusiastic reactions, and I am often asked if this would be possible in different locations.

How is nature doing?

We base our nature monitoring on field observations and pictures. The number of fauna and flora species has increased annually. In particular bird counts and vegetation snapshots give us a tangible idea.

Is this the best monitored and most intensively managed section of beach in the Netherlands / Europe?

Yes. This is the best monitored and most researched section of beach in the world. The Argus pole sees everything with its 12 eyes. Surveillance rounds are patrolled on foot and by car on a daily basis. Visitors, sports players, managers and pavilion managers are more on-site eyes and ears.
Both the beach and its surroundings are carefully monitored.

Lost on the Sand Engine

Some situations were so odd, we could never have anticipated them. On a very foggy day, with the Sand Engine all abandoned, a blind man had lost his way on the Sand Engine. I was able to assist him. Amazing that of all people, he ran into me...

A complete school group got lost too. It was dark, of course. But if you read the signs and pay attention to your environment, you will always find your way again.

Just go ahead and try

Ineke van der Hee

Report of a meeting with the former Head Engineer and Director of RIKZ (National Institute for Coast and Sea) and Rijkswaterstaat West Netherlands South.

Ineke van der Hee was involved in the decision-making process of the Sand Engine in the period between 2003-2006. From 2010 - 2014, she was the Head Engineer and Director of Rijkswaterstaat West Netherlands South, and in this position responsible for the construction of the Sand Engine.

When did the story of the Sand Engine start for you?

In 2003, the innovation department of the National Institute for Coast and Sea (RIKZ) had an idea to deal differently with sand for coastal defences. There had to be a smarter sand deposit system. I was interested right from the start.

So you were in favour of constructing the Sand Engine from the very beginning?

Yes, because innovation also means taking risks. You have to be open to that. And I did not see any major risks in the Sand Engine. The sand was not the risk, in any case. Suppose it had not worked - the sand would not be gone. It may have shifted, but it is still useful. So my standpoint was: why should we not do it? Let's just try.
Rijkswaterstaat is always looking for innovative solutions to future water issues, trying out new ideas and demonstrating these to co-workers, water managers and the public. The Sand Engine fitted the bill.

Still, Rijkswaterstaat is not known for its leading role in the beginning…

No, that is correct. The concept of the Sand Engine was growing in the innovation circles.
Simultaneously, a large group within Rijkswaterstaat saw problems. They were very sceptical in the beginning. Their main argument was: it is not in the right place.
Naturally, many parties, both within and outside Rijkswaterstaat pointed out the disrupting effects.

How did you break through that?

First we looked within the organisation for the people who were in favour and brought them together. Then we continued telling the story internally, we kept explaining the principle. Slowly the group in favour grew. Looking back, I now recognise that the project organisation for construction of the Sand Engine picked up on that well, and got to work with enthusiasm.

What was the pivotal point?

We reviewed the risks, and agreed what to do if it didn't work. We created a plan B. Maybe it was not going to work at all, but then at least people see that we made an effort to innovate. And that was fine for most. There was some resistance, both within Rijkswaterstaat and the external parties. There was also a lot of discussion outside my organisation. The misunderstanding about the Waterman Plan was not helpful, of course.

What happens next?

I think the Sand Engine is a key example of how market parties, the government and science can create innovations together. This innovation and the knowledge that is being developed allows the dredging companies to move forward. At this moment, many people and parties are enthused. We should use this momentum.

Coastal supplements policy and

Contribution by Jasper Fiselier

Jasper Fiselier is Leading professional at Royal HaskoningDHV Water Management.

He was involved in the Plan Study for the Sand Engine and preparing the EIA. Based on his expertise relating to the morphological and hydrological process in coastal defences, he played a vital role as a content advisor in the plan preparation and decision-making process.

What happens to the coast if we do nothing?

The natural tendency of large sections of the Dutch coast is erosion. The coast line has moved land-inward over the past few millennia, among others due to the sea level rise.
At a few hundred metres before the Delfland coast line, you can see the remains of a Roman fort and of the former Ter Heijde. This erosion process has been stopped to some extent by placing breakwater heads. Since 1990, the coast line is mainly maintained using supplementary coastal deposits.

The coastline is not an optimally bow-shaped line everywhere. Some places stick out like a rampart.
Ramparts suffer from extensive erosion. Along the coast, long breakwaters obstruct the lateral transport of sand, also causing local erosion.
If we stop the supplementary deposits, these points are the quickest and farthest to recede. Safety is compromised in places like the Delfland coast, protected by a narrow line of sand dunes over a long stretch.

What are regular supplementary deposits?

The coast is measured annually between dune stretches and the approximate NAP (regular Dutch water level) - 7 metres depth gauge.
If it is clear from such annual measurements that we are going to be short on volume, we make supplementary deposits. There are dozens of places where large supplementary deposits of sand are required every 5 years.

Will this increase in the future?

The Netherlands is the champion in supplementary coastal deposits already.
This is due to our coastal policy with the motto 'soft where possible and hard if necessary'. Supplementary sand deposits are also very cheap in the Netherlands. We have lots of sand nearby and we have a dredging sector capable of efficient supplementary deposits using large vessels.

We are currently making annual supplementary sand deposits of approximately 12 million cubic metres per year. The estimates of the probable increase range from 20 to 80 million m3 per year. The bandwidth is caused by the bandwidth in the forecast sea level rise, and also the extent to which we aim to have large reservoirs such as the Wadden Sea grow in line with the sea.

What is the baseline situation, and what is the situation in 20-30 years?

Upon construction, the Sand Engine looks like a peninsula. Immediately upon completion, the Sand Engine needs the hook for a while to 'attach to the land' and provide sand to the beach.

morphology

Where does the sand go?

After 20 to 30 years, the Sand Engine will have worn away further on the seaside. The measurements currently indicate erosion to an extent of 1 million m3 per year. This is mainly due to the Sand Engine. This erosion will decrease the sand supplements further to below 0.5 million m^3 per year.

That will be closer to the sand supplements required for the Delfland coast before the construction. The Sand Engine will become flatter and much longer, leading to expansive beaches.

Wide beaches lead to dune development based on a process of natural dune development.

After 20 years, this may amount to 10 metres, and locally as much as 50 metres of extra dunes.

Most of the sand will remain close to the coast line. Some of it contributes to dune development and a small portion disappears into deeper waters.

Think of a smarter way

Marcel Stive

Report of a meeting with Professor Marcel Stive, Professor of Coastal engineering at Delft University of Technology, Faculty of Civil Engineering and Geosciences from 2001.

Marcel Stive is a member of the Expertise Network Flood Defences, and also an advisor to Dutch coastal projects.
He also advises foreign authorities.
He was involved in the Sand Engine development process from the very start.

Where does your story of the Sand Engine start?

The story about coastal expansion along the Delfland coast stretches over the past 20 years. At some point, the process ground to a halt due to an unfortunate public perception. Then the challenge was: “think of a smarter way“.

Why did it grind to a halt?

We had discussed coastal expansion along the Delfland coast for a long time, based on the Waterman Plan. This plan attracted much sympathy from parties involved, both in politics and the business world.
Then a consortium made a new plan for coastal expansion, letting go of the principles of building with nature. Public opinion rallied against it.
That was sand in the engine... The mission was then: “think of a smarter way“.
We set out to analyse things, Dirk Sijmons, Gerard Loman and I. Dirk to define the spatial planning requirement, Gerard to assess feasibility, and I for the coastal morphology aspects. Then we specified the concept of a mega-dose of supplementary sand deposits.

When did the story of the Sand Engine start for you?

IIn my perception, the Coast Booklet was the starting point. At the request of the former Secretary of State for Traffic and Water Management, Ms Melanie Schultz, Ms Lenie Dwars-huis instructed the Tielrooij Committee to prepare a vision.
This resulted from the Weak Links policy. Minister Schultz had reserved 750 million euros to tackle the Weak Links at the time. Then the Minister challenged everyone to come up with plans for multi-functional spatial planning for a natural coast line.
Then it was clear that if you want more than water safety, you have to contribute.

Why was it successful?

We had a vision, the concept of a mega deposit.
The decisive factor, however, was the political action of Lenie Dwarshuis and Tineke Huizinga. They invited good advice, acted with great political sensitivity and made decisions. Lenie provided support within the Provincial Council. And Tineke had the political courage to get involved.

The administrative officers were the crucial factor?

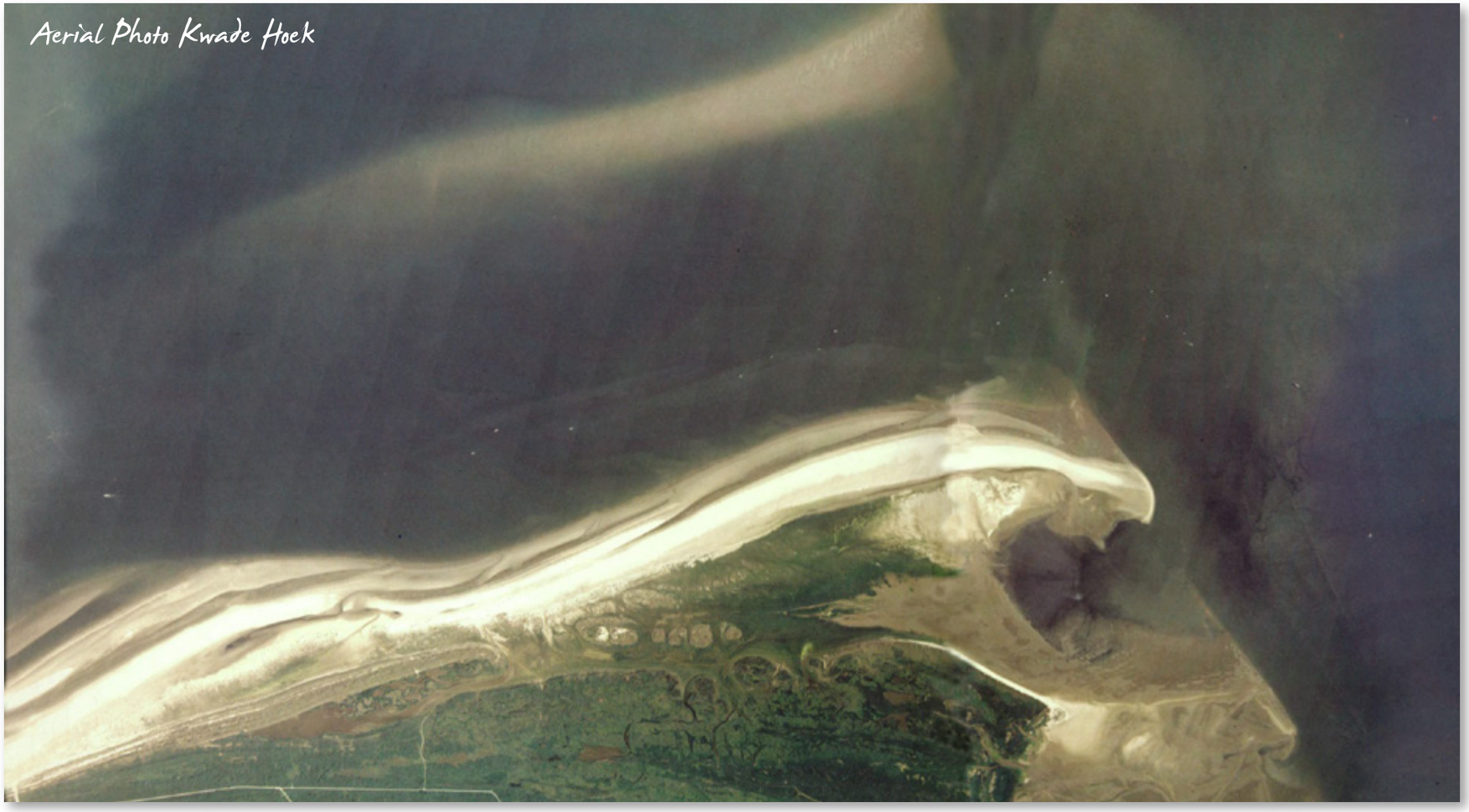
Yes. Lenie and Tineke were ‘administrative champions’.
I very much appreciate them for believing in it. If they would have had qualms, the Sand Engine would not have materialised.

The pilot is now running. When is it successful?

I would be baffled if we are not successful. But I have not properly considered the follow up. I was focusing on plan preparation and realisation for such a long time. We did not think too deeply on what we would come across once the Sand Engine would be in place. For example, how to deal with the media, with visitors and communication.

What’s the next step?

Let’s learn some lessons from the Sand Engine first.
We set up an extensive research programme.
Many aspects of the Sand Engine are being researched, including the morphological processes, swimming water safety, ecological development, changes in ground water and governance.
We are plenty innovative - but first we should learn about the morphological processes, the development of the vegetation, dune development, recreation, etc.


Aerial Photo Kwade Hoek

Innovation is taking risks – but when it works, it bears plenty of fruit!

Tineke Huizinga

Report of a meeting with Tineke Huizinga (former Secretary of State Traffic and Water Management, and former Minister of VROM, Ministry of Housing, Spatial Planning and the Environment).

In the period February 2007 - February 2010, Tineke Huizinga was the Secretary of State of Traffic and Water Management.
She was responsible for the decision-making process about the Sand Engine.
In 2010, Tineke Huizinga became the Minister of Housing, Spatial Planning and the Environment.

Where does your story of the Sand Engine start?
I first heard about the Sand Engine at the 2007 Innovation Day in Maarssen. The 'dredgers' were jointly presenting the 'Building with Nature' concept. I still stress the importance of innovation.
I am convinced that you get ahead with innovation. Continue to innovate, or risk being left behind in economic terms. But unfortunately, risk always plays a role in innovations. And that costs money. Innovation requires being prepared to take a risk.

You were willing to take a risk with the Sand Engine?
Yes, certainly. I was very interested in the 'Building with Nature' concept. I was captivated with what you could do with nature. The Sand Engine was a key opportunity to apply this concept in reality. That immediately spoke to me.

Just dredging companies?
I don't remember the details, but thinking back now, I associate the Sand Engine with an appealing presentation from market parties.
More parties were probably involved. But for me it was the idea that counted. It was also important that the idea at least in part came from market parties. It was a good time to show good collaboration between the government, science and the market.

And the details were prepared with good progress?
Were you involved in this?
As a Secretary of State, you are less closely involved, you cannot keep track of all developments. But the people around me supported the Sand Engine.

It sounds as if it all went very smoothly?
No, not really. The spending cuts within the Ministry were a major threat. In times of crisis, money for innovation is never certain.
The Sand Engine was on the list of projects to be suspended several times.
I ensured it was removed from such spending cuts lists. I never had any doubt that the Sand Engine had to be made.
This innovation, as a specification of Building with Nature had to happen.

What happens next?
First have a look where else we can apply the Sand Engine idea. Take it to an international platform.
In this context, it is important for the Netherlands to have a single 'water face' abroad. All water-related parties should jointly communicate the water knowledge. Delta Alliance is an excellent platform. Let's get to work to communicate it, present it at conferences etc.

Who owns the Sand Engine?
Good question. I don't know. We are a group. We should communicate and market it together!

We should have a different way

Annemieke Nijhof

Report of a meeting with Annemieke Nijhof, Director-General at the Ministry of Infrastructure and the Environment from February 2008 through January 2012.

In this position, Annemieke Nijhof was responsible for the Netherlands' water policy.

From 2008 through 2012, exactly the period of the decision about the Sand Engine.

That is correct. In 2008 I was introduced to the Sand Engine concept.
The idea was there already, but in those days, the the Sand Engine concept was becoming more specific, and plans were made. And it was realised by the time I left the Ministry.

But it was not a piece of cake

No, it was not at all smooth sailing. It started with the Innovation Platform meeting in the Kurhaus Hotel. The objective was to communicate innovation. The Sand Engine was discussed as an idea. This elicited two reactions: 1. We are doing this already; and 2. A woo-woo idea that is not feasible.
Still, we reached agreement for further studying the idea. This was based on an agreement, and commitment was garnered for follow-up. The key driver was the broad consensus that you could not eternally continue studying. No longer carrying out pilots on a non-commitment basis.

Still, it was long uncertain whether or not the national government was willing to realise the Sand Engine.

Initially, it was not about the Sand Engine. Rijkswaterstaat had a very different problem. The funding of coastal maintenance was not yet fully organised.

What was your opinion?

I thought the management and maintenance of the coast was not organised effectively. They incurred major costs for bringing in vehicles and vessels for depositing the sand. And that went on year in, year out.
It was clear to me: there has to be another way.
And then the Sand Engine concept popped up. A fantastic iconic project for building with nature and sand. That was very convenient and it was very helpful in convincing people that we should really transfer to a different management and maintenance format, with a different contract type.

An opposition within the administrative top!

We both gave Tineke Huizinga, the then Secretary of State of Traffic and Water Management, a completely different advice. Bert Keijts was very clear. Don't do it! It's in the wrong place. And: first pay attention to a structural solution in management and maintenance.
I supported the Sand Engine; it is an iconic project and I regarded it as an experiment. My key considerations were climate-related: if the sea level rises, will we still continue with our present methods? But before taking such a clear position, I first called the dredging companies. Could they actually fulfil their promising concept, and did they want to cooperate?

How did you solve the situation?

It was Tineke Huizinga who settled the matter. Eventually, in her opinion, we should make room for innovation, and she decided to realise the Sand Engine as a pilot.

So Rijkswaterstaat drew the short straw?

That's what it looks like now. But we can conclude now that there is more investment in the development of management and maintenance. So Rijkswaterstaat's efforts were not in vain.

Looking back, what do you think were the success factors?

The will power of many of those involved. Many of them had the courage to clearly express that 'this thing is going to be reality'. This gave the entire process a very clear focus. There was a general feeling of 'we are working on something new'. That was the driving force.

Are you proud?

Yes! I feel it is important that we managed to convert an idea into a solid project based on an undertow of water world concepts. This has formed the foundation of a paradigm exchange within management and maintenance. After the Sand Engine, we have a very different view on the way in which we should defend our coast.

It is one step in a broad range of developments

Ronald Waterman

Report of a meeting with Ronald Waterman; he was a member of the Provincial Executive Committee of South Holland from 1978 through 2011. He is currently a consultant with Deltares, the Ministry of Infrastructure and the Environment, the Port Authorities of Rotterdam and the Province of South Holland. He is also the honorary Director of the Building with Nature Foundation, and a guest teacher.

His life is characterised by finding answers to the question how many existing and future problems in urban concentrations relating to spatial planning, economy and the environment can be resolved with a cohesive, well-considered solution while creating added value. In his position as a member of the Provincial Executive Committee, he was directly involved in the decision-making process about the Sand Engine.

The Sand Engine ...

The Sand Engine is a special baby in the large family of coastal locations through Building with Nature. I am not primarily interested in the Sand Engine as such; rather, I am interested in integral coastal development, making use of materials, forces and interactions in nature. The story of 'Building with Nature' has a broad context, and starts before the Sand Engine story.

How far back in time should we go?

I place 'Building with Nature' in a long-term development of Rijkswaterstaat in the Netherlands. We started with building mounds in the old days; then we constructed dams, locks and dikes to protect us against the sea and river water. Subsequently, we had the polder pumping systems, first using windmills, then steam-operated pumping systems, followed by the impressive Zuiderzee works. The next phase in this development was the Delta locks, to control opening and closing entire sea firths. The latest phase in water management is the integral, multi-functional, sustainable coastal reinforcement and coastal development based on 'Building with Nature'.

What does that involve?

The essence of coastal reinforcement based on Building with Nature is aiming for a new, dynamic balanced coast line, with a minor maintenance factor in the form of a periodical sand deposits.
This means no longer dominant roles for dams and dykes as ramparts against the sea; instead, dunes and beach in harmony with the sea. A flexible, dynamic balance between dunes, beach and sea. The coast has many processes, including tides, wind, waves, gravity.
These powerful forces continually change dunes and beaches. This involves waxing and waning. In Building with Nature, we aim to make use of the shifting sands and the forces and interactions involved.

But the coast is more than just sand!

It is not just the physical, hydraulic and ecological processes. The coast also has spatial functions. In my perspective, an integrated, multi-functional and sustainable coastal policy plays a central role. How can we approach all problems and functions of the coast in interactive cohesion, and how can we provide added value. That is relevant in all delta areas in the whole world. We can see immense urban and economic developments in all delta areas. 80% of the largest urban agglomerations are located in a delta area. Everywhere, they are faced with the challenge to combine human activity and the spatial design with adequate protection against the sea. In particular in such vulnerable, lower-lying and densely populated areas, space is at a premium. There are three things you could do: better use of the third dimension with multi-functional land use; using the possibilities in the existing hinterland; or move into the sea. The sea will give you more space with opportunities for functionality while increasing safety.

When did the specific concept of the Sand Engine come into the picture?

That is hard to say, as the Sand Engine was preceded by a long process of planning, research and consultation relating to coastal expansion along the Delfland coast. I always advocated recovering the approximate historical coastline in the shape of a concave coastal line. From IJmuiden to Scheveningen, the coastal line is concave. Near The Hague, it becomes convex. My goal is a concave coastline.

But a plan had been prepared for the coastal expansion?

That is correct. As early as 1980, the Province of South Holland decided to research coastal

expansion. In 1990, they decided to involve the market parties in further development. In 1995, this resulted in a poor design in the shape of an island with as many as 60,000 homes and some token green.
This deviated from the original plans. The principle of Building with Nature was violated. This plan blocked any further development for a while.

What happens next?

Of course there is a next phase. The Sand Engine is just one step on the way to a hollow curved coastline of the Delfland coast. The hollow curved coastline is the natural shape. New opportunities will come, such as a sea marina with a tidal lagoon near Hoek van Holland and a substantial natural area in front of the Delfland coast. That will not materialise tomorrow. But in the long run, there will be more and more opportunities to recover the Dutch coastline.
Of course, Building with Nature abroad is a wonderful opportunity too. But that should not automatically be based on the Sand Engine concept. Each site requires customisation based on the local situation. The Sand Engine is a wonderful research project that will provide extensive knowledge that can be applied worldwide.

The Sand Engine family

Description of the projects, of the 'family'

The family is characterised by having 'Building with Nature' as their underlying principle, and the vast majority aims for flexible, dynamic balanced coastlines with a minimum of solid sea defences, and for limited maintenance. To a smaller or greater extent, these fulfil different functions relevant to the existing hinterlands and the adjacent sea. The Sand Engine has a special place among this range of coastal expansions.

1. The Slufterdam.
2. The Second Maasvlakte.
3. Van Dixhoorn Triangle near Hoek van Holland.
4. Expanding dunes and beach along the entire Delfland coast.
5. Spanjaards Duin.
6. The Sand Engine.
7. Expanding and raising the beach near Scheveningen.
8. The option of a fourth Scheveningen Port.
10. Dyke-in-Dune construction Noordwijk (completed).
11. Dyke & Garage-in-Dune construction Katwijk.
12. Katwijk sea marina
13. Seaport Marina IJmuiden / Kennemerstrand / Kennemermeer.
14. Hondsbossche and Pettener sea defences.
15. Hoek van Holland sea marina

Don t make a quilt. Instead, make the step towards long-term integral coastal maintenance

Jan Schaart

Report of a meeting with the CEO of Van Oord Nederland B.V.

Van Oord, an off-shore contractor firm, constructed the Sand Engine in 2010 - 2011 in a joint venture with Boskalis, a dredging company.

What does the Sand Engine mean for your company?

It is an excellent example of 'Building with Nature'. We constructed it together with Boskalis. Now we can use the Sand Engine as an example everywhere. We learned so much, in particular how to build up such a sand construction economically, layer by layer.

Where does your story of the Sand Engine start?

In fact, we were not really involved until the realisation in 2010. The tender request was: who can deposit the highest number of cubic metres of sand for 50 million euros? Due to the materials and rolling stock we had available for the Second Maasvlakte project, we had a lot of capacity at our fingertips, allowing us to make a great offer.
But looking back in time, our story starts in Dubai.

Dubai, the palm tree island just off the coast?

In 2004, we delivered the palm tree island in Dubai.
You only see the top, but most of the work is actually under water. We started building up the sand layer by layer.
That is when our perspective on 'Building with Nature' was further developed and we built up a lot of knowledge.

Did you make the design in-house? Was this not provided with the tender request?

No. The market has clearly shifted. The contractor is increasingly expected to provide the design. That is how it started in Dubai too: "Build me a palm tree island", said the Sheikh. We accepted the order, but we still had to figure out how to build something like that.
I think it is a great development.
Make the plan studies shorter, and let the contractor provide the design, well-considered in terms of realisation options, for example the vessels and rolling stock available.

But your company then incurs more risks?

That is correct. The principals make sure all risks are covered. We are to make the design, and bear the consequences if things don't work out as expected. This is why we like to determine which risks could reasonably not be transferred to a market party, such as a contractor, in close consultation with the principal, for example Rijkswaterstaat in the Netherlands.
Design it, build it, and provide management and maintenance for 20 or 30 years.

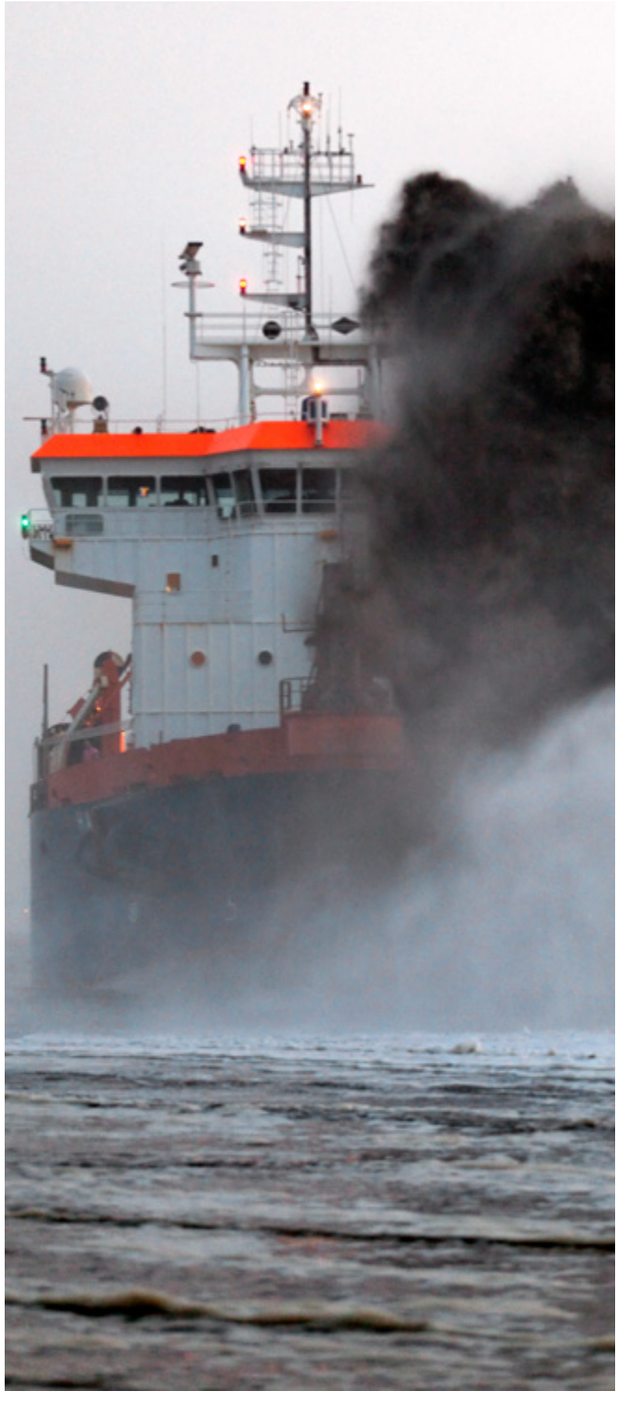
>>

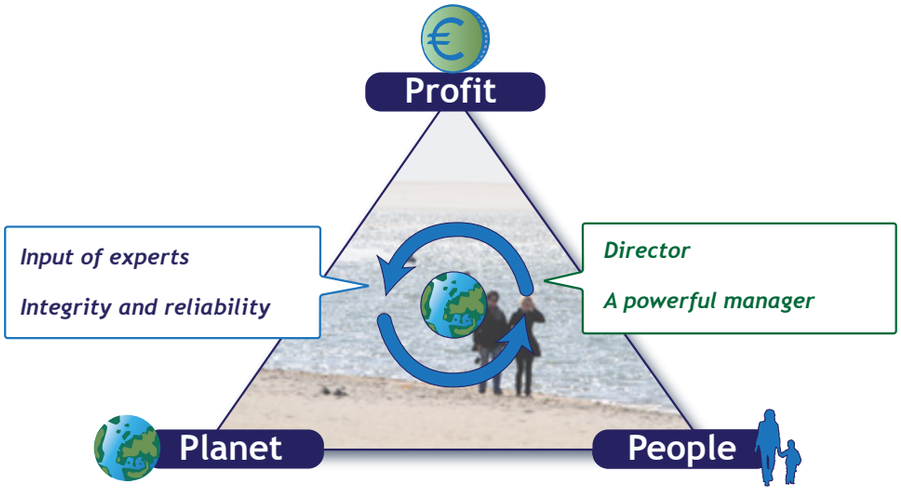
Dutch projects for experimenting and learning.

A major research programme is tied to the Sand Engine. We are involved in the programme via Ecoshape. We are still learning so much from the Sand Engine. As Dutch hydraulic engineers and builders, this knowledge is excellent for marketing abroad. There are many sections of sandy coast throughout the world. We can add a lot of value with our knowledge and experience.

And in 30 years' time...

We will have a completely different range of partnership formats between contractors and principals. The model that contractors are responsible for long-term management of the construction will have been commonplace for decades at that point. Now we are very interested to receive a long-term concession for coastal maintenance from the government, rather than tendering one quilt patch at a time. We would welcome the opportunity of creating the optimal approach for long-term coastal maintenance.





Ellen Verkoelen

Report of a meeting with Ellen Verkoelen, member of the Provincial Executive Committee South Holland and member of the Council for rural areas.

Ellen Verkoelen was the Managing Director of the South Holland Environmental Federation from 2000 through 2009, and as such involved in the decision-making process about the Sand Engine.

Successful projects and development provide a balance between Profit, Planet and People. Without that balance, things go wrong.
The Sand Engine is balanced. That is why it was successful.

How was this balance achieved?

Thanks to a strong director. Lenie Dwarshuis was a powerful executive who directed the entire process. She balanced all interests in the project. She really went for it. That is the role I see fit for executives in projects and developments. Standing in the middle of the triangle, and creating balance. Knowledge is also important.

For the Sand Engine, it was essential that knowledge was brought in at the right time.
I very much appreciated the consultants of Royal HaskoningDHV. They were excellent in their role as the expert. Reliable prominent experts with integrity were involved, including Veerman, Waterman and Stive.

When did the story of the Sand Engine start for you?

For me, the story started with the Second Maasvlakte project.
This created some euphoria: we could do so much with sand. In the slipstream of the Second Maasvlakte project, ideas about the Sand Engine popped up. We aimed to tie the various plans together. Our goal was to create a large mass by combining all compensation and plans. This is why I supported the Sand Engine idea from the very start. This development was focusing on retaining and reinforcing nature along the coast.

But the Sand Engine is more than just nature?

In my vision, three things came together:
1. The maintenance of the coastline to counter erosion costs too much money. Should we continue this method?
2. Where can we develop new natural areas?
3. We wanted to innovate, how can we develop something new?

Combining these three questions created very broad support for the Sand Engine. This was a very strong formula. Although there was certainly resistance.

Who, what, when?

The standard principle is that change makes organisations afraid. They continue to base their course on qualities of the past, which >>

makes them often too conservative. This was noticeable in the Water Control Boards. These are technical institutes geared towards adequate management of the water systems. Interventions in complex water management require due care. It is their task to detect the consequences to water management.

How about Rijkswaterstaat?

How about Rijkswaterstaat?
Rijkswaterstaat was conservative as well.
Their job is to manage the coast and ensure compliance with the safety requirements. Our current system does not require them to innovate. But this situation required innovation. The current management method costs a lot of money, and wil continue to increase in costs. And here we had the opportunity to give the Sand Engine added value by linking it to nature development and recreation. We had to grab this opportunity - so did Rijkswaterstaat.

Did you ever think it was not going to work?

No, never. I thought it would work from the very beginning.
The experts had great arguments, the market parties were involved, and we had a powerful executive: Lenie Dwarshuis, she really went for it.
I saw the balance in the triangle People, Profit, Planet emerging, so that could not go wrong. The only risk was politics.
Eventually, we needed enough support in the Provincial Executive Committee to ensure they would pull in the project, and to ensure their financial contribution. And it worked. Lenie Dwarshuis did not even blink.

A success story then. What's next?

Yes, a great success. In one respect we could have done better. That's what we are now faced with. The story did not reach the general public enough.
Communication with the public is very important in projects. From the first stage of a project, the research or inventory phase until the final phase: when making choices and taking responsibility for realisation, communication is very important. Unfortunately, this was not a strong point in the Sand Engine.

Tell us more?

It was too much a project from the Province of South Holland. The communication process was based on the South Holland story. Parties and prominent persons outside the province were not adequately involved in the Sand Engine.

So now it is the national government's turn?

In the future, bring it to a higher level.
Make it a Dutch icon, and fit the Sand Engine into a broader vision on innovation and sandy coastal reinforcement with nature development. It would hurt me if this pilot project would not give rise to any follow up. What that requires now is solid PR and leading figures from business, science and government circles committing to follow-up projects.

A clear impression of the consequences

Marnix Norder

Report of a meeting with the former City Councillor of The Hague with Urban Development, Public Housing and Integration in his portfolio, and City Councillor of the Scheveningen sub-district.

From 2004 through 2014, Marnix was involved in the decision-making process relating to the realisation of the Sand Engine as a representative of the City of The Hague.

The Sand Engine is more or less on your doorstep. How do you like it?

All experts convinced me that it is a solid construction. The media are positive about the Sand Engine. The options for kite-surfing have dramatically increased. That's great.

You needed to be convinced?

Certainly. The Sand Engine was not a given to me. I was fairly critical at the start. I did not immediately see the added value. It does not provide any benefit, only risks to the Scheveningen shipping lane and swimmer safety.
Personally, I felt that was a challenge. As a Councillor, I am always in favour of innovation. It is good to think about innovations, and realise some of them.

What did this mean to your role in the process?

I did not oppose the Sand Engine, but I did not advocate it either.
I was able to be clear towards my fellow Councillors and adopt a positive position. The Province and the national government paid for everything, and they are responsible for any consequences.

If you had wanted to, could you have stopped it?

Well, I did not want to stop it. I had an interest in the coast. Which was to resolve the Weak Link. The redesign of the sea promenade had to be incorporated.
But this cost more than the solutions purely based on safety.
Lenie Dwarshuis was a big help in finding a solution. For me, the Sand Engine was in the slipstream of this project.

What was crucial to you?

The moment when the possible consequences of the Sand Engine were made very clear, and how this could be resolved. This was presented a little late in the process. In the beginning, I was under the impression that it was a technical gadget, and the social effects are all yours. Fortunately, this changed. We suddenly got a very clear picture of the impact and what would be done about it. That was the turning point for me.

If we had to do it again, would you change anything?

Not much. But next time, build the process from the bottom up. Let the plan emerge in a calm process with the stakeholders. And having this type of coastal solution developed elsewhere is something I am happy to leave to others. That is a great task for the hydraulic engineering sector. I focus on telling people about the beautiful city of The Hague.

Proud of our expertise

We were involved at a late stage

Piet Jonker

Report of a meeting with Piet Jonker, Managing Director of Dunea from 1996 onwards. Dunea is the drinking water company for the western area of South Holland.

So Dunea was involved at a late stage?

Yes, that is correct. In the preparation of the realisation stage, the issues relating to the drinking water supply emerged. Reinforcing the Delfland coastline and the construction of the Sand Engine both affect the fresh water bubble and the ground water flows in the dunes. There are some issues. They are depositing salty sand on the beach. That salt rin-ses out, and should not get into the fresh water bubble. That is temporary. The shift of the ground water flows, however, is structural. This would not be so bad if the dunes were not reinforced with rubble from The Hague after an erratic bombing effort of the English in World War II.

This rubble pollutes the ground water and flows into the sea. The Sand Engine and the reinforcement of the Delfland coastline change the ground water flows, causing polluted ground water to flow into the drinking water bubbles. This was fully unacceptable to us.

So you wanted to prevent the Sand Engine from being constructed?

No, we are a government company. So we were not interested in stopping such a project. We were interested in being a partner and finding a solution. We agreed that sufficient measures had to be put in place to sustainably secure the drinking water production.

If these measures would be inadequate, we could always change our mind. Fortunately, this proved unnecessary.

It was a last-minute thing.

Yes, the project was under extreme time pressure. The Rijkswaterstaat project leader wanted to continue and make decisions quickly. We wanted to carefully study it and define the measures in detail. That created tension. But we managed, although it necessitated top level consultation with Rijkswaterstaat. We are glad our expertise was recognised and applied to date.

Do you think the decision-making process about the Sand Engine would have been different if you had been involved at an earlier stage?

The Sand Engine would have been materialised anyway. I don’t know if the design would have been different. In any case, as little salty sand as possible would have been deposited near the dunes. This was included in the EIA, and we could have then had more time to review the effective measures. Such measures could have been considered in the beginning of the design process of the Sand Engine. Now we needed to repair things afterwards.

What does the Sand Engine mean to you now?

Not that much. We were always focusing on the drinking water production in the sand dunes. We like telling our story. We are happy that a good solution was found, realising a safe coastline and safe drinking water production. Additionally, the Sand Engine ensured a deeper relationship with Rijkswaterstaat. So if a similar project is to be carried out elsewhere, a second Sand Engine, it would mean something to us only if it concerns an area that generates drinking water. Then I would be happy to assist.


Boskalis

Swimming safely at the Sand Engine

Contribution by Eltjo Ebbens

Until recently, Eltjo was a strategy consultant and project manager for Royal HaskoningDHV. As a consultant, he was involved in the Sand Engine plan preparation, and also in specifying and coordinating the management of the Sand Engine.

Swimmer safety was an issue at an early stage.

Quite early in the Sand Engine plan study, we determined that swimmer safety is a key aspect in the development of the Sand Engine. The Sand Engine, after all, will affect the coastal currents. Previously, we could predict where the rip tides (deep channels that arise by water flowing back between sand bars at low tide) would arise. With the emergence of the Sand Engine, a dynamic sand bar area can arise. This means that rip tides could arise in various places.

How is swimmer safety organised?

In view of the pilot character of the Sand Engine, we decided against building a separate rescue post on the Sand Engine. Instead, we preferred aligning with the existing infrastructure as much as possible. Subjects that we made arrangements about:

1) making materials available ;
2) the process relating to issuing a swimming prohibition;
3) communication and information to the swimmers and
4) the evaluation and monitoring of swimmer safety.

Experience to date?

The 2012 beach season was the first year we gained experience with the Sand Engine.

In view of the speed of the morphological developments and the lack of experience, we prohibited swimming. The first year was also the busiest in comparison with the beach seasons 2013 and 2014 in terms of the number of incidents and the rescue actions. For example, in August 2012, a group of visitors were surprised by the tide coming in fast. The rescue team had to pick them up from a submerged sand bar. In December 2012, an entire school group were rescued from the Sand Engine. They were surprised by the presence of the Sand Engine.

There were some incidents in 2013 too

In 2013, there were fewer incidents in comparison with the fist beach season. The visitors have become better accustomed to the presence of the Sand Engine.

2014 was calm

The 2014 beach season was a very calm year without any specific swimmer safety incidents.

The rescue teams are supported to full satisfaction by the special ‘swimmer safety app’ specifically developed for the Sand Engine by Deltares. Based on radar images, the app makes accurate forecasts of the sites where rip tides could form. This gives the rescue teams an extra tool for monitoring swimmer safety.

Finally a project with a long-term vision

Adri Bom - Lemstra

Report of a meeting with Adri Bom-Lemstra. She was a Water Plan Policy Officer to the Delfland District Water Control Board until March 2015.

Adri Bom-Lemstra's portfolio included Water Defences and Spatial Planning. She was involved in the decision-making process about the Sand Engine in that capacity.

Sand Engine?

I was always enthusiastic about it.
Finally a project in line with the Lemstra motion. My father, Wolter Lemstra, was of the opinion that the government did not have a clear vision on the question how to anticipate long-term developments relating to issues such as climate change, the development of Schiphol, accessibility of the Randstad area.
In 2005, he submitted a motion to the Senate, which was adopted, calling on the government to base investment in spatial planning more on a long-term vision and on the future structure of the Randstad area. The Sand Engine is a very good way of bringing that motion into practice.

So you always supported it?

When I entered the scene in the steering group in 2010, the planning was already in an advanced stage. Still, a few major decisions were to be made. The decision to realise the Sand Engine was not yet made. But that was not even a discussion for me. We just had to carry out that pilot.
It puts the Netherlands in the limelight. We show the world what we can do. The main thing is that we show that we are working on the future. We are preparing our country for climate change.

So Delfland was a pioneer?

No, we had some internal discussions. The water defence was well maintained. Why invest more? Eventually, it was the will to innovate that decided things.
We were able to explain to the Executive Committee that no additional investment was requested and that water safety was assured.

The Sand Engine has been realised. What was the pivotal factor in the decision-making process?

This was Lenie Dwarshuis' eminent achievement. She navigated the project to successful completion.

But it was not just due to the power of a single person, even if she was a powerful executive?

It was a combination of various factors. Good timing of persons and bodies. The cost was a factor to Rijkswaterstaat. If you have to deposit supplementary sand every single year, it makes sense to see if you can do this different, cheaper. And then there were the dredging companies. They strongly supported construction, of course.

Would you do the same again?

No, I would not go so fast. First await some results. What is the impact on management and water safety? Is it really cheaper?
Before continuing, first we must have solid monitoring figures on the table.
Let's first prove that there is a clear benefit.


INNOVATIEVE PILOT

Important innovation, supported by the Golden Triangle

Roeland Allewijn

Report of a meeting with the Director of Safety and water utilisation of Rijkswaterstaat.

In this position, Roeland Allewijn is responsible for, among others, the National Knowledge and Innovation Programme for Water and Climate.

Where does your story of the Sand Engine start?

In the 1990s, really. Rijkswaterstaat admitted at that time that reinforcing with sand was the best principle for reinforcing our coastline. This approach gave rise to the concept of the Sand Engine at a much later stage.
We slowly grew towards it.

Sand Engine, a good idea?

We will see. We are closely monitoring the development. It is too early to draw any conclusions. The expected benefits of the concept are still to be proven. If positive, we should consider it as an option for maintenance of the Dutch coastline. I feel it is very important that this pilot was realised.

How do innovations arise?

The Sand Engine arose based on intensive collaboration within the so-called 'Golden Triangle' of Market, Government and Knowledge Institutions.
They were working together in developing concepts and specific products that can be marketed at home and abroad.
This ensures integral approaches of issues and actual, feasible solutions.

So the collaboration within the Golden Triangle was a key factor?

Yes, in combination with a group of enthusiastic people. A single party, a single person cannot ensure the realisation of such an innovation. It is all about the group. A broad group was the driver in the Sand Engine. A key factor for the completion of the Sand Engine.

What happens next?

Marketing the concept!

Whose job is that?

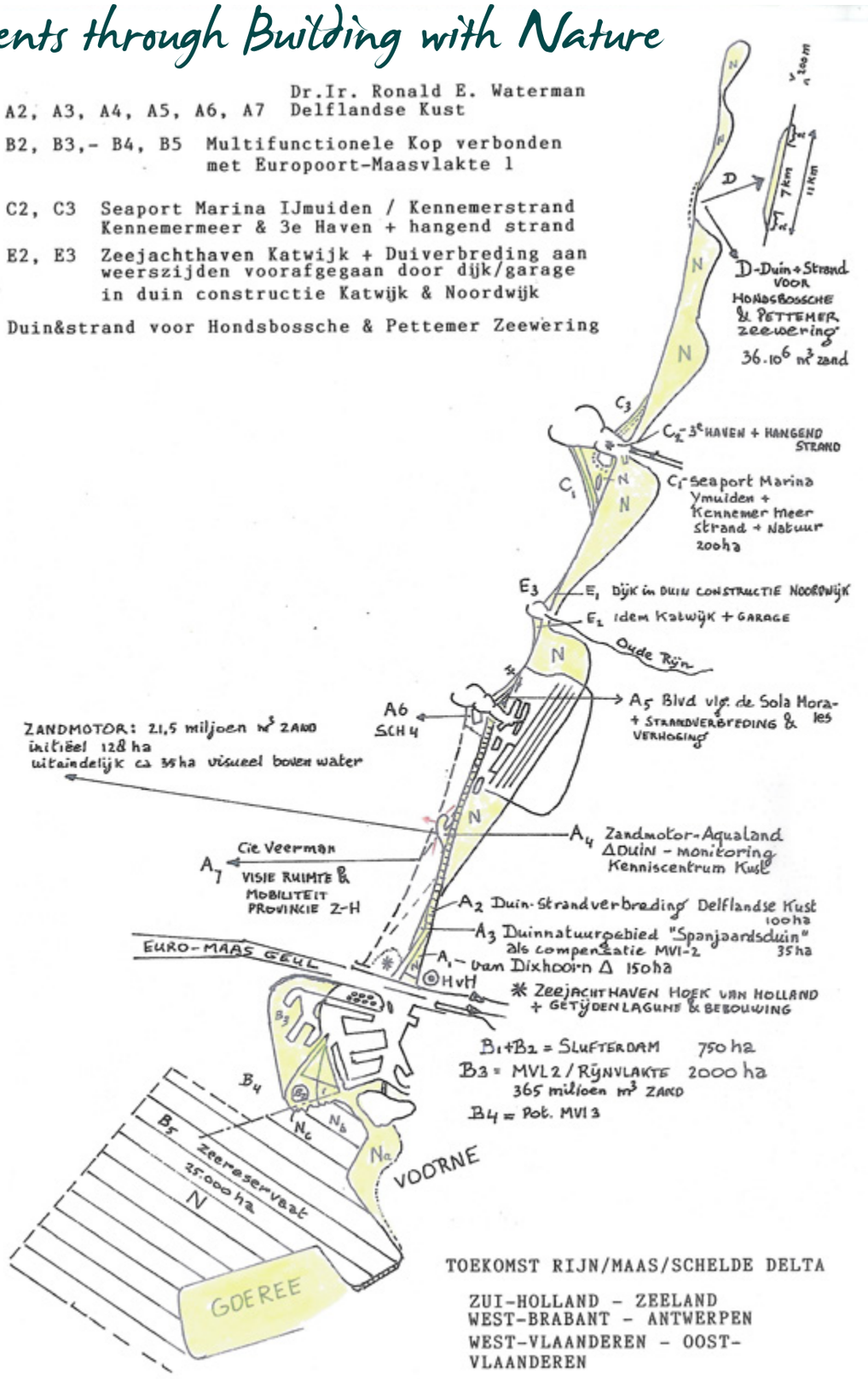
All parties in the Golden Triangle have a key role to play in this context. Deltares, in collaboration with the universities, should ensure further substantiation of the concept. The market should pick it up and market the concept abroad.
And Rijkswaterstaat should continue specifying methods for reinforcing the coast with sand.

'It is fun to see the picture that Andre Kuipers made from space. The small finger of the Sand Engine is clearly visible. We changed the Dutch coastline. I think it is a wonderful innovation and I am honoured to contribute to further developments in the context of the innovation programme. It is a great time to be involved.'

Coastal developments through Building with Nature

Dr.Ir. Ronald E. Waterman

- A1, A2, A3, A4, A5, A6, A7 Delflandse Kust
- B1, B2, B3,- B4, B5 Multifunctionele Kop verbonden met Europoort-Maasvlakte 1
- C1, C2, C3 Seaport Marina IJmuiden / Kennemerstrand Kennemermeer & 3e Haven + hangend strand
- E1, E2, E3 Zeejachthaven Katwijk + Duiverbreding aan weerszijden voorafgegaan door dijk/garage in duin constructie Katwijk & Noordwijk
- D Duin&strand voor Hondsbossche & Pettemer Zeewering



TOEKOMST RIJN/MAAS/SCHELDE DELTA

ZUI-HOLLAND - ZEELAND
WEST-BRABANT - ANTWERPEN
WEST-VLAANDEREN - OOST-VLAANDEREN

It is a flagship – the Sand Engine is ahead of everything

Carola van Gelder

Report of a meeting with the Monitoring and Evaluation Project Manager of the Sand Engine.

Carola has been working with Rijkswaterstaat since 2007; since 2012 as the Monitoring and Evaluation Project Manager of the Sand Engine. She is also the project leader of the cohesive long-term research programme for the sandy coast:'Coastal Genesis 2'.

Where does your story of the Sand Engine start?
When I was involved in the Sand Engine, it was already there. I could immediately start setting up the monitoring programme.

Is this focusing only on water safety?
No, it focuses on achieving all of the Sand Engine's objectives: water safety, nature, recreation and research. The central focus of my programme is: does the Sand Engine fulfil the objectives determined in advance? My assignment is to manage the research and translate it into policy-relevant information. Eventually, we aim to indicate if the Sand Engine is an effective and efficient way to reinforce the coast in the Netherlands and beyond.

Is the monitoring programme actually going on now?
Yes, we published the first policy evaluation in early 2014. This is available from the website. We conducted a baseline measurement in 2011 and monitoring started in 2012. But that was not always plain sailing.

Was there no consensus between the parties involved?
That played a role sometimes - but it was mainly about making choices together.
The research budget is limited. Researching everything that the institutions involved had in mind was not possible.
The question was: what do we really need? The monitoring programme had to focus on a select number of specific elements.

The Sand Engine has now been operational for three, four years. Can you draw preliminary conclusions?
No, it's still early days. The various research topics each have their own dynamics and speed. Relating to morphology, the Sand Engine performs exactly as predicted. The sand is spreading out as expected. It is still too early to see if the development of nature, above and under the water surface, is going as planned.

When will that be visible?
We have to be patient. Monitoring for 10 years is a real necessity. Then we can draw conclusions with great certainty, also on the added value to nature and recreation.
In 2016 we will publish an intermediate report, that will be the five-year milestone.

But should we market the Sand Engine abroad?
Well, it is not a copy-paste thing. Reinforcing using sand must be customised to each individual site.
So we should really talk about a 'sand strategy'. Use the lessons learned in the Sand Engine project and translate it into a customised solution.

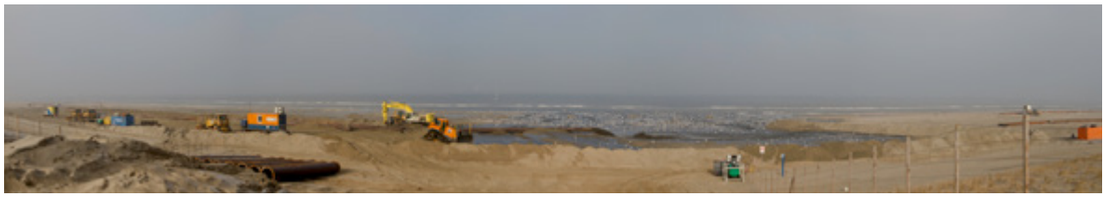
Do you meet any sceptical people?
I see people involved become increasingly enthusiastic.
A few years ago, the sceptics were still voicing their concerns loud and clear: it costs too much money, too much risk, you can't swim any more, etc. I hardly ever hear that anymore!

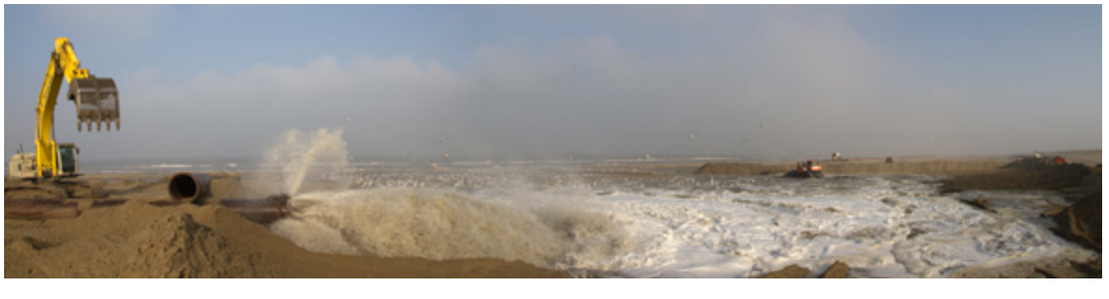
How come?

The Sand Engine is there now. Everyone can see the consequences. We spent a generous amount of time in telling the full story, the objectives and the morphological dynamics, the impact on swimmer safety. This communication provided benefits. Citizens, companies and institutions are now better informed and they can visit and experience the Sand Engine in person.

Was realisation of the Sand Engine a good decision?

Yes, it is a wonderful opportunity to learn about coastal defence optimisation. For example, we can learn so much from it for preparing policy relating to the Wadden area. We have also seen that it is possible to create major added value in people's experience. The Sand Engine has shown a clear transition into a positive experience, the landscape, nature and the recreational possibilities.





Yes, it will provide full return on investment

Jaap van Thiel de Vries

Report of a meeting with the coordinator of the Nature Coast research programme performed by five universities and knowledge institutions focusing on the Sand Engine.

Jaap van Thiel de Vries is also a Programme Manager with Ecoshape, coordinating the Building with Nature innovation programme. He was promoted on dune erosion during storm floods.

In the past three years, we managed to complete a great step forward, gaining much better insight into the morphology, hydrology and ecology processes. The idea is that these insights can be applied in a broader context, allowing us to develop similar concepts of sandy strategies elsewhere in the world.
This is important, as possible new applications of the concept cannot be copied one on one for a different place.

Based on the current knowledge development, we are gaining a better impression of the factors that may be relevant, enabling us a broader application of sand-based coastal defence concepts.

But we are not at that point yet?

No, knowledge development is currently in full swing, and has support from the entire Dutch hydraulic engineering sector. In the first place, Rijkswaterstaat invested in a comprehensive monitoring programme to monitor and record the development of the Sand Engine.
The starting point is: 'if we understand the behaviour of the Sand Engine, it will help us develop sand-based strategies elsewhere'.
Ecoshape, in collaboration with Dutch consultants, contractors and the government, is working on further specification of the business case behind the sand-based strategies.

The Sand Engine is not so big, why so many parties and researchers?

The Sand Engine creates focus. Because we are looking at the same area in the research based on different disciplines, we are able to study all interactions between processes and mechanisms together, gaining a more accurate impression of the driving forces behind the development of the Sand Engine. We can now analyse the Sand Engine as a system, including the governance aspects.

Many parties - was everyone willing to join in?

It cost time and energy to get all parties and funds together.
Eventually, we expressed the wonderful ambition of setting up a single, integrated research programme. Step by step, it became clear to all parties that they could work on it together, retaining their own perspective. And that objectives are best realised when sharing knowledge. The content gained a central place and consultation between the Golden Triangle of contractors, government and knowledge institutions resulted in a shared research programme. From the perspective of Knowledge Development, the Sand Engine creates energy: many young researchers and students are working on it. It attracts the very best.

But this comes with a hefty price tag?

It will provide full return on investment. Other countries are already interested in the Sand Engine concept. We link research to the practical application, so this must provide useful results for Netherlands Limited.
This is an iconic project that appeals to a broad group. It is motivating for your researchers, contractors, governments and many others. And the Sand Engine is not an isolated piece. This is a component, an expression of a broad development towards using different types of flood defences. Everywhere within the Netherlands, we can see that people's perspective of flood defence concepts is developing towards combinations with spatial quality and other functions.

So Sand Engines will be popping up everywhere in the future!

I always speak of the 'Sand Engine concept' rather than 'the Sand Engine'. It really is about the principle of Building with Nature. The Sand Engine concept is not a fixed thing. The essence is a basic principle of building with sand, and then determining the design, structure and use in cohesion with the environment.
The power of a sandy coastal strategy is that the flood defence is there not just to serve us once in 10,000 years - rather, it will continually be useful for various users.

Current research programme

Derived from www.naturecoast.nl

PhD 1: Hydrodynamics/Swimmer safety, Max Radermacher - Delft University of Technology

- How do hydrodynamic (flow and wave) conditions change along a mega-nourishment during a tidal cycle; and how do these conditions change as the mega-nourishment evolves on the time scale of months and years?

PhD 2: Morphological evolution, Jantien Rutten - Utrecht University

- Which processes drive the day-to-day cross-shore sand exchange between the shallow surf zone and the dry beach; and what is the relative importance of cross-shore and alongshore processes?

PhD 3: Sediment exchange between beach and dunes, Lianne van der Weerd - University of Twente

- How do topography and sand surface conditions in the source areas vary over various temporal and spatial scales; where and when does net aeolian deposition occur over various temporal and spatial scales; and how do observed patterns in aeolian deposition relate to meteorological conditions and topography and sand surface conditions in the source areas? What do these findings imply for the optimal design of a mega-nourishment regarding sand supply for dune formation?

PhD 4: Bio geomorphology of dune formation, Corjan Nolet - Wageningen University

- What are the key processes and conditions for making the transition from a bare beach to a vegetated dune; and what system stages exist in this process, how and at what rate do these system stages develop, and how stable are they? What are the causes and indicators and their threshold value for shifts between system stages?

PhD 5: Benthic bio geomorphology in the shallow coastal seas, Simeon Moons – NIOZ

- How does the enhanced but small-scale spatial diversity, and the longer time scale of morphological development in a Sand Engine affect the diversity of benthic communities?
- Can a substantial effect of benthos on coastal stability be proven experimentally?
- Can a Sand Engine favour the development of stabilizing benthic communities in the coast?

PhD 6: Marine food webs in the shallow coastal sea, Marjolein Post - Wageningen University

- Does the Sand Engine lagoon and sheltered area offer enhanced nursery area conditions for juvenile fish and does this have a positive effect on population sizes in the North Sea?
- What is the importance of the benthic community for the quality of the nursery area?
- Does the Sand Engine offer enhanced conditions and attracts foraging birds?
- At what spatial scale do mega-nourishments have a significant effect on fish and birds in the North Sea?

PhD 7: Vegetation succession in existing dunes, Marinka van Puijenbroek - Wageningen University

Aims to understand and predict the effects of the Sand Engine on primary dune formation and vegetation establishment and succession, and to improve the interface among the three modules (geomorphology, vegetation dynamics and hydrology) and to validate them in three situations (mega-nourishment, regular nourishment, integrated management).

PhD 8: Impact in community assembly in beach ecosystems, Emily van Egmond - VU University Amsterdam

Aims to test the generality of community assembly and food web patterns in the surf zone and wet and dry beaches, in close cooperation with PhD 7. The main focus is on the impact of geomorphology through inundation frequency and microclimate modification on external resource input and how this subsequently fuels food webs and steers community assembly of both flora and fauna.

PhD 9. Interaction between hydrology and geomorphology: effects on freshwater reserve, salt intrusion, fresh water outflow, beach stability, Sebastian Huizer - Utrecht University:

- What is the development of the fresh-salt water interface and 3D salinity distribution in the Sand Engine itself and the neighboring beach system during the different stages of morphological development; and how will this be affected by varying sea water levels due to tides and surges?
- What is the effect of inputs of fresh water by precipitation, salt water by sea spray and water loss by evaporation; and what are the possibilities to increase coastal fresh groundwater reserves in other areas of the world via mega-nourishments?

PhD 10. Geochemistry of nourished sediment: changes in environmental conditions for flora and fauna in time and space, Iris Pit - Utrecht University

- What are the consequences for the availability of trace elements and buffering capacity when sea sediment is transferred from anaerobic to aerobic conditions to form a mega-nourishment; and how does trace element availability and buffering capacity at a mega-nourishment relate to a traditional nourished site and a non-nourished site;
- How can trace element availability and buffering capacity change in time and space on a mega-nourishment?

PhD 11. Freeridership and ecosystem services: societal winners and loosers, fair distribution of costs and benefits, Ewert Aukes - University of Twente

- How are gains and benefits perceived (and by whom) and which governance arrangements are in use to (re-) allocate gains and losses and handle free-riders?
- To what extent do governance arrangements (or the absence of them) support or hinder transactions to compensate for losses and to deal with free-riders; and which innovative governance arrangements can deal with compensation of losses and the handling of free-riders?

PhD 12. Mega-nourishments and compelling storylines, Lotte Bontje - Delft University of Technology

- What roles do storylines play in the development and implementation of policy related to coastal management?

Results of the quest – did we get any wiser?

After my search and many highly inspiring discussions, I returned to base camp. Together with Koen Oome and Carrie de Wilde, I prepared the 'balance sheet' of the project. Did we get any wiser about the decision-making process that resulted in the Sand Engine? Which factors were important, and what can we learn to use with other innovations within water management and possibly in other policy areas?

The Sand Engine fits into a broad and long development

Speaking with all persons involved, you get the distinct feeling that sooner or later, the Sand Engine would have materialised. From the 1980's onwards, there was a broadly supported ambition among the administrative executives and policy makers to do more with the coast. Research and exploration into possible coastal developments were an issue from the 1980s onwards. The Sand Engine is a good fit in a broad development of making and discussing plans.

The Sand Engine's fate was hanging by a very thin thread a few times.

The Sand Engine in its current form and place, however, was not always self-evident. Looking at the story of the Sand Engine, we can see plenty of resistance. During the decision-making process, the Sand Engine's fate was hanging by a very thin thread a few times.
For example, what had happened if Prime Minister Balkenende had been captivated by a different innovation at the Maarssen Innovation Day. Or if Secretary of State Huizinga had felt more pressure about spending cuts, and had left the Sand Engine on the 'cut list'?
The Province may have wanted to spend the money for recreation in a different way. Three moments that proved key milestones in the decision-making process about the Sand Engine.

Well-considered strategy

Was the realisation of the Sand Engine more coincidental? Could it have gone either way? From the discussions, the impression is that a large number of factors mutually supported and reinforced each other. We can see that the time was right, after so many years of study and exploration into coastal development. There was a clear, specific version, there were key lobbyists and ambassadors, and a member of the Provincial Executive Committee who wanted to go for it. Was it happenstance that these factors coincided? No. The discussions show that this was based on a well-considered strategy and deployment of many factors.

Whose strategy?

The strategy is of a group of passionate people forming a coalition to make the Sand Engine happen. Roeland Allewijn clearly indicated this: a single party, a single person cannot ensure the realisation of such an innovation. A broad group was the driver in the Sand Engine, from various perspectives, all committed. An important aspect is that this concerned persons representing the full Golden Triangle (government, market parties and knowledge institutions), forming a coalition to make the Sand Engine happen.

Embedded in a broad lobby

The idea of the Sand Engine was embedded in a broad, intensive lobby that had been going for a much longer time. Ronald Waterman and the New Holland Foundation had advocated coastal development and Building with Nature for a longer time. In many places within the governments, market parties and science, the spirit was ready for a concrete coastal initiative.
To many the Sand Engine, after decades of discussion, was a specific possibility to realise visions and ambitions of various parties and from various perspectives.

Make a bigger pie

The broad lobby and support gave the Sand Engine wind in its sails. However, the strategy that was the foundation of the entire process went beyond that. The Sand Engine was linked to a range of goals, was embedded in a larger context, and was dressed with a 'great story', as Hans Kleij indicated in our discussion. This was not just about another coastal defence method. It was also about spatial quality, nature, recreation and knowledge development.
The Sand Engine was proposed as an innovation for combining these objectives, greatly increasing the number of proponents.
All those involved chose their own focus in the substantiation, forming a broad coalition. Looking back on the discussions with the key players, I recognise that all had a cohesive reasoning, with differences only in defining the goals.
Still, the Sand Engine did not come about simply by adding up the various interests. It was also materialising as goals were balanced and cohesive in the bigger picture. This clearly shows in the interview with Ellen Verkoelen. Balance between Planet, People and Profit was a key success factor.

Trust in expertise

From the discussions, we can conclude that the decision-makers were fully confident in the technical content and specifications. In the entire process, the focus was on goals and ambitions, rather than on technical details. This does not mean that these did not play any role. The technical content and details were essential at the appropriate times. In the early phase, the scientific parties could convincingly indicate that the Sand Engine works. During the specification of the Sand Engine, the experts were able to indicate with sufficient authority how the Sand Engine works and the possible consequences it may have.
This input was so convincing that the decision-making process, in spite of the risks presented, had a positive outcome.

Powerful management

We previously mentioned a number of factors that were of great importance in the decision-making process.
However, these factors could not have provided such a major contribution to the realisation of the Sand Engine without the powerful management that was directed by key players. Thanks to this direction, the right items were discussed at the right time by the right persons. This direction and management, in combination with political courage, was eventually the critical success factor.
Not a single one of the above-mentioned factors was critical by itself; it was the combined strategic commitment at the right times that ensured the realisation of the Sand Engine. The clear leader, i.e. Lenie Dwarshuis as a member of the Provincial Executive Committee, was a success factor.

Other innovations

The Sand Engine does not offer a ready-made recipe for someone with a good idea, either water-related or not, ready to communicate it and aiming to realise it. Each innovation has its own circumstances and characteristics. Possibly, one or more success factors in the Sand Engine process can be copied and translated. After 15 discussions with the key persons in the Sand Engine decision-making process, we can provide the following helpful lessons learned:

- Ensure a broad support lobby and organise ambassadors;
- Serve more than one goal, and balance People, Profit and Planet; - Provide the specific technical content at the right time, ensuring this is presented with authority, allowing non-expert administrative and political parties to rely on their information. >>

Trust in expertise is a very important factor.
- Combine the above with powerful management and leadership. An innovation requires a powerful, directive leader.

What happens next with the Sand Engine?

The discussions gave an impression of both the decision-making process and the ambition of those involved. Clearly, the Sand Engine was not a goal in itself.

It is an innovation that we can learn from - learn a lot from. We can then translate the lessons learned into new applications within the Netherlands or outside the Netherlands.

The Sand Engine is now an icon for hydraulic engineering in the Netherlands. A major research programme is tied to the Sand Engine. The focus on the Sand Engine gives rise to scientific added value by combining and aligning the various research studies for a single area.

Also, the Sand Engine is a reason for discussing new coastal defence concepts based on Building with Nature, both at home and abroad. When looking back in 50 years' time, we could commemorate that in the first decade of the 21st century, we started a clear revolution in the way we defend our coastline.

And that this gave rise to many new concepts, both in the Netherlands and throughout the world. This may not concern another Sand Engine as we know it now; instead, it may concern an entire range of sandy constructions. The Sand Engine is not a ready-made recipe; mainly, it can serve as an inspiring foundation for further development and new concepts.

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