Deltares

Enabling Delta Life

The World of Deltares

2013-2016

Foreword

Deltares is a leading independent institute for applied research, operating worldwide in the field of water, subsurface and infrastructure. Since it was established in 2008, more than 800 Deltares specialists have developed innovative insights to make living in deltas safe, economically and socially achievable and environmentally sustainable.

Our research is always a response to the needs of society. We focus on five themes: Flood risk, Ecosystems and environmental quality, Water and subsoil resources, Delta infrastructure and Sustainable delta planning. These priorities guide our strategic research objectives.

Here, in The World of Deltares, we set out the strategic research objectives for each theme for 2016 and the concrete steps we will be taking in 2013 to achieve those goals.

By contrast with previous years, this edition provides an overview of the entire Deltares portfolio: strategic, long-term research, applied research for the medium term and also more short-term contract research for private parties. Knowledge advancement is not something we do alone. We are convinced that it is only by forging alliances that we can tackle the challenges we face. That is why we collaborate closely with universities, other institutes and the private sector both at home and abroad.

And we do not keep our breakthroughs to ourselves; we share them with others. Development of new knowledge depends on sharing the knowledge we have. Government authorities, community organisations and the commercial sector benefit from our research and specialist consultancy. Deltares is an independent, not-for-profit organisation. Our activities always aim to maximise knowledge development and knowledge transfer.

I am proud of the fact that Deltares, despite declining subsidies from the national government, has succeeded in establishing and extending a consistent research line. So I sincerely hope you will enjoy reading this overview of the Deltares portfolio: The World of Deltares.

Best regards,
Maarten Smits,
Managing Director

Deltares
Enabling Delta Life

Introduction

This book of maps, The World of Deltares, presents an overview of the planned activities of Deltares from 2013 to 2016. The aim of this book is to inform interested parties about the complete set of activities performed by Deltares: development of knowledge, transfer of knowledge and specialist consultancy.

The book starts off with a map of the organisation. This map gives insight in Deltares' strategic position, how Deltares organises this position and in the people of Deltares who execute this. The following map presents all themes and programmes, as well as the total revenue in 2012.

As with previous editions, this book is composed along the five themes and 27 programmes into which Deltares has divided its activities. The Argumentation Factory has visualised these on Theme maps and Programme maps. Theme maps outline activities within each theme, focussing on the main issues. These concern, among others, the long-term ambitions, the international field of activity and the key benefits for the public and private sector.

Each theme is divided in four to eight programmes, which show the more specific focus of Deltares' activities. They are visualized on Programme maps. The information suchs as key partners, trends and research questions is shown on the left side of each Programme map.

The right side is composed of three related components: What is the current status of the programme and what are the ambitions for 2016 and for 2013? To illustrate the activities within the themes, Deltares has selected example projects within each theme, which are displayed on Project in practice.

This is The World of Deltares.

The Argumentation Factory was privileged to support Deltares in mapping out its world. For this purpose a process was developed in which, together with Deltares, research questions were formulated clearly and information was collected efficiently. Subsequently The Argumentation Factory has edited information, structured it, verified its consistency, converted it into maps and has assembled these maps into this book. The theme leaders and programme leaders were closely involved during the entire process.

The Argumentation Factory is proud to present the end result, and also grateful for the longstanding and constructive cooperation with Deltares.

Katrin Weber
Daniël Coenen
Sara Blink

The Argumentation Factory

What is Deltares and how does it work?

Position

What is Deltares?

Deltares is a leading independent institute for applied research, operating worldwide in the field of water, subsurface and infrastructure.

What is the mission of Deltares?

Deltares develops, applies and transfers knowledge of top-level expertise in order to enable delta life.

What is Deltares' role within the public and private sector and scientific world?

- Deltares is an independent advisor for governments on a local, regional and national level.
- Deltares accelerates innovation worldwide and strengthens the position of the Dutch private sector.
- Deltares develops applied solutions derived from scientific research.
- Deltares combines its own knowledge with knowledge from other research institutes.

Operation

How does Deltares organise its work?

Themes

- Deltares' activities are divided into five themes, each reflecting challenges connected to living in deltas.
- Together the themes contribute to the realisation of Deltares' mission.

Programmes

- Deltares has organised its themes into several multi-year programmes.
- Together the programmes contribute to the realisation of the themes' ambitions.

Programme lines

- Deltares has organised its activities within each programme into multi-year programme lines.
- Together the programme lines contribute to the realisation of the programme goals.
- Programme lines consist of a number of projects.

Which knowledge-based activities does Deltares distinguish?

Development of knowledge

- Development of applicable knowledge based on fundamental research.
- Deltares develops and integrates knowledge, with global leading research institutes and local research organisations.
- Deltares develops interdisciplinairy knowledge and tools, tailored to the needs of Deltares' clients.

Transfer of knowledge

- Transfer of knowledge is based on open cooperation with governments, the private sector and research institutes.
- Deltares initiates transfer of knowledge by actively gathering and providing information.
- Deltares mainly transfers knowledge through software, models, publications and training programmes.

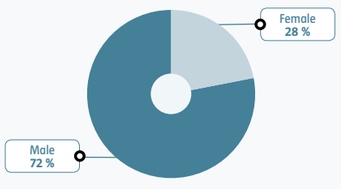
Specialist consultancy

- Specialist consultancy consists of advice on complex issues demanding specialist knowledge for integrated solutions.
- Deltares cooperates with partners worldwide in its specialist consultancy.

Staff

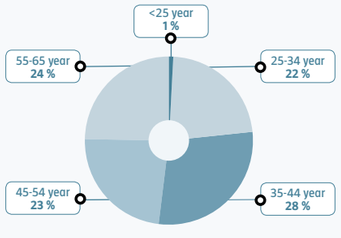
What people work at Deltares?

Deltares' staff consists mostly of men...



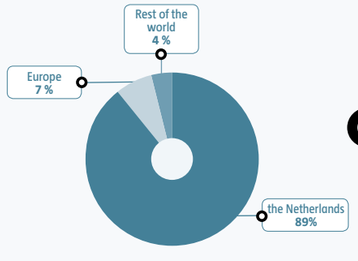
Gender of the people at Deltares

...the staff is of all ages...



Age of the people at Deltares

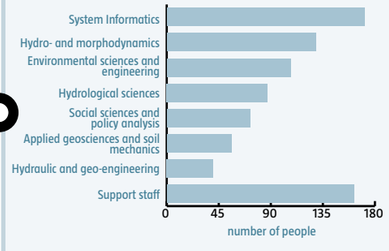
...and is mostly from the Netherlands.



Nationality of the people at Deltares

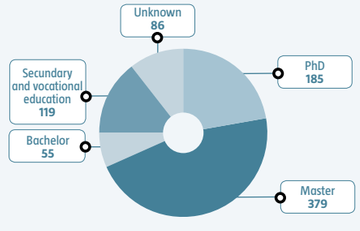
How is Deltares' staff trained?

Deltares' staff consists of a specific mix of disciplines...



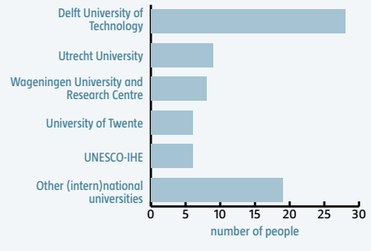
Educational background of the people at Deltares

...the 824 staff members are highly educated...



Education degree of the people at Deltares

...and most of the PhD students work in Delft.



Number of Deltares PhD students per university

Which are Deltares' themes and programmes and how is revenue divided?

Theme 1 Flood risk

Which programmes make up theme 1?

- Flood risk strategies
- Real-time information for flood event management
- Coastal, estuarine and river morphodynamics
- Event-driven hydro- and morphodynamics
- Dikes, levees and dams

Theme 2 Ecosystems and environmental quality

Which programmes make up theme 2?

- From catchment to coast
- Ecosystem services
- Eco-innovation
- Eco-engineering
- Next generation information tools

Theme 3 Water and subsoil resources

Which programmes make up theme 3?

- River basin management
- Water supply in urbanising deltas
- Sustainable energy from water and subsoil
- Characterisation and visualisation of the subsurface

Theme 4 Delta infrastructure

Which programmes make up theme 4?

- Ports and waterways
- Offshore engineering
- Coastal and river structures
- Underground construction in urban areas
- Roads and railroads in delta areas
- Subsidence
- Industrial systems and infrastructure
- Coastal developments

Theme 5 Sustainable delta planning

Which programmes make up theme 5?

- Delta governance
- Climate, water and spatial planning
- Concepts, methods and instruments for spatial planning and policy making
- Sustainable delta cities

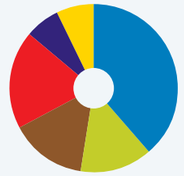
This programme supports the other themes and programmes

- Software innovation

Revenue

How is revenue divided among the themes for 2012?

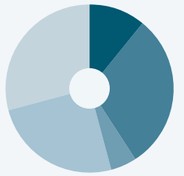
(x €1.000)



€	43.500	Theme 1	Theme Flood risk
€	15.500	Theme 2	Theme Ecosystems and environment quality
€	16.500	Theme 3	Theme Water and subsoil resources
€	21.000	Theme 4	Theme Delta infrastructure
€	7.500	Theme 5	Theme Sustainable delta planning
€	8.000	Software	Programme Software innovation
€	**112.000**		**total**

How is revenue divided among the funding sources for 2012?

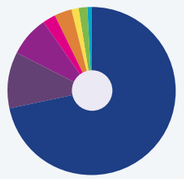
(x €1.000)



€	12.200	Min EA	Ministry of Economic Affairs
€	33.700	Min IE	Ministry of Infrastructure and the Environment
€	5.500	SR Prog	Subsidised research programmes
€	28.100	Private	Private sector
€	32.500	Public	Public sector
€	**112.000**		**total**

How is revenue spread across the world for 2012?

(x €1.000)



€	80.190	NL	the Netherlands
€	12.200	Eur	Europe (excl. the Netherlands)
€	8.900	SE Asia	South East Asia
€	2.600	Mid E	Middle East
€	3.800	America	America
€	1.400	Austr	Australia
€	2.000	Africa	Africa
€	910	Rest	Rest of the world
€	**112.000**		**total**

What are the revenue ambitions for 2016?

- The revenue from the European Union, foreign governments and the private sector in the Netherlands and abroad will increase significantly.
- International revenue will amount to one third of the total Deltares revenue.
- The total revenue will remain the same, or may increase slightly.

What is the theme ‘Flood risk’?

Basic information

What is the focus of this theme?

The theme is about flood risk in deltas (coasts, rivers and estuaries) all around the world.
The theme develops knowledge, tools and approaches for flood risk management in deltas (coasts, rivers and estuaries).

Who is the theme leader?

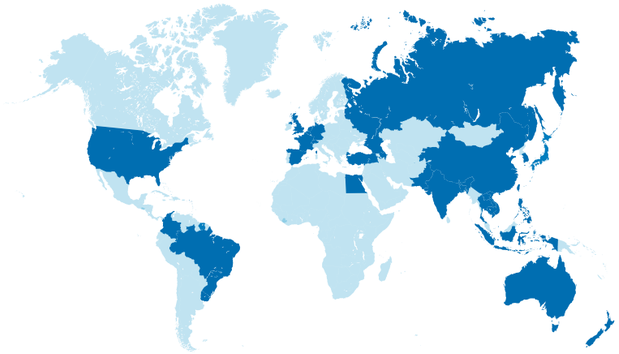
Jan Aart van Twillert (janaart.vantwillert@deltares.nl)

Which programmes are included in this theme?

- Flood risk strategies
- Real-time information for flood event management
- Coastal, estuarine and river morphodynamics
- Event-driven hydro- and morphodynamics
- Dikes, levees and dams

International

In which parts of the world is Deltares currently active and which will have been added by 2016?



Australia, Azerbaijan, Bangladesh, Belgium, Brazil, Cambodia, China, Colombia, Egypt, France, Germany, Indonesia, the Netherlands, New Zealand, Philippines, Russia, Singapore, Spain, Switzerland, Thailand, Trinidad and Tobago, United Kingdom, United States, Uruguay, British Virgin Islands and Vietnam. — countries and regions

Deltares increases its activities in the current countries and regions. — 2016

Context

What are relevant trends?

- The flood risks in deltas are increasing because of climate change, land subsidence and urbanisation.
- Climate change is increasing flood risks, due to rising sea levels and changing wind, wave and precipitation patterns.
- Land subsidence is increasing because of soft soils, changes in water use and geological effects.
- The growing population and increasing economic activity aggravate the consequences of flooding.
- The number of stakeholders involved in flood risk management is increasing.
- New insights are leading to a growing importance of natural processes in flood risk management.

Which issues from the public and private sector and scientific world will be addressed?

- How can (impacts of) hydraulic loads and water defence strengths be predicted and assessed?
- How can measures to prevent, manage and mitigate floods remain effective, affordable and technically feasible?
- How can the Netherlands be optimally prepared for flooding, during extreme events and in the long term?

Ambition

What are the goals until 2016?

- Deltares will develop procedures and warning tools to manage and mitigate effects of floods.
- Deltares will provide innovative, cost-effective solutions to improve flood risk management in deltas and urban areas.
- Deltares will improve its understanding of the occurrence and impacts of floods.
- Deltares wil improve its understanding of how to deal with (impacts of) flood hazards and extreme events.

What is Deltares’ position, now and in 2016?

- Deltares is currently, and will be in 2016, a national leader with extensive expertise and experience of flood risks.
- Currently Deltares is an international leader on some topics, and will be leading on all topics in 2016.

Results

What are the benefits for the public sector?

- Public authorities manage flood risks more effectively and efficiently with innovative methods and tools.
- Public authorities reduce flood risks due to better understanding of warning and modelling.
- Public authorities maintain and design flood protection defences more effectively and efficiently with tools and methods.

What are the benefits for the private sector?

- Dutch engineers and dredging companies improve their position and turnover using knowledge and tools.
- Deltares’ reputation generates business opportunities abroad for Dutch engineers and dredging companies.

Facilities

Which facilities and (experimental) field locations are used?

- Deltares uses wave facilities, such as the Delta Flume, the Scheldt Flume and Atlantic Basin.
- Deltares uses experimental facilities, such as the GeoHall, for small- and medium-scale physical modelling.
- Deltares uses experimental full scale test facilities in the field, such as IJkdijk and the Markermeerdijk test sites.

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources	(x €1.000)
Min EA	€ 2.300
Min IE	€ 20.500
SR Prog	€ 550
Private	€ 6.400
Public	€ 13.750
total	€ 43.500

World	(x €1.000)
NL	€ 34.950
Eur	€ 3.950
SE Asia	€ 1.850
Mid E	€ 100
America	€ 2.000
Austr	€ 500
Africa	€ 50
Rest	€ 100
total	€ 43.500

What are the revenue ambitions for 2016?

- Deltares will slightly increase its revenue.
- Deltares will increase its international revenue and will maintain its current level of national revenue.

What is the programme 'Flood risk strategies'?

Basic information

What is the main goal of this programme?

Deltares implements methods and tools for effective and efficient strategies to manage flood risks in (urban) deltas.
The flood risk strategies cover: flood prevention, spatial planning and disaster management (multi-layer approach).

Who does Deltares work with?

Acciona, Alterra, Arcadis, CPB Netherlands Bureau for Economic Policy Analysis, Delft University of Technology, Deltasync, Dura Vermeer, Dutch Delta Programme, EIVP, Environment agency, Erasmus University of Rotterdam, Fugro, HKV Lijn in Water, HR Wallingford, IFSTTAR, Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture (IRSTEA), ISSMGE, Ministry of Infrastructure and the Environment, municipalities, NIFV, Oxford Brookes, partners of research programme Kennis voor Klimaat, PBL Netherlands Environmental Assessment Agency, regional water authorities, Renselaer Polytechnic Institute, Rijkswaterstaat, Royal Netherlands Meteorological Institute, Royal HaskoningDHV, Sintef, STOWA, TNO, University of Twente, USACE-ERDC, Utrecht University, VU University Amsterdam, Wageningen University and Research Centre and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

Delft University of Technology: hydrodynamics and flood risk management.
HR Wallingford: flood risk management.
IRSTEA: flood defence systems in urban areas.

Who are the programme leaders?

Frank den Heijer (frank.denheijer@deltares.nl) and Bas van de Pas (bas.vandepas@deltares.nl)

Context

What are relevant trends?

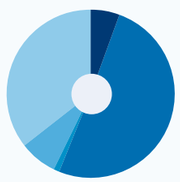
- Population and economic activity in deltas is growing which increases the effects of flooding.
- The effects of climate change are increasing the demand for knowledge of extreme events like flash floods.
- A growing number of extreme events, like floods, is increasing global demand for rapid flood risk assessments.
- Incidents like Fukushima are increasing the demand for expertise on vulnerability of structures and society.
- People are demanding regionally and locally suitable implementation of flood risk reduction measures.

Which issues from the public and private sector and scientific world will be addressed?

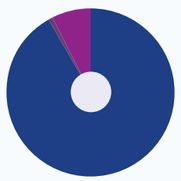
- How can risk assessment instruments of the flood defence system be further improved?
- How can the impact of flooding from regional and national water systems be predicted?
- What can Dutch governments and research institutes learn from flooding cases elsewhere in the world?
- What changes in spatial planning lead to better protection against flooding?
- How can the European Flood Directive be implemented throughout Europe?
- How can critical infrastructure and objects be protected against flooding?
- How can hydrological and hydraulic knowledge be modelled for application in flood risk management worldwide?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x €1.000)
Min EA	€ 600
Min IE	€ 5.200
SR Prog	€ 100
Private	€ 750
Public	€ 3.650
total	**€ 10.300**



World	(x €1.000)
NL	€ 9.450
Eur	€ 100
SE Asia	€ 750
Mid E	€ 0
America	€ 0
Austr	€ 0
Africa	€ 0
Rest	€ 0
total	**€ 10.300**

Status

What are the programme lines and what are they about?

- **Flood risk management and environment:** Developing participation in international knowledge networks.
- **Flood's influence in (urban) delta areas:** Developing concepts and tools for flood risk strategies.
- **Critical infrastructure:** Assessing the vulnerability of critical infrastructure in case of floods.
- **Assessment systems for flood risk management:** Developing concepts for asset management and delta management, including dealing with uncertainties.
- **Tools for flood risk assessment:** Developing multi-layer tools, guidelines and rapid assessment tools.

What is the mixture of activities in the present programme portfolio?

- The focus is on development of knowledge leading to tools and methods.
- Transfer of knowledge occurs by cooperating with research partners, via (inter)national projects and software.
- Specialist consultancy occurs within the Delta Programme on the implementation of flood risk management and the multi-layer approach.

What are the most important results so far, who uses them and how do they apply them?

- The Dutch government uses upgraded risk assessment tools for flood defence systems.
- Policy makers work with extended flood risk management tools, including tools on flood consequences.
- Policy makers use a multi-layer approach for flood risk assessment.
- Consultancy firms and researchers apply newly developed fundamental knowledge for flood risk approaches.
- Public water authorities improved their flood risk management by implementing risk approach strategies.

In which parts of the world is Deltares active?

- Deltares works in the Netherlands, Europe, the United States, Asia and South and Central America.

Which role does Deltares play in the international field of expertise?

- Deltares is leading in the development of models and tools for flood risk assessment.
- Deltares develops knowledge together with key partners on vulnerability, exposure and consequences of floods.

Ambition

What are the ambitions for 2016?

- Deltares develops knowledge on a full flood risk approach instead of on a dike failure approach. ▦
- Deltares applies rapid flood risk assessment tools worldwide. ★
- Deltares systematises its software approach and focuses on developing open source software. ▦
- Deltares' tools are further developed and used by open communities, especially in Europe, Asia and the US. ⟷
- Deltares transfers knowledge to communities by publishing papers and reports and providing tools and software. ⟷
- Deltares optimally uses global data sets and is able to easily apply its knowledge in any region worldwide. ★
- Deltares increases revenue from European and international public funds.
- Deltares changes its focus to urban environments, full risk assessments, cost-effective solutions for design and innovative building solutions.

Which results does Deltares want to achieve in 2013?

- Participating in the European Flood Directive implementation community by contributing to an expert group. ⟷
- First results of rapid assessment tools for the global market are used in projects. ⟷
- Risk assessment tools are used in pilot projects in the United States, South East Asia and Europe. ▦
- Software users are active in open communities and contribute to the improvement of tools. ⟷
- An international roadmap in the field of flood risk management is available. ▦
- Specialist consultancy focuses on full risk assessments, including failure probabilities and consequences. ★

▦ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Real-time information for flood event management'?

Basic information

What is the main goal of this programme?

Deltares initiates innovative new concepts on the provision of real-time information used in risk-based decision making during flood events.

Who does Deltares work with?

AON Benfield, Arcadis, Australian Commonwealth Scientific and Research Organisation, Bundesanstalt für Wasserbau, Bundesamt für Seeschifffahrt und Hydrographie, Dartmouth Flood Observatory, Delft University of Technology, EuroGOOS, European Space Agency, Fugro, Hansje Brinker, HKV Lijn in Water, IBM, National Oceanographic Centre, Nelen & Schuurmans, National Oceanic and Atmospheric Administration, North-West Shelf Operational Oceanographic System, regional water authorities, Rijkswaterstaat, Royal HaskoningDHV, Royal Netherlands Meteorological Institute, Stichting IJkdijk, storm flood and storm surge forecasting centres, STOWA, Tessella, TNO, TWIG, UNESCO-IHE, United States National Weather Service, University of Twente, University of Delaware, University of Southampton, Vortech and Wageningen University and Research Centre.

Who are the main research partners and in which field of expertise do they contribute?

- Royal Netherlands Meteorological Institute: weather prediction, operational data, knowledge and procedures.
- HR Wallingford: computational aspects, crisis communication and life safety modelling.
- Delft University of Technology and Wageningen University and Research Centre: uncertainties, data assimilation techniques, modelling concepts in hydrology.

Who are the programme leaders?

Albrecht Weerts (albrecht.weerts@deltares.nl) and Eric Huijskes (eric.huijskes@deltares.nl)

Context

What are relevant trends?

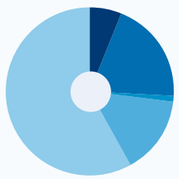
- Extreme weather conditions are increasing because of climate change.
- The population and economic activity in deltas are growing.
- People's daily demand for fast provision of information is increasing due to technological developments.
- Technological developments make people less willing to accept risks and a lack of information.
- People are increasingly expecting transparancy in decision making due to increasing availability and accesibility of data.

Which issues from the public and private sector and scientific world will be addressed?

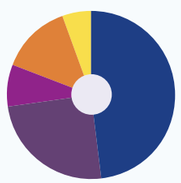
- How can next generation integrated forecast systems make use of continuing IT developments?
- What is the predictability of loads, strengths and risks for flood event management?
- What is the value of loads, strengths and risk forecasts?
- How can information provision during a flooding crisis be optimised for various end-users?
- How can the quality of forecasts of loads, strengths and risks continuously be guaranteed?
- How can operational data (measurements, simulations and forecasts) be optimally provided to the public?
- How can probabilistic forecasts of loads, levee strength and risk of flooding best be used in operational procedures, warnings and for informing the public?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x €1.000)
Min EA	€ 450
Min IE	€ 1.450
SR Prog	€ 100
Private	€ 1.100
Public	€ 4.250
total	**€ 7.350**



World	(x €1.000)
NL	€ 3.550
Eur	€ 1.800
SE Asia	€ 600
Mid E	€ 0
America	€ 1.000
Austr	€ 400
Africa	€ 0
Rest	€ 0
total	**€ 7.350**

Status

What are the programme lines and what are they about?

- **Next generation forecast systems (NGFS):** Integrating technologies for timely, accurate and reliable forecast information.
- **Technical and social aspects of flood event management:** Supporting forecasters and decision makers with procedures, training and efficient use of social media.
- **Real-time assessment tools for response and recovery:** Developing and applying of monitoring, assessment and analysis tools in flood event management.

What is the mixture of activities in the present programme portfolio?

- The focus is on transfer of knowledge by developing software that can be used in practice.
- Development of knowledge occurs by learning from the application of information tools in other fields.
- Development of knowledge concerns IT concepts for effective handling of large data sets, new data sources and computationally heavy models in a real-time setting.
- Regarding the introduction of probabilistic forecasts, data assimilation and training methods, focus is on transfer of knowledge and specialist consultancy.
- Specialist consultancy occurs concerning the introduction and accomodation of forecasting systems including data assimilation and real-time control tools.

What are the most important results so far, who uses them and how do they apply them?

- OpenDA (open source) is applied for more accurate forecasts and is used by forecasters in real-time applications.
- WaterCoach, a serious game training tool, is used by Rijkswaterstaat forecasters in the Netherlands.
- Forecasting system Delft-FEWS enables governments worldwide to provide the public with timely warnings.
- RTC tools (open source) are used in real-time applications for operational control of water quantity and quality.

In which parts of the world is Deltares active?

- Deltares works in the Netherlands, Europe, the Americas, Asia, Australia and Africa.

Which role does Deltares play in the international field of expertise?

- Deltares is world leading in flood forecasting and in development of flood forecasting systems and software.
- Deltares is recognised as an expert in the area of operational data assimilation.

Ambition

What are the ambitions for 2016?

- Forecasters and decision makers use probabilistic information and improved procedures to deal with uncertainties in forecasts, warnings and responses. ⟷
- Deltares provides and shares (open source) tools and training via internet. ⟷
- Next generation forecast systems are ready to handle large data volumes and next generation hydrosoftware and to work with new IT concepts. ▟▙
- Deltares develops various commercial real-time forecast services based on Delft-FEWS. ▟▙
- Deltares improves its international position, particularly in coastal regions.
- Deltares is active in South East Asia, Australia and the Americas.
- Deltares seeks financing via a mix of contributions from existing and new (inter)national Delft-FEWS users.
- Deltares continues to participate in EU projects and national research programmes (Flood Control 2100 and Digital Delta).

Which results does Deltares want to achieve in 2013?

- Start with implementing Delft-FEWS for flood forecasting across Australia for the Bureau of Meteorology. ★
- Start of a PhD in the area of next generation forecasting systems. ▟▙
- Start of the development of tools and procedures for fast response and recovery of flood extent and damage. ▟▙
- Functional design of real-time tools and procedures for fast response and risk assessments during flood events. ▟▙
- PhD thesis on improving forecasting through data assimilation with distributed hydrological models. ▟▙
- Connection to operational services in MyOcean and EuroGOOS. ⟷
- Deltares is active in Colombia, Ecuador and Australia.

▟▙ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Coastal, estuarine and river morphodynamics'?

Basic information

What is the main goal of this programme?

Deltares develops and applies knowledge of morphological changes in rivers, estuaries and coasts and tools for the prediction of them.

Who does Deltares work with?

Alterra, Arcadis, Boskalis, Bundesanstalt für Gewasserkunde, Bundesanstalt für Wasserbau, ConocoPhillips, Delft University of Technology, partners of the consortium EcoShape, HKV Lijn in Water, IMARES, INVEMAR, Royal Netherlands Meteorological Institute, Ministry of Infrastructure and the Environment, National Centre for Earth-surface Dynamics, Netherlands Centre for Luminescence Dating, Rijkswaterstaat, Royal HaskoningDHV, Singapore-Delft Water Alliance, Statoil, TNO, University of Twente, UNESCO-IHE, University of Minnesota, University of Texas at Austin, United States Geological Survey, United States Navy Office of Naval Research, Utrecht University, Wetlands International and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: coastal, estuarine and river morphodynamics and applied geology.
- UNESCO-IHE: development of models and morphodynamic modelling.
- Utrecht University: coastal, estuarine and river morphodynamics.

Who are the programme leaders?

Ad van der Spek (ad.vanderspek@deltares.nl)

Context

What are relevant trends?

- Climate change, rising sea levels and subsidence are increasingly affecting the mutually connected systems of rivers, estuaries, deltas and coasts.
- The increasing impacts on interconnected natural systems is increasing the demand for integral solutions.
- Policy horizons are extending due to the long-term impact of climate change, rising sea levels and subsidence.
- Mangrove systems are increasingly deteriorating worldwide because of human activities.

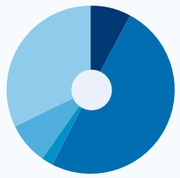
Which issues from the public and private sector and scientific world will be addressed?

- What are the effects of large-scale coastal sand buffers on waves, currents, ecology, economy, safety and recreation?
- How can sand buffers as coastal maintenance measures help to mitigate the impacts of climate change?
- In what way do the morphodynamics of a muddy coast differ from that of a sandy coast?
- How can knowledge about muddy coast morphodynamics be applied to restore deteriorated muddy coasts?
- How can long-term changes in morphology and sediment composition be explored with process-based models?

Revenue

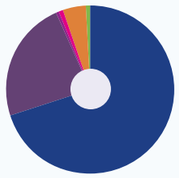
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x €1.000)



Min EA	€	550
Min IE	€	3.400
SR Prog	€	150
Private	€	550
Public	€	2.200
total	**€**	**6.850**

World (x €1.000)



NL	€	4.800
Eur	€	1.600
SE Asia	€	50
Mid E	€	50
America	€	300
Austr	€	0
Africa	€	50
Rest	€	0
total	**€**	**6.850**

Status

What are the programme lines and what are they about?

- **Climate buffers:** Researching the functioning of sand buffers, their effects on the coastal system and their ability to protect the coast against impacts of climate change.
- **Long-term coastal evolution:** Understanding and predicting coastal evolution on time scales ranging from decades to centuries.
- **Muddy coasts:** Developing morphodynamic expertise to improve and restore muddy mangrove coasts.
- **Integrated river systems:** Researching the functioning of the river-estuary-coast chain; the river from source to sink.

What is the mixture of activities in the present programme portfolio?

- The emphasis within this programme is on the development and transfer of knowledge.
- Knowledge is being developed in (applied) research projects, often in cooperation with universities.
- Transfer of knowledge occurs through conference presentations and international journal publications.
- Transfer of knowledge occurs by participation in (inter)national specialists networks and communities.
- Specialist consultancy takes place by applying scientific knowledge in practice.

What are the most important results so far, who uses them and how do they apply them?

- Oil and gas producers use publications on process-based variation in internal architecture of sedimentary hydrocarbon reservoirs, to improve their production strategies.
- Rijkswaterstaat applies knowledge of natural transport of sand and mud to increase coastal safety and to run their coastal maintenance programme effectively and efficiently.
- Knowledge institutes and consultants apply improved and expanded numerical models to predict coastal evolution and to assess the impacts of measures.

In which parts of the world is Deltares active?

- Deltares works in the Netherlands, Europe, North America, Singapore, Thailand and Indonesia.

Which role does Deltares play in the international field of expertise?

- Deltares is an international leader in developing models and performing research, together with partner institutes.
- Deltares is a leading partner in the development of (numerical) models and knowledge.
- Deltares advises on issues like coastal erosion, river discharges and environmental quality and safety.

Ambition

What are the ambitions for 2016?

- Deltares leads the development of science-based concepts and tools for prediction of coastal evolution, on time scales ranging from centuries to millennia. ▦
- Deltares' strategies for improving and restoring degraded mangrove systems are applied in several countries. ⟷
- Deltares is one of the leading institutes on morphodynamics and evolution of river branches in large deltas worldwide. ▦
- Deltares expands its work for national agencies on climate buffers to international projects.
- Deltares increases its turnover from international activities.
- Deltares applies its knowledge by participating in high-quality international projects. ★

Which results does Deltares want to achieve in 2013?

- Publications on the evolution of tidal inlets in the Wadden Sea and the Dutch delta areas. ⟷
- Publications on the design and development of mega-scale artificial sandbars and coastal extensions. ⟷
- Improved understanding of the sediment balance of the Dutch coast. ▦
- Dissertation on simulating the long-term evolution and internal architecture of deltas. ▦
- Report on a conceptual model for long-term coastal evolution. ▦
- Start of a joint industry project on process-based long-term modelling of rivers, estuaries and deltas. ▦
- Dissertation and publications on the role of mangroves in the development of muddy coasts. ⟷
- Pilot study on modelling floating ice in rivers. ▦
- Pilot study on the integrated functioning of rivers and estuaries in a river basin. ▦
- Pilot study on conceptual models of tropical coasts like coral reefs and mangroves in the Dutch Caribbean. ▦
- Start of a large project on mangrove restoration in South East Asia. ▦
- Locally funded cooperation project on mitigation of coastal erosion and mangrove restoration with INVEMAR (Colombia). ★
- New knowledge on steering of natural processes of development of the Dutch coast, to improve the effectiveness and efficiency of coastal management and maintenance. ▦

▦ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Event-driven hydro-and morpho-dynamics'?

Basic information

What is the main goal of this programme?

Deltares develops and applies hydro- and morphodynamical knowledge, models and tools to evaluate the response of coasts, rivers and estuaries to natural events such as storms and tsunamis.

Who does Deltares work with?

Alterra, Arcadis/Alkyon, Boskalis, Bundesanstalt für Wasserbau, Bundesanstalt für Gewässerkunde, CSIRO Australia, Delft University of Technology, Fugro Geos, HKV Lijn in Water, K-Water, Kyoto University, Naval Research Laboratory, Nigata University, Office of Naval Research, regional water authorities, Rijkswaterstaat, Rosenstiel School University of Miami, Royal HaskoningDHV, RWTH Aachen University, UNESCO-IHE, Università Ferrara, University of Hokkaido, University of Plymouth, University of Twente, Utrecht University, University of Western Australia, United States Department of Agriculture, United States Geological Survey, Wageningen University and Research Centre and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: morphodynamics and hydrodynamics.
- Office of Naval Research: operational coastal modelling.
- United States Geological Survey: coastal and riverine processes.

Who are the programme leaders?

Ap van Dongeren (ap.vandongeren@deltares.nl) and Kees Sloff (kees.sloff@deltares.nl)

Context

What are relevant trends?

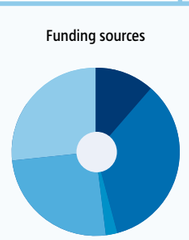
- Climate change is leading to rising sea levels, changes in wind and wave climates and more extremes in precipitation.
- Flood risks in deltas are increasing since hazards and consequences are both increasing.
- Population and economic activity are increasing in ever more vulnerable deltas worldwide.
- The increasing number of stakeholders in flooding areas is leading to an increased demand for an integral response.
- Funding agencies are increasingly requiring open source models to promote transparancy and transfer.

Which issues from the public and private sector and scientific world will be addressed?

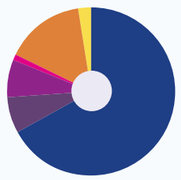
- How can models, developed for the Dutch situation, be made applicable for tropical coasts?
- How can uncertainty in wave height, water and bed level be computed and reduced and incorporated into practice?
- How can the quality of numerical models to compute water levels, waves and morphological change be improved to have higher quality of assessments?
- Which factors are important for the development of early warning systems for dune erosion, coastal inundation and swimmer safety?
- What is the response of the riverbed and river course to flood prevention measures, navigational channel improvements, resource mining and hydro-power generation?
- How do changes in river morphology, during a high-water event, affect water levels, discharges, distributions and the flood probability?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x €1.000)
Min EA	€ 500
Min IE	€ 1.500
SR Prog	€ 100
Private	€ 1.000
Public	€ 1.150
total	**€ 4.250**



World	(x €1.000)
NL	€ 2.850
Eur	€ 300
SE Asia	€ 300
Mid E	€ 50
America	€ 650
Austr	€ 100
Africa	€ 0
Rest	€ 0
total	**€ 4.250**

Status

What are the programme lines and what are they about?

- **Coastal hydraulic and morphological knowledge, models and data:** Developing and applying coastal hydraulic and morphological knowledge, models and tools.
- **Riverine hydraulic and morphological knowledge, models and data:** Developing and applying riverine hydraulic and morphological knowledge, models and tools.

What is the mixture of activities in the present programme portfolio?

- The focus is on specialist consultancy by applying knowledge, models and tools in the international market.
- Knowledge is transferred via journal publications, PhD dissertations, presentations, courses and open source software.

What are the most important results so far, who uses them and how do they apply them?

- A pilot of the demonstration version of an early warning system of rip currents for lifeguards to increase swimmer safety.
- Models of wave transformation over coral reefs used by coastal managers and scientists.
- A subgrid bank erosion approach for 2D morphological simulations in Delft3D applied in an American research project.
- An open source model (XBeach) for the determination of coastal impacts and dune erosion on storm time scales available to the public and used by universities and coastal management authorities.
- A quick assessment tool (WAQBank) for bank erosion forecast based on 2D hydrodynamic simulations applied by consultants for planning and design.
- PhD studies on theory and computational tools for simulating the evolution of sandbars and sorting processes in meander bends to improve 2D and 3D modelling.

In which parts of the world is Deltares active?

Deltares works in Europe, the United States, Australia, South East Asia, Eastern Asia, Central Asia and Latin America.

Which role does Deltares play in the international field of expertise?

- Deltares is a leading partner in the development of numerical models and knowledge.
- Deltares cooperates with local partners on data collection.

Ambition

What are the ambitions for 2016?

- Deltares is leading (with acknowledged partners) on coastal morphology in tropical and temperate coasts. ▦
- Deltares is one of the leading institutes on river dynamics in river branches in large deltas world wide. ▦
- Deltares has integrated its knowledge, models and tools for rivers, estuaries and coasts. ▦
- Deltares software is the industry standard. ⟷
- Software, tools and knowledge are readily used in specialist consultancy, by Dutch and international partners. ⟷
- All products from research projects are open source, including an user support system and three annual courses. ⟷
- Deltares focuses on activities in the Unites States, Australia, South America and Eastern Asia.
- Deltares expands its programme lines to tropical deltas and coasts.
- Deltares generates more funding from foreign sources, including supranational organisations, and from dedicated programmes such as the second phase of Building with Nature.

Which results does Deltares want to achieve in 2013?

- Application of the unstructured model on the Mekong delta. ★
- Six PhD tracks, ten master theses, four journal papers and ten conference papers. ▦
- Publication of a white paper on coral reef modelling in collaboration with the World Bank. ⟷
- Two courses and publications on XBeach. ⟷
- Specialist consultancy to American end-users and consultants on Mississippi coastal restoration. ★
- Specialist consultancy and review for flood-plain restoration and nature rehabilitation in Dutch river branches. ★
- Specialist consultancy on coastal safety in relation to multi-functional use. ★
- Application of models on an atoll island in the Pacific. ★
- Carrying out projects in Latin America and South East Asia.
- European Union funding (FP7) on coastal safety (RISC-KIT and FAST).

▦ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Dikes, levees and dams'?

Basic information

What is the main goal of this programme?

Deltares improves policy, design and management of dikes, levees and dams regionally and internationally.

Who does Deltares work with?

AGT, Alterra, Arcadis, Boskalis, Delft University of Technology, Engineer Research and Development Center, ENW, Fugro, HKV Lijn in Water, HR Wallingford, Imperial College of London, International Society for Soil Mechanics and Geotechnical Engineering, Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture, Ministry of Economic Affairs, Ministry of Infrastructure and the Environment, Ministry of the Flemish Community, municipalities, provinces, regional water authorities, Rijkswaterstaat, Royal HaskoningDHV, Technology Foundation STW, TNO, STOWA, SWECO, United States Geological Service, United States Army Corps of Engineers, University of Twente, Utrecht University, Van Oord, Wageningen University and Research Centre and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

- Alterra: peat levees and grass revetments.
- Delft University of Technology: liquefaction, piping and probabilistic design.
- TNO: hydraulic structures and probabilistic use of subsoil data.

Who are the programme leaders?

Meindert Van (meindert.van@deltares.nl) and Frans Hamer (frans.hamer@deltares.nl)

Context

What are relevant trends?

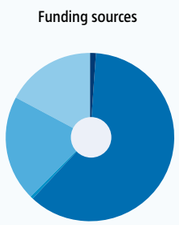
- The assessment of the Dutch primary flood defences is shifting from water level exceedance to probability of failure of dikes, levees and dams.
- The Dutch assessment shift and improving insights are stimulating the attention to failure mechanisms interaction.
- The demand for international standards and design methods for flood defences is increasing due to a higher occurrence of floods worldwide.

Which issues from the public and private sector and scientific world will be addressed?

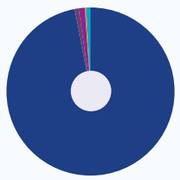
- Which investments in flood defences are optimal in terms of safety and life cycle costs?
- How can the probability of failures be better predicted by more knowledge on the strength of dikes, levees and dams?
- How can innovative flood defence concepts, such as eco-engineering and multifunctional flood defences be implemented?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x €1.000)
Min EA	€ 200
Min IE	€ 8.950
SR Prog	€ 100
Private	€ 3.000
Public	€ 2.500
total	**€ 14.750**



World	(x €1.000)
NL	€ 14.300
Eur	€ 150
SE Asia	€ 150
Mid E	€ 0
America	€ 50
Austr	€ 0
Africa	€ 0
Rest	€ 100
total	**€ 14.750**

Status

What are the programme lines and what are they about?

- **Innovations:** Developing and implementing innovative design tools for dikes, levees and dams.
- **Integrated approach:** Developing tools on the integrated approach of the strength of dikes, levees and dams.
- **Internationalisation:** Adapting specific national high-level knowledge on dikes and levees to more internationally applicable methods.

What is the mixture of activities in the present programme portfolio?

- The focus is on development of knowledge by large-scale experiments and software development.
- Transfer of knowledge is achieved by developing guidelines, software, training and cooperation in networks.
- Specialist consultancy is excecuted by performing audits and providing second opinions on the strength of dikes, levees and dams internationally.

What are the most important results so far, who uses them and how do they apply them?

- Software and methods for the design of environment-friendly dikes to reduce the impact of waves.
- A manual for designers of geo tubes 'Geosystems: design rules and applications'.
- Full-scale tests to validate innovative piping reducing measures used by regional water authorities to strengthen dams.
- Contribution to the International Levee Handbook and an international training for dike inspection.
- Regional water authorities use DAM 1.0, a flood defence strength analysing module, for their operational management.
- Engineers improve their insight in peat and soft clay behaviour, and thus in dike strengths, using new models.

In which parts of the world is Deltares active?

Deltares works in Europe, the United States, China, Singapore, Vietnam and Colombia.

Which role does Deltares play in the international field of expertise?

- Deltares delivers knowledge that is required worldwide on levee engineering and soft soil mechanisms.
- Deltares provides suitable, scientifically accountable solutions to problems in practice.
- Deltares is a world leader in performing audits for the strength of levees, dikes and dams.

Ambition

What are the ambitions for 2016?

- Deltares remains an international leader in modelling failure mechanisms of dikes, levees and dams. ⟷
- Tools for the design of eco-engineering and multi-functional flood defences are widely used in pilot projects. ⟷
- Deltares' smart levees (online monitoring and real time analysis of failure probabilities) are used worldwide. ⟷
- Failure mechanisms are implemented in tools and instruments for the Dutch legal safety assessment (WTI 2017). ⟷
- Deltares remains a world leader in research and consultancy projects on flood defences. ★
- Deltares performs audits on dikes, levees and dams worldwide. ★
- Deltares doubles its yearly revenue of international projects.

Which results does Deltares want to achieve in 2013?

- Report on data collection and analysis of EU Hydralab tests in Hannover on wave reduction by vegetation.
- Use of DAM 1.0, a flood defence strength analysing module in international projects. ★
- Upgrade of national guidelines for the assessment of dikes and levees.
- Pilot test to use geotextiles as a piping reducing measure.
- Technical report and software application to analyse liquefaction. ⟷
- Report on the joint research effort on soft soil engineering with the US Army ERDC. ⟷
- FEM software application to analyse piping mechanisms taking into account time dependency and heterogeneity of the subsoil.

Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

Project in practice

Piping experiments at IJkdijk test site

Piping is the internal erosion process that may occur during periods of high water in the sandy layer beneath a dike. Sand grains are transported by water seeping under the dike, creating tubular openings (pipes) under the dike, which may finally lead to a complete collapse of the dike.

Deltares was commissioned by the Water Authority Rivierenland to carry out a study concerning the effectiveness of geotextiles to prevent piping. In September 2012, Deltares carried out a very successful full-scale piping test, at the IJkdijk test location in Groningen. The geotextile was embedded vertically in the upper part of the aquifer underneath the dike, retaining the sand but allowing the free flow of water. Piping was soon seen below the clay dike at the downstream side of the textile, but the geotextile was successful in stopping the further development of the piping channel. The test was compared to a former test without geo-textile, where a complete collapse of the dike was realised. The next step in the development, foreseen in 2013, is a larger scale test at a longer section of dike in the Rivierenland area.

ulrich.forster@deltares.nl

What is the theme 'Ecosystems and environmental quality'?

Basic information

What is the focus of this theme?

The theme explores ways to integrally restore, improve and protect the quality of aquatic and subsurface environments.
The theme explores ways to protect and promote ecosystem services and sustainable use of natural resources.

Who is the theme leader?

Harm Duel (harm.duel@deltares.nl) and Tom Schilperoort (tom.schilperoort@deltares.nl)

Which programmes are included in this theme?

- From catchment to coast
- Ecosystem services
- Eco-innovation
- Eco-engineering
- Next generation information tools

Ambition

What are the goals until 2016?

- Deltares will develop and synthesise knowledge on relations between the abiotic (non-living) and biotic (living) elements in water and soil systems.
- Deltares will develop methods and tools to quantify the ecosystem services that water and soil systems provide.
- Deltares will develop, test and demonstrate technologies that will reduce pollution and minimise the ecological disruption of human activities (ecotechnology).
- Deltares will develop and stimulate the application of eco-engineering solutions in Europe, Asia and Northern America.
- Deltares will develop and globally apply new generation tools for modelling and measuring ecological quality.

What is Deltares' position, now and in 2016?

- The European science community regards Deltares as a key player in integrating science and making it applicable.
- In 2016, Deltares' position will be recognised by key stakeholders such as governments, private sector and non-governmental organisations worldwide.
- Deltares will maintain its position as a frontrunner in modelling water quality and aquatic ecosystems.
- In 2016, Deltares will be a preferred partner for the Dutch private sector in developing innovative methodologies and sustainable solutions.

Results

What are the benefits for the public sector?

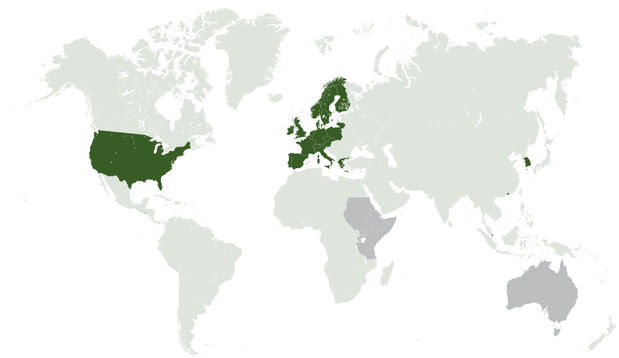
- (Regional) water authorities have practical tools to realise the concept of ecosystem services in practice.
- Policy makers, regional water authorities and end-users improve their decision making about the aquatic and subsurface environment.
- Policy makers, regional water authorities and end-users have better and cost-effective measures to improve, rehabilitate and protect the chemical and ecological status of the aquatic and subsurface environment.
- The European Union and (local) governments improve the implementation of their environmental policies.

What are the benefits for the private sector?

- The Dutch private sector strengthens its position in the international field of green economy.
- Stakeholders in the development of infrastructure have a toolbox to create eco-engineering solutions.
- Small and medium-sized enterprises are given business opportunities for innovative ecotechnologies.

International

In which parts of the world is Deltares currently active and which will have been added by 2016?



Europe, Hong Kong, South Korea, Northern America and Singapore.	countries and regions
Australia and East Africa.	2016

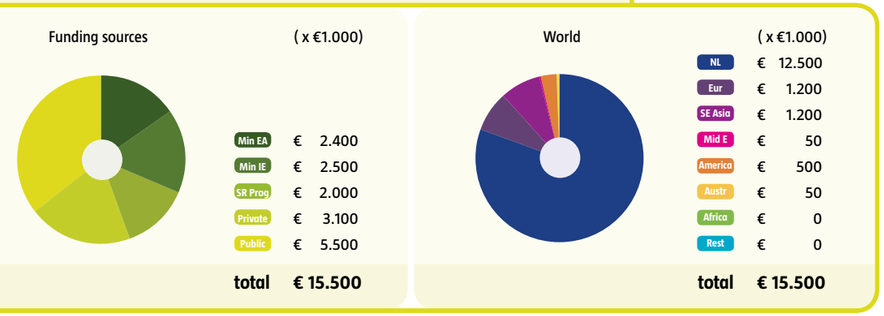
Facilities

Which facilities and (experimental) field locations are used?

- Deltares uses its experimental facilities and modelling software in geochemical laboraties in Delft and Utrecht.
- Deltares uses experimental full scale field facilities such as the lake Markermeer.
- Deltares uses research facilities of collaborating institutes, such as the Van Kleef Centre in Singapore.

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



What are the revenue ambitions for 2016?

- Deltares will increase its overall revenue, mostly via the programmes Ecosystem services and Eco-innovation.
- Deltares will increase the share of international funding, particularly now that Dutch public funds are decreasing.
- Deltares will increase the share of funding by international charity funds and non-governmental organisations.

Context

What are relevant trends?

- Dutch research and innovation policy is increasingly focused on specific sectors and business cases ('top sector approach').
- For EU member states European environmental policy frameworks are becoming more important.
- European Innovation Partnerships (EIPs) are developing into important instruments for development and promotion of eco-innovation and eco-engineering solutions.
- Green economies are becoming increasingly important politically, in both developed and developing countries.
- Charity funds and non-governmental organisations are increasing their investments in low income countries.

Which issues from the public and private sector and scientific world will be addressed?

- How can the impact of multiple pressures on the ecological status of the aquatic environment, from catchment to coast, be determined on a scientifically valid basis?
- How can the impact of multiple stresses on the capacity of ecological systems be quantified to improve ecosystem services?
- How can technological innovations reduce or mitigate the environmental impact of economic activities?
- How can eco-engineering solutions enhance the aquatic environment quality while increasing its socio-economic value?
- How can decisions on restoring and protecting ecosystems be supported by integrated assessment tools?

What is the programme 'From catchment to coast'?

Basic information

What is the main goal of this programme?

Deltares improves its understanding of (bio)geochemical and ecological processes of the entire river basin and connecting coastal waters.
The programme includes the effects of global changes in spatial use, demographies and climate.

Who does Deltares work with?

Alterra, Arcadis, Cefas, Centre for Environmental Studies Leiden, Czech Environmental Information Agency, Finnish Environment Institute, GKSS Forschungszentrum Geesthacht GmbH, Grontmij/Aquasense, IMARES, Joint Research Centre European Commission, KWR Watercycle Research Institute, Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Ministry of Infrastructure and the Environment, Moffat & Nichol, Rijkswaterstaat, National University of Singapore, Royal Netherlands Institute for Sea Research, National Institute for Public Health and the Environment, Radboud University Nijmegen, Royal HaskoningDHV, Scottish Association for Marine Science, STOWA, University of Amsterdam, University of Duisburg-Essen, Utrecht University, United States Geological Survey, VU University Amsterdam and Wageningen University and Research Centre.

Who are the main research partners and in which field of expertise do they contribute?

University of Utrecht: geohydrology.
Wageningen University and Research Centre: water quality and aquatic ecology.
National University of Singapore: tropical ecosystems.

Who are the programme leaders?

Leonard Osté (leonard.oste@deltares.nl)

Context

What are relevant trends?

Land use is intensifying which leads to deforestation and changes in agricultural crops.
Climate change is affecting ecology and biodiversity, leading for instance to a growing number of invasive species.
Urbanisation of deltas is putting pressure on the chemical and ecological state of the environment.
People are demanding sustainable use of natural resources and less enviromental impact of economic activity.
Environmental policy from the European Union as formulated in the Blueprint Water is moving towards more integration of water quality and other policy fields.

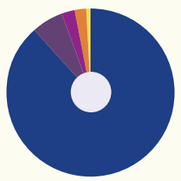
Which issues from the public and private sector and scientific world will be addressed?

How can understanding of ecosystems be improved to enable integrated assessment and management?
What is the impact of multiple stresses on the chemical and ecological status of aquatic systems and the subsurface environment?
How can policy objectives as set by the Water Framework Directive, Marine Strategy and others be realised?
How do compounds like nanoparticles, mineral oil, micro plastics, heavy metals and nutrients move through catchments?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources	(x €1.000)
Min EA	€ 1.000
Min IE	€ 1.900
SR Prog	€ 700
Private	€ 1.200
Public	€ 3.500
total	**€ 8.300**



World	(x €1.000)
NL	€ 7.350
Eur	€ 500
SE Asia	€ 200
Mid E	€ 0
America	€ 200
Austr	€ 50
Africa	€ 0
Rest	€ 0
total	**€ 8.300**

Status

What are the programme lines and what are they about?

Across spatial and temporal scales: Integrating multi-party knowledge of processes ranging from small plots to coastal waters, and from days to decades.
Connecting compartments: Geochemical and ecological processes at interfaces such as river-sea and groundwater-surface water.
Systems under stress: Integrating and synthesising knowledge on the impact of multiple stresses on geochemical processes and ecological functioning of the aquatic and subsurface environment.
Recovery processes: Ecological response to improved water quality and consequences for the carrying capacity of the aquatic environment.

What is the mixture of activities in the present programme portfolio?

Development of knowledge is carried out within national and European research projects.
Transfer of knowledge takes place via software, tools and publications in scientific and branch journals.
Specialist consultancy in the Netherlands focuses on the implemention of European Union policy.
Specialist consultancy in foreign countries often concerns water quality modelling.

What are the most important results so far, who uses them and how do they apply them?

Strategic options for an ecologically robust aquatic system (the lake IJsselmeer) are identified for Rijkswaterstaat.
Water managers can account for bioavailability and background concentrations in quality standards for heavy metals.
Water managers now use an optimisation model to compose the most cost-effective set of river load reductions.
Deltares has been invited to join an expert team to evaluate the intercalibration of an assessment method.

In which parts of the world is Deltares active?

Deltares works in the Netherlands, Europe, South East Asia, the Gulf region, Canada and the United States.

Which role does Deltares play in the international field of expertise?

Deltares delivers key knowledge on (modelling of) ground and surface water quality, measurement of bioavailable concentrations and microbial degradation of compounds in the environment.
Deltares delivers its specific expertise through international consortia for research projects.
Deltares integrates multi-party knowledge on ecological and water quality issues, and makes it applicable.

Ambition

What are the ambitions for 2016?

Deltares is an international leader on ecosystem analyses based on catchment modelling.
Deltares is recognised worldwide as a specialist in quantifying interface processes, such as sea-land with interdisciplinary knowledge.
Deltares integrates specific expertise into a holistic understanding of the aquatic and subsurface environment. ▦
Deltares improves knowledge of ecological processes, such as grazing and macrophyte growth. ▦
Deltares predicts the behaviour of cyanobacteria (toxic algae) and pathogens in aquatic systems. ★
Deltares implements its newly developed knowledge in next generation information tools. ⟷
Deltares has published ten PhD theses, forty scientific papers and ten branch journal publications. ⟷
Deltares increasingly applies its new knowledge in international specialist consultancy activities. ★
Deltares is a key partner in the development of national and European quality standards for ecology, surface water, groundwater and sediments. ▦

Which results does Deltares want to achieve in 2013?

Bio-availability models for copper, zinc, and nickel to be used by (Dutch) water managers. ⟷
Start of research projects on integrated water quality in estuaries. ▦
New upscaling approaches in catchment modelling to be tested in real-life cases. ▦
Improved understanding of the effects of abiotic processes on the presence and growth of (submerged) aquatic plants and potentially harmful cyanobacteria. ▦
Approximately fifteen scientific papers on lake ecology, chemicals and marine ecosystems. ⟷
Worldwide consultancy projects on ecosystem analysis which simulate catchments and coastal waters. ★
Project initiatives in European countries, as well as in South East Asia, North America and Australia.

▦ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme ‘Ecosystem services’?

Basic information

What is the main goal of this programme?

- Deltares increases the understanding of the effects of changes in the ecosystem on ecosystem services.
- Deltares improves the applicability of knowledge about changes in the ecosystem and ecosystem services.

Who does Deltares work with?

Alterra, Centre for Ecology and Hydrology, Institute for Environmental Studies, Georg August Universität Göttingen, Grontmij, Radboud University Nijmegen, Royal HaskoningDHV and Technische Universität Dresden.

Who are the main research partners and in which field of expertise do they contribute?

- Alterra: quantification of (effects of change on) ecosystem services.
- Centre for Ecology and Hydrology: aquatic ecology.
- Institute for Environmental Studies: impact of marine litter on the economic sector.

Who are the programme leaders?

Suzanne van der Meulen (suzanne.vandermeulen@deltares.nl)

Context

What are relevant trends?

- The growing competition for land and water use for ecosystem services, is increasing the demand for assessments of possible synergies and trade-offs.
- The socio-economic importance of ecosystems and their ecosystem services are increasingly being acknowledged and included in European Union decision making.
- Developing countries are applying the ecosystem services concept within the context of health and poverty alleviation.

Which issues from the public and private sector and scientific world will be addressed?

- How do changes in marine and coastal systems, river basins, wetlands and subsurface influence ecosystem services?
- How can the use of ecosystem services for different societal needs be balanced?
- What are the trade-offs between ecosystem services?
- How can knowledge about ecosystem services support the design of measures that achieve multiple societal goals?
- How can the (potential) societal contribution of ecosystem services be quantified?
- What are practical indicators for quantifying service delivery in the context of payment for ecosystem services?

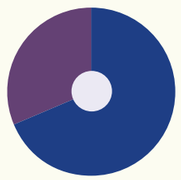
Revenue

How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x €1.000)

Min EA	€	200
Min IE	€	0
SR Prog	€	400
Private	€	0
Public	€	200
total	**€**	**800**

World (x €1.000)



NL	€	550
Eur	€	250
SE Asia	€	0
Mid E	€	0
America	€	0
Austr	€	0
Africa	€	0
Rest	€	0
total	**€**	**800**

Status

What are the programme lines and what are they about?

- **Ecosystem services in marine and coastal systems:** Improving understanding of, and developing methods for quantification of (changes in) ecosystem services in marine and coastal systems.
- **Ecosystem services in land systems:** Improving understanding of, and developing methods for quantification of (changes in) ecosystem services in land systems.

What is the mixture of activities in the present programme portfolio?

- The focus is on development and transfer of knowledge.
- Development of knowledge occurs in several European research projects.
- Transfer of knowledge occurs via networks, knowledge platforms, conferences, courses and publications.
- Specialist consultancy services are provided in projects for Dutch and foreign authorities to support implementation of policy and integrated measures.

What are the most important results so far, who uses them and how do they apply them?

- A report on European experiences with ecosystem services is used by the Australian National Water Commission as a handbook for recognising the broader benefits of aquatic systems in water planning.
- The results of case studies are used by Dresden Technical University for a survey on ecosystem service assessments with stakeholders.
- Dutch consultants explore spatial development opportunities using ecosystem service assessments.

In which parts of the world is Deltares active?

- Deltares works mainly in the Netherlands and Europe, and has started initiatives in Africa, North America and Asia.

Which role does Deltares play in the international field of expertise?

- Deltares is being recognised for its unique position in developing knowledge and methods applicable in practice.
- Deltares delivers expertise and specialised tools for understanding ecosystem functioning.
- Deltares integrates knowledge about the natural system and the socio-economic system.

Ambition

What are the ambitions for 2016?

- Deltares has a track record in quantifying impacts of ecosystem change on ecosystem services.
- Deltares has a state-of-the-art-methodology for assessing and advising on natural resource management.
- Deltares extends its transfer of knowledge by publishing in scientific papers.
- Deltares is frequently a partner in multidisciplinary consultancy projects, national and international.
- Deltares maintains its activities in Europe and expands in Asia and Africa.
- Deltares is increasingly funded by foreign institutions and is continuing its funding by the Dutch government and the European Commission.

Which results does Deltares want to achieve in 2013?

- Methodology for ecosystem service assessment in river basins and coastal areas.
- European Union project, CRISEAS, on ecosystem service assessment, if assigned.
- Make one or two contributions to books about ecosystem service assessment in water and/or soil systems.
- Transboundary ecosystem service assessments are executed.
- Contribute to the design of a ‘payment for ecosystem services (PES) scheme’.
- Start PhD activities in Indonesia which will assess the aquatic ecosystem services’ contribution to health.
- Increase revenue through mainly Dutch and EU government financed projects and private sector funding.

Development of knowledge · Transfer of knowledge · Specialist consultancy

What is the programme ‘Eco-innovation’?

Basic information

What is the main goal of this programme?

- Deltares creates practical, technological solutions to reduce negative impact of economic activities on the environment.
- Deltares creates practical, technological solutions to optimally benefit from natural systems and their resources.

Who does Deltares work with?

Alterra, Arcadis, Barr, DSM, National University of Singapore, regional water authorities, Solvay, Universität Stuttgart, Utrecht University and Wageningen University and Research Centre.

Who are the main research partners and in which field of expertise do they contribute?

- Wageningen University and Research Centre: environmental technology.
- Utrecht University: geosciences.
- National University of Singapore: passive sampling technologies.

Who are the programme leaders?

Thomas Keijzer (thomas.keijzer@deltares.nl)

Context

What are relevant trends?

- People are increasingly demanding biobased industrial production processes.
- People are increasingly acknowledging the need to reduce the impact of economic activities on soil and water.
- Efficient use of (increasingly rare) earth resources is becoming more and more pressing.
- Intensifying land use is increasing the importance of monitoring environmental quality and understanding the effects of measures.
- Intensifying land use in deltas is leading to a growing demand for innovative technological solutions to facilitate more efficient land use.

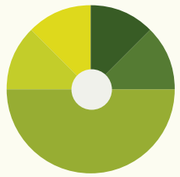
Which issues from the public and private sector and scientific world will be addressed?

- What environmental remediation technologies are available and how can these be implemented?
- How can threats to soil, groundwater and surface water be monitored cost-effectively?
- Which cost-effective technologies can be used to determine the quality of soil, ground water and surface water?

Revenue

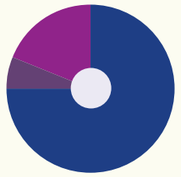
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x €1.000)



Min EA	€	100
Min IE	€	100
SR Prog	€	100
Private	€	400
Public	€	100
total	**€**	**800**

World (x €1.000)



NL	€	600
Eur	€	50
SE Asia	€	150
Mid E	€	0
America	€	0
Austr	€	0
Africa	€	0
Rest	€	0
total	**€**	**800**

Status

What are the programme lines and what are they about?

- **Reduction of negative impacts and increase of resource efficiency:** Developing technologies to reduce the impact of environmental contaminants, such as nanoparticles, and to increase the efficient use of resources.
- **Innovative monitoring of environmental quality:** Developing monitoring technologies and approaches related to the shift towards a biobased economy.

What is the mixture of activities in the present programme portfolio?

- Development of knowledge, transfer of knowledge and specialist consultancy are all equally present.
- Development and transfer of knowledge are related to the monitoring of environmental quality.
- Transfer of knowledge occurs via the joint development of innovative monitoring technologies.
- Specialist consultancy reduces negative impacts on the environment and increases resource efficiency.

What are the most important results so far, who uses them and how do they apply them?

- Puridrain, an innovative method to reduce the amount of phosphate in surface water, has matured and has been implemented by several regional water authorities.
- The microbial corrosion sensor for underground steel infrastructure is being used by several multinational enterprises for field testing and comparison with traditional methods.
- The proof of concept of lab-on-a-chip sensors to determine algal toxins in surface water is being tested on a laboratory scale.
- Cooperation with small and medium-sized enterprises is established to take the lab-on-a-chip sensors to the field.
- Passive sampling technologies to monitor environmental quality are now used regularly in research and practice.

In which parts of the world is Deltares active?

- Deltares is active in the European Union and other high income countries worldwide.

Which role does Deltares play in the international field of expertise?

- Deltares is a leader in the development of knowledge and application of passive sampling technologies.
- Deltares delivers key knowledge and has consultancy experience on reducing negative impacts of contaminants in soil, groundwater and surface water.
- Deltares is partner in implementing and field testing of sensors for the soil, groundwater and surface water systems.

Ambition

What are the ambitions for 2016?

- Deltares has improved technologies to assess and mitigate risks related to emerging contaminants in the soil, groundwater and surface water systems. ▪▪
- Deltares focuses on future contaminants related to biobased industrial processes and nanotechnology. ▪▪
- Knowledge is mainly being developed with both other research institutes and multinational enterprises. ▪▪
- Deltares develops lab-on-a-chip and passive sampling technologies with small and medium-sized enterprises for fast transfer of knowledge and market uptake. ▪▪
- The consultancy activities will be extended to data interpretation of passive sampling technologies, as well as risk assessment and remedial activities for nanoparticles. ★
- The funding by enterprises and other research institutes will increase through partnerships and cooperation.
- Financing from Dutch governmental sources and European research projects will remain.

Which results does Deltares want to achieve in 2013?

- Deltares interprets passive sampling data for regional water authorities and other clients. ★
- An operational lab-on-a-chip sensor for the field measurements of algal toxins in surface waters. ▪▪
- Start of a European project related to the risks of nanoparticles in the soil, groundwater and surface water systems. ▪▪
- Start of development of passive sampling technologies for contaminants related to the biobased economy. ▪▪
- Transfer of knowledge related to the deployment of passive sampling of surface water to water authorities. ⟷
- Share design and construction knowledge to deploy Puridrain with selected partners. ⟷
- Initiated cooperation with enterprises to test sensors in the soil, groundwater and surface water systems. ▪▪
- Focus is especially on Singapore, Canada and the United States.
- Partnerships for activities related to bio-based industrial processes and development of lab-on-a-chip sensors. ▪▪

▪▪ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Eco-engineering'?

Basic information

What is the main goal of this programme?

Deltares develops knowledge and promotes the applicability of eco-engineering solutions to improve ecosystem health and ecosystem goods and services.

Who does Deltares work with?

Alterra, Arcadis, Institut national de recherche en sciences et technologies pour l'environnement et l'agriculture, Barr, Boskalis, B-Ware, Centre for Ecology and Hydrology, Centre for Environmental Systems Research, Delft University of Technology (TU Delft), Ecologic Institut GmbH, Estonian University of Life Sciences, Finnish Environment Institute, IMARES, Institute of Environmental Protection, Institute for Environmental Studies, Joint Research Centre European Commission, Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Macaulay Land Use Research Institute, Middle East Technical University, National Environmental Research Institute of Aarhus University, National University of Singapore, Netherlands Institute of Ecology, Norwegian Institute for Water Research, partners of the EcoShape consortium, PUB Singapore's National Water Agency, Queen Mary University of London, regional water authorities, Rijkswaterstaat, Royal HaskoningDHV, Royal Netherlands Institute for Sea Research, STOWA, Swedish University of Agricultural Sciences, The Government Service for Land and Water Management, Universidad Polytécnica de Madrid, Universität für Bodenkultur Wien, University of Duisburg-Essen, University of Cambridge, University College of London, University of Florence, University of Hull, University of Patras, University of Reading, Utrecht University, Wageningen University and Research Centre, Warsaw University of Life Sciences, Wetlands International and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

National University of Singapore: tropical coastal ecosystems.
EcoShape: Building with Nature approach.
University of Duisburg-Essen: river ecosystems.

Who are the programme leaders?

Tom Buijse (tom.buijse@deltares.nl)

Context

What are relevant trends?

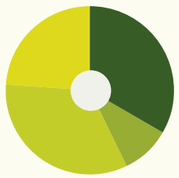
European Union policies are increasingly requiring surface water to support ecosystem health and services.
The EU Green Infrastructure vision is stimulating that engineering solutions use natural processes instead of fighting them.
Aquaculture is replacing mangrove forests, resulting in the loss of mangrove ecosystem services, such as serving as ecosystem nurseries and providing flood protection.
The navigation organisation PIANC has embraced the eco-engineering approach (Building with Nature).
People are increasingly demanding sustainable, nature based flood defences because of climate change.

Which issues from the public and private sector and scientific world will be addressed?

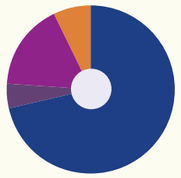
How can flood protection and ecosystem restoration be combined using green infrastructure?
How can the ecological status of heavily modified water bodies be improved cost-effectively and sustainably?
How can agricultural and aquacultural practices be adapted to reduce impact on rivers, lakes and wetlands?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x €1.000)
Min EA	€ 700
Min IE	€ 0
SR Prog	€ 200
Private	€ 700
Public	€ 500
total	€ 2.100



World	(x €1.000)
NL	€ 1.500
Eur	€ 100
SE Asia	€ 350
Mid E	€ 0
America	€ 150
Austr	€ 0
Africa	€ 0
Rest	€ 0
total	€ 2.100

Status

What are the programme lines and what are they about?

- **Multifunctional solutions:** Improving the use of dynamic processes for sustainable and cost-effective multifunctional solutions for both ecosystem health and ecosystem goods and services.
- **Risks and uncertainties:** Quantifying risks and uncertainties in the development and self-maintenance of eco-engineering solutions.
- **Intervention-effect relationships:** Improving the understanding of intervention-effect relationships regarding hydrological and morphological restoration and environmental quality.

What is the mixture of activities in the present programme portfolio?

The focus is on development and transfer of knowledge; application in specialist consultancy projects is limited.
Development of knowledge takes place in real world pilots and international research projects.
Transfer of knowledge occurs through web based knowledge systems (wikis), PhDs, conferences and courses.

What are the most important results so far, who uses them and how do they apply them?

Various green adaptation solutions in urban areas in India and the city of Rotterdam.
Coastline rehabilitation using mangrove recovery in Indonesia.
An eco-based design of the dike Oeverdijk and the dam Oesterdam for Rijkswaterstaat.
Assessments of the natural flood defence in the polder Noordwaard.
Key knowledge contributions to the EcoShape eco-engineering guidelines and wiki.
Proofs of eco-engineering concepts within the Dutch and Singapore cases of the EcoShape programme.
Assessment methods for hydromorphology and ecology of rivers for the EU project on restoring rivers for effective catchment management (REFORM).

In which parts of the world is Deltares active?

Deltares works mainly in the Netherlands, as well as in Europe, Singapore, Indonesia, India and the United States.

Which role does Deltares play in the international field of expertise?

In innovation consortia, Deltares connects knowledge from the private sector, research institutes and universities.
Deltares' role is to combine expertise in hydrology, morphology, ecology, modelling and engineering.

Ambition

What are the ambitions for 2016?

Research focuses on risks, mitigating uncertainties and intervention-effect relationships of multifunctional eco-engineering solutions. ▦
Eco-engineering is part of the curriculum of TU Delft, Wageningen University and HZ University of Applied Sciences. ⟷
New knowledge and innovations are generated by participating in real world pilot projects. ▦
Several PhD studies on topics within the programme are finalised. ▦
Wikis are widely used and constantly improved by end-users. ⟷
Deltares is regularly invited to advise on the implementation of eco-engineering solutions. ★
Deltares is regularly invited for key-note lectures on eco-engineering solutions. ⟷
Jointly with EcoShape partners and consultancy firms a large number of specialist consultancy projects is acquired to apply eco-engineering concepts (Second Building with Nature programme). ★
Foreign expansion doubles foreign revenue, mainly in Europe and Asia and also in America and Australia.
Financing through EU research programmes and assignments in specialist consultancy has increased.

Which results does Deltares want to achieve in 2013?

All intermediate results of REFORM are made publicly available through the wiki and a workshop in Brussels. ⟷
EcoShape eco-engineering guidelines and a wiki are published, including Building with Nature results. ⟷
Projects of the second Building with Nature programme are awarded. ▦
The EU FP7 proposal FAST quantifies the feasibility and risks of nature based flood defences. ▦
Various conference presentations on oyster reef restoration and other nature based flood defence techniques. ⟷
Specialist consultancy projects on natural flood defence solutions in various regions worldwide. ★
Increased consultancy activities in the Netherlands, South East Asia and the United States. ★
Market potential for eco-engineering in North America is explored and a strategy is developed.
Funding share of EU subsidies, foreign companies, public bodies and non-governmental organisations increases.

▦ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Next generation information tools'?

Basic information

What is the main goal of this programme?

Deltares provides state-of-the-art models, tools and information systems to support management of ecological and chemical quality of water, soils and sediments.

Who does Deltares work with?

Alterra, Arcadis, Brockmann Consult, CEFAS, Delft University of Technology, Deltares Inc., DHI, Institute for Environmental Studies, Het Waterschapshuis, IMARES, National Environment Agency Singapore, National University of Singapore, MUMM, municipalities, Netherlands Space Organisation, PUB Singapore's National Water Agency, regional water authorities, Rijkswaterstaat, Port of Rotterdam, Royal HaskoningDHV, Royal Netherlands Institute for Sea Research, Singapore Delft Water Alliance, STOWA, TNO, University of Amsterdam, University of Hamburg, United States Geological Survey, Utrecht University, Wadden Academy, Wageningen University and Research Centre, Water Insight and Waternet.

Who are the main research partners and in which field of expertise do they contribute?

- Alterra: National Hydraulic Instrument (NHI) and groundwater modelling.
- IMARES: coastal (ecological) modelling.
- National University of Singapore: water quality modelling and real-time information systems.

Who are the programme leaders?

Nicki Villars (nicki.villars@deltares.nl)

Context

What are relevant trends?

- Modelling tools and instruments are increasingly open source, with communities contributing to development.
- Models and datasets are increasingly forming integrated information systems.
- Models are increasingly being used to integrate information in real-time, providing forecasts and early warnings.
- Models and tools are increasingly modular and generic, allowing components to be coupled and exchanged.

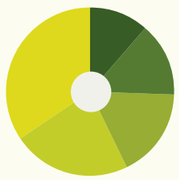
Which issues from the public and private sector and scientific world will be addressed?

- How can timely and fit-for-purpose information be provided about the status and trends of ecosystem conditions?
- Which measures can improve or safeguard ecosystem quality and to meet European and national policy objectives?
- What monitoring strategies are needed to provide optimal information on water, soil and sediment systems?
- How can models and monitoring data be integrated to improve model predictions?
- How can large ecosystem datasets be optimally managed to allow efficient access and (re-)use of data?

Revenue

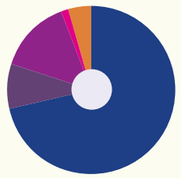
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x €1.000)



Min EA	€	400
Min IE	€	500
SR Prog	€	600
Private	€	800
Public	€	1200
total	**€**	**3.500**

World (x €1.000)



NL	€	2.500
Eur	€	300
SE Asia	€	500
Mid E	€	50
America	€	150
Austr	€	0
Africa	€	0
Rest	€	0
total	**€**	**3.500**

Status

What are the programme lines and what are they about?

- **Integrated modelling:** Further developing generic instruments for integrated modelling of ecology and water quality in groundwater, surface water, soils and sediments.
- **Policy support tools:** Further developing tools, guidelines and models for supporting implementation of national and international policies.
- **Operational instruments and monitoring strategy:** Further developing tools to support early warning systems and operational management systems, including data model integration, data management and monitoring strategies.

What is the mixture of activities in the present programme portfolio?

- Focus is on development of new models and tools and their application in specialist consultancy projects.
- Development of knowledge occurs in the context of research projects, strategic research investments and through focused activities within specialist consultancy work.
- Transfer of knowledge occurs via open source communities, training courses and workshops and application of the models in research and consultancy projects.

What are the most important results so far, who uses them and how do they apply them?

- Models and tools related to ecosystem quality are used worldwide in research and consultancy projects.
- Tools for real-time information systems and operational management systems have been developed.
- Groundwater quality transport models are integrated with data to assess the risk of the spreading of contaminants.
- Tools have been developed for regional water authorities to calculate the effects of measures on ecosystem health, to support implementation of the Water Framework Directive.

In which parts of the world is Deltares active?

- Deltares is active in the Netherlands, Europe, the Middle East, Hong Kong and Singapore.

Which role does Deltares play in the international field of expertise?

- Deltares has a leading role internationally as a developer of ecology and water quality models.
- Deltares develops and manages models and the supporting tools and instruments.
- Deltares integrates its models and tools with those of other parties and shares them with others through formal training as well as open source communities.

Ambition

What are the ambitions for 2016?

- New knowledge is anchored in generic software and tools. ⟷
- Deltares' role has been extended from developing alone to contributing to developments by others. ⟷
- Models and tools are more modular, enabling easy coupling to models of other institutes and organisations. ⟷
- End-to-end ecosystem models are developed in cooperation with partners to assess broader policy issues. ▦
- The Deltares modular, integrated modelling system for ecology and water quality is widely accepted. ▦
- Key developments are published and presented at conferences, meetings and exchanged via open source communities and webinars. ⟷
- Deltares' software and tools continue to be the backbone of most specialist consultancy within this theme. ★
- Deltares extends its position as an international leader to the United States and Australia.
- Funding comes from Dutch and foreign, public and private sources with an increase of the foreign share.

Which results does Deltares want to achieve in 2013?

- Preliminary realisation of a catchment model. ▦
- Start activities for coupled groundwater and surface water models and an algae early warning system. ▦
- Realise a coupling between Delwaq-OpenDA-FEWS software for operational information systems. ▦
- Start of cooperation with strategic partners on end-to-end ecosystem-modelling. ▦
- D3D-WAQ is open source and an open source community is established. ⟷
- A number of publications, presentations, trainings and workshops is realised. ⟷
- An increase in activity in the United States on knowledge development and application of software and tools. ★
- One or more EU project(s) with a significant software and tools component is awarded.
- Open source communities contribute in kind to software development.

▦ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

Ecohydraulics in large shallow lakes

Many shallow lakes suffer from poor water clarity due to an excess of suspended particles in the water column. This leads to a poor ecosystem health as the lack of light inhibits the development of submerged aquatic vegetation that forms a key element of a healthy aquatic ecosystem in shallow lakes.

In a PhD study Deltares explored the interplay of water movement, turbidity and vegetation in large shallow lakes. The study encompassed field and flume studies looking at the effects of vegetation on wave attenuation and water quality. The effectiveness of various measures, such as local deepening and wave-reducing barriers, was studied. An important finding is that lakes that seem similar in general appearance actually function in very different manners. Water depth, lake size, spatial variability and seasonality are factors to be taken into account when selecting or evaluating specific measures. In addition to improved knowledge, a simple framework was made for quick assessment of these factors in individual lakes.

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What is the theme ‘Water and subsoil resources’?

Basic information

What is the focus of this theme?

- The theme deals with water supply and water distribution in river basins and deltas, now and in the future.
- The theme explores the possibilities for using soil and water more efficiently.

Who is the theme leader?

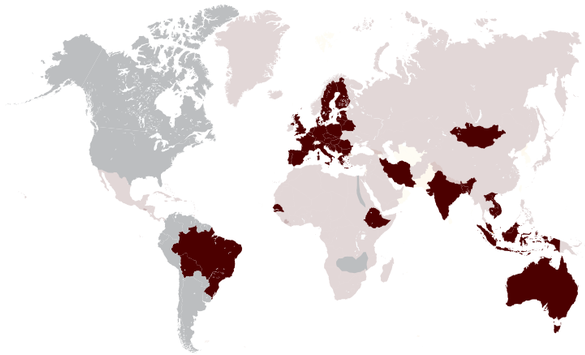
- Jaap Kwadijk (jaap.kwadijk@deltares.nl)

Which programmes are included in this theme?

- River basin management
- Water supply in urbanising deltas
- Sustainable energy from water and subsoil
- Characterisation and visualisation of the subsurface

International

In which parts of the world is Deltares currently active and which will have been added by 2016?



Australia, Bangladesh, Bolivia, Brazil, Cambodia, Ethiopia, Europe, India, Indonesia, Iran, Laos, Malaysia, Mongolia, Senegal, Singapore, Taiwan, Vietnam. — countries and regions

South East Asia, North America, South America, Nile basin countries and Zambesi basin countries. — 2016

Context

What are relevant trends?

- Climate is changing and sea levels are rising.
- The growing world population is increasing the scarcity of natural resources and space in deltas.
- Computing power continues to rapidly increase.
- The accessibility and availability of meteorological and satellite data is growing rapidly.
- The availability of open source software is increasing.

Which issues from the public and private sector and scientific world will be addressed?

- How do climate, demographic and technological changes affect water supply and demand in deltas and river basins?
- How can the extent of (future) salinisation of groundwater and surface water be determined?
- How can undesirable effects of temporary water surplus in cities be avoided?
- How can water use in cities be improved?
- How can water and soil resources be used to generate and save energy in deltas?
- How can more detailed information about the subsoil reduce risks of building on land and at sea?

Ambition

What are the goals until 2016?

- Deltares will map current and future global water availability.
- Deltares will assess the impact of climate change and rising sea levels on the Rhine and Meuse basins.
- Deltares will develop tools and measures which enable cities to increase their self-sufficiency with regard to water supply.
- Deltares will test new methods for generating and saving energy when using water.
- Deltares will develop methods to quickly assess and visualise physical properties of the subsoil.
- Deltares will close the gap between the models simulating the ocean and those simulating continental hydrology.

What is Deltares’ position, now and in 2016?

- Deltares is currently a national leader and a prominent international player.
- In 2016, Deltares will be a global leader on water assessments in river basins and urbanising deltas.
- In 2016, Deltares will be a worldwide competitive player on applied research on sustainable energy and characterisation of the subsoil.

Results

What are the benefits for the public sector?

- Policy makers within water and land use management, and Delta Programme participants, make more adequate medium and long-term decisions.
- Cities improve their water availability by an increase in rainfall harvesting, more efficient water use, reduction of water loss and reduction of water pollution.
- The Netherlands reduces its greenhouse gas emissions by using new approaches to generate and save energy that use water and soil.

What are the benefits for the private sector?

- (Re)insurance companies use global data on flood and drought risks for risk and premium calculations.
- Agricultural enterprises near coasts get to know the future salinity in their (ground)water.
- Contractors reduce costs through more detailed and more efficiently collected information on the subsoil.
- Consultants save costs by using open source software.

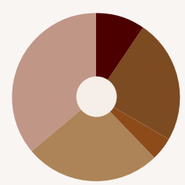
Facilities

Which facilities and (experimental) field locations are used?

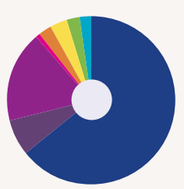
- Deltares uses field experiment locations for energy saving and power production at universities in Utrecht and Delft.

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x € 1.000)	
Min EA	€	1.600
Min IE	€	3.900
SR Prog	€	750
Private	€	4.300
Public	€	5.950
total	**€**	**16.500**



World	(x € 1.000)	
NL	€	10.590
Eur	€	1.150
SE Asia	€	2.900
Mid E	€	150
America	€	400
Austr	€	550
Africa	€	400
Rest	€	360
total	**€**	**16.500**

What are the revenue ambitions for 2016?

- Deltares will maintain its overall revenue.
- Deltares will increase its international revenue and will have less revenue from national projects.

What is the programme 'River basin management'?

Basic information

What is the main goal of this programme?

Deltares supports local, regional and national governments in adapting to changing hydrological conditions via water resources planning and management.

Who does Deltares work with?

Alterra, Carthago Consultancy, Commonwealth Scientific and Industrial Research Organisation, Delft University of Technology, European Centre for Medium-Range Weather Forecasts, École Nationale du Génie Rural des Eaux et des Fôrets, Erasmus University Rotterdam, International Institute for Applied Systems Analysis, Joint Research Centre European Commission, King's College London, Royal Netherlands Meteorological Institute, Ministry of Infrastructure and the Environment, National Flood Forecasting Centre, Pantopicon, PBL Netherlands Environmental Assessment Agency, Potsdam Institute for Climate Impact Research, PusAir Bandung, UNESCO-IHE, University of Kassel, Maastricht University, University of Twente, Utrecht University, University of Leicester, VU University Amsterdam, Wetlands International, Wageningen University and Research Centre and WWF.

Who are the main research partners and in which field of expertise do they contribute?

- Utrecht University: hydrology.
- VU University Amsterdam: impacts of changes in land use on hydrology.
- PBL Netherlands Environmental Assessment Agency: global water risk assessment.

Who are the programme leaders?

Rinus Vis (rinus.vis@deltares.nl)

Context

What are relevant trends?

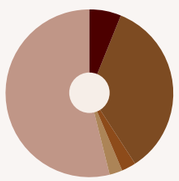
- Climate change is affecting water availability and consequently distribution of water in river basins.
- Changes in land use are affecting hydrological processes in response to rainfall.
- Growing economies and populations are increasing the demand for water in river basins, especially in deltas.
- Growing economies and populations are increasing impacts of floods in river basins, especially in deltas and along coasts.

Which issues from the public and private sector and scientific world will be addressed?

- How can the growing demand for water in river basins and deltas be met?
- How can the impact of large-scale changes in hydrological conditions be quantified?
- How can the impact of large scale changes in land use, including urbanisation, on flood risks be predicted?
- What are flexible and long term robust strategies to protect people against consequences of climate change and large scale changes in land use?
- What are strategies to reduce vulnerability to drought?

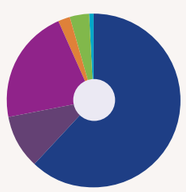
Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources (x € 1.000)

Min EA	€	500
Min IE	€	2.730
SR Prog	€	220
Private	€	210
Public	€	4.230
total	**€**	**7.890**



World (x € 1.000)

NL	€	4.900
Eur	€	790
SE Asia	€	1.690
Mid E	€	0
America	€	160
Austr	€	0
Africa	€	300
Rest	€	50
total	**€**	**7.890**

Status

What are the programme lines and what are they about?

- **Scenario development:** Exploring the impact of socio-economic trends and climate change on deltas, river basins and the demand for water.
- **Tool development:** Developing tools to assess the impact of large scale changes in the climate and land use on the hydrology of river basins, including global water risks.
- **Impact assessment:** Assessing the impact of changing river discharges on the availability of water for different uses.

What is the mixture of activities in the present programme portfolio?

- Focus is on specialist consultancy (about 70 per cent revenue), supported by knowledge development.
- Knowledge development (mainly PhD's) is about 20 per cent and transfer of knowledge is about 10 per cent.

What are the most important results so far, who uses them and how do they apply them?

- The Delta Programme applies methods to assess the vulnerability of river deltas, and to design robust and flexible adaptation strategies.
- Researchers and market parties worldwide use a tool to predict large scale hydrological impacts of climate change.
- Insurers and the World Bank make (financial) decisions with a global assessment tool for flood risks.
- Researchers use several publications on scenario development, hydrology and river basin management.
- Dutch consultants and researchers use a first release of hydrological model OpenStreams for river basin modelling.
- Deltares uses its upgraded Framework of Analysis to structure its approach of large integrated projects.

In which parts of the world is Deltares active?

- Deltares works in Australia, countries in Europe, South East Asia, Africa and South America.

Which role does Deltares play in the international field of expertise?

- Deltares is a research partner in consultancy consortiums working on large water management projects.

Ambition

What are the ambitions for 2016?

- Deltares has its own tool for hydrological modelling of river basins, including water allocation and water quality. ▪▪▪
- Deltares continues applying results of its research in consultancy projects. ★
- Deltares increases activities in Australia, North America and developing regions in Africa and South and Central America.
- Deltares works with a mix of research funds, but increases its share of financing from the private sector.
- Deltares focuses its development of knowledge on tool development, scenario development will be abandoned. ▪▪▪

Which results does Deltares want to achieve in 2013?

- Prototypes of modules for global flood and drought risk assessment. ▪▪▪
- PhD thesis and publications on the effect of land use on hydrology. ⟷
- PhD thesis and publications on seasonal global water forecasting. ⟷
- Elaboration of flood and drought risk maps for (financial) decision making. ▪▪▪
- Application of the Dutch adaptation pathway approach for delta management outside the Netherlands. ⟷
- Specialist consultancy projects on integrated water management in Europe, America and South East Asia. ★

▪▪▪ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Water supply in urbanising deltas'?

Basic information

What is the main goal of this programme?

Deltares develops knowledge and solutions to manage water demand and supply in urbanising deltas worldwide.

Who does Deltares work with?

Acacia, Alterra, Arcadis, Delft University of Technology, Government Service for Land and Water Management, Het Zeeuwse Landschap, HKV Lijn in Water, InnovationNetwork, Kiemkracht, KWR Watercycle Research Institute, Ministry of Economic Affairs, Ministry of Infrastructure and the Environment, municipalities, Natuurmonumenten, National University of Singapore, provinces, regional water authorities, Royal HaskoningDHV, Rijkswaterstaat, Smit's Bouwbedrijf, Tauw, TNO, Utrecht University, VU University Amsterdam, Waternet, Wageningen University and Research Centre and ZLTO.

Who are the main research partners and in which field of expertise do they contribute?

- Alterra: land use modelling and eco-innovation in urban environments.
- Utrecht University: large scale geohydrological modelling.
- Delft University of Technology: urban water management.

Who are the programme leaders?

Remco van Ek (remco.vanek@deltares.nl)

Context

What are relevant trends?

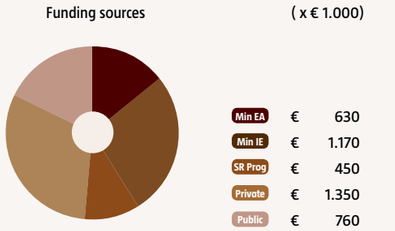
- The demand for water is increasing due to a growing world population.
- Climate change is expected to hamper water and food supply due to more frequent and extreme weather events.
- By 2050 nearly 70 per cent of the world population will live in urban areas.
- By 2050, 40 per cent of the world population will live in river basins under severe water stress.

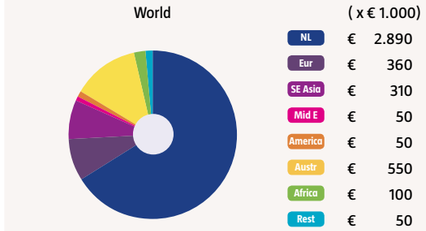
Which issues from the public and private sector and scientific world will be addressed?

- How does drought affect agriculture and the environment in rural areas near delta cities?
- How can negative impacts of drought on agriculture and the environment in rural areas near delta cities be reduced?
- How can present and future supply and demand of water in delta cities be determined?
- What is the present and future availability of fresh (ground)water resources in urbanising deltas?
- What are cost-effective innovative ways to improve the availability of fresh (ground)water in urbanising deltas?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?





Status

What are the programme lines and what are they about?

- **Living labs:** Field testing of innovative measures to optimise fresh water availability in urban and rural areas.
- **Professionalising drought early warning systems:** Improving integration of agricultural production models and water supply models for crisis management.
- **Rapid assessment tools for urban water supply:** Developing tools to assess the supply of fresh water for delta cities in data-scarce areas.

What is the mixture of activities in the present programme portfolio?

- The majority of the activities focus on specialist consultancy.
- A slight minority of the activities focus on development of knowledge.
- Transfer of knowledge comprises about 10 per cent of the revenue.

What are the most important results so far, who uses them and how do they apply them?

- Farmers, local authorities and the Delta Programme use knowledge about increasing the underground storage of fresh water in coastal areas.
- Policy makers and researchers use an open access portal (GLOWASIS) on water availability to simulate and observe global water scarcity from 1960 onwards.
- Researchers use review papers about the open access data portal GLOWASIS.
- International hydropower utilities use an open source toolbox on real-time control of rivers and water reservoirs.
- The city of Arnhem and the Delta Programme use a prototype of a rapid assessment tool for urban water supply.

In which parts of the world is Deltares active?

Deltares works primarily in the Netherlands and Europe, and for some activities in Singapore and India.

Which role does Deltares play in the international field of expertise?

Deltares develops tools and measures which help to secure water availability in urbanising deltas.

Ambition

What are the ambitions for 2016?

- Deltares has increased expertise on water scarcity and proposes improved solutions for rural and urban areas. ★
- Deltares has a tool to manage fresh water resources in urbanising deltas, which is applicable in data-scarce areas. ▞
- Users, such as farmers and consultants, are able to apply Deltares' solutions for water scarcity and water resources. ⟷
- Consultants are able to apply (open source) rapid assessment tools and have agreements on further development with Deltares. ⟷
- Deltares is frontrunner on drought early warning systems via improved linkage between land use and hydrology. ▞
- Public and private organisations have incorporated new knowledge on drought for the usage by early warning systems. ⟷
- Dutch companies work with Deltares in international specialist consultancy projects on fresh water supply in urbanising deltas. ★
- Deltares is globally competitive (scientifically and commercially) regarding water supply in urbanising deltas.
- Deltares works with delta cities in South East Asia (Jakarta) and North and South America (Belo Horizonte).

Which results does Deltares want to achieve in 2013?

- Innovative measures to maintain fresh water lenses in brackish environments (finalising project GO-FRESH). ▞
- Coherent framework to link land use and hydrology models to improve drought early warning systems. ▞
- Improved rapid assessment tool for urban water supply used for delta cities worldwide. ▞
- Results of field testing of measures to increase the volume of fresh water in brackish environments. ▞
- Increase of specialist consultancy projects abroad based on current knowledge and tools developed earlier. ★

▞ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Sustainable energy from water and subsoil'?

Basic information

What is the main goal of this programme?

Deltares contributes to the reduction of CO_2 emissions by investigating innovative ways to exploit thermal and mechanical energy from water.

Who does Deltares work with?

ADCIM, AKZO Nobel Salt Portal, Arcadis, Aveco de Bondt, Bioclear, Bluewater BV, Bluewater Energy Services, Bodem+, Brabant Water, Corus/Tata Steel, Dunea, Dynatech, DHV Water, ECN, Essent, Flowserve, Public Works Rotterdam, Grontmij, IF Technology, Jacobs Engineering, Knowledge Centre WMC, Kwakernaak BV, Lenntech, Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, Mokveld Valves, municipalities, Norit Nijhuis, Norit PT, Oranjewoud, Productschap Tuinbouw, provinces, regional water authorities, Rendo, Royal HaskoningDHV, Royal Netherlands Institute for Sea Research, Shell Global Solutions, SKB, Stichting Bodemsanering NS, STOWA, Tauw, Tebodin, Tidal Testing Centre, Tocardo, Vitens, Waterleiding Maatschappij Drenthe, Waternet, Wageningen University and Research Centre and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

Wageningen University and Research Centre: water quality and thermal modelling of the subsurface.
ECN: exchange of near/far field modelling approaches of (offshore) wind farms and tidal parks.

Who are the programme leaders?

Ivo Pothof (ivo.pothof@deltares.nl)

Context

What are relevant trends?

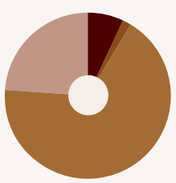
Global warming is leading to a sense of urgency from society and politicians for reducing CO_2 emissions.
Global warming is increasing the demand for cooling in the summer.
Existing design methods and regulations do not yet optimally facilitate the integration of renewable energy sources in Heating Ventilation Air Conditioning (HVAC) systems.

Which issues from the public and private sector and scientific world will be addressed?

How does the Aquifer Thermal Energy Storage (ATES) affect drinking water resources and groundwater quality?
How can urban environments benefit from integrated renewable thermal energy sources?
What is the maximum injection temperature in an ATES system without negative consequences for the system and the environment?

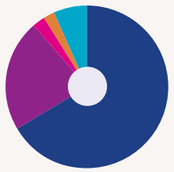
Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources (x € 1.000)

Min EA	€	280
Min IE	€	0
SR Prog	€	80
Private	€	2.740
Public	€	960
total	**€**	**4.060**



World (x € 1.000)

NL	€	2.700
Eur	€	0
SE Asia	€	900
Mid E	€	100
America	€	100
Austr	€	0
Africa	€	0
Rest	€	260
total	**€**	**4.060**

Status

What are the programme lines and what are they about?

Thermal energy: Researching optimal design and control of ATES and HVAC systems using renewable energy sources such as geothermal energy and surface water.
Mechanical energy: Developing modelling tools for performance and environmental impact prediction of tidal parks.

What is the mixture of activities in the present programme portfolio?

The focus is development of knowledge and software tools which are applied through specialist consultancy.
Specialist consultancy brings in 65 per cent of the revenue; development of knowledge 35 per cent.
Transfer of knowledge generates small revenue via software, seminars and policy recommendations.

What are the most important results so far, who uses them and how do they apply them?

Urban and regional governments use research results to optimise their regulations for ATES permits.
Urban and regional governments use research results to support their spatial planning of the underground.
Consultants, energy companies and Deltares use WANDA 4 Heat for design and control of district heating systems.
Water companies use WANDA 4 Heat to assess the temperature increase in drinking water pipelines.

In which parts of the world is Deltares active?

Deltares focuses on the Netherlands and stakeholders will apply the knowledge abroad.

Which role does Deltares play in the international field of expertise?

Deltares connects academic research to practical applications via software, troubleshooting and training.

Ambition

What are the ambitions for 2016?

ATES systems are common practice; WANDA 4 Heat and Delft3D are state-of-the-art tools with an outstanding reputation. ⊞
Dutch consultants have increased their revenue from renewable HVAC systems using Deltares' knowledge and software tools. ⟷
Deltares is a partner for internationally operating companies on renewable energy systems. ★

Which results does Deltares want to achieve in 2013?

At least one peer-reviewed journal publication on the use of ATES systems in a polluted underground. ⟷
At least two peer-reviewed journal publications on interference and thermal efficiency of ATES systems. ⟷
WANDA 4 Heat extension for the modelling of complex building HVAC systems. ⊞
Innovative case study on the integration of a geothermal source in a district heating system on the university campus in Delft. ⊞
Delft3D prototype for the modelling of the performance and environmental impact of a tidal park in the sea. ⊞
Consultants use Delft3D for specialist advice on tidal parks. ⟷

⊞ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme ‘Characterisation and visualisation of the subsurface’?

Basic information

What is the main goal of this programme?

Deltares develops knowledge, tools and solutions to visualise and characterise the near subsurface.

Who does Deltares work with?

Boskalis, Biosoil, Cultural Heritage Agency, Delft University of Technology, DPWE, Ghent University, Ministry of Infrastructure and the Environment, National University of Singapore, partners of consortium EcoShape, Port of Rotterdam, regional water authorities, Rijkswaterstaat and TNO.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: fundamental research on near surface geophysics.
- Boskalis: applied offshore geophysics.
- TNO: imaging and data management of the subsurface.

Who are the programme leaders?

Bob Hoogendoorn (bob.hoogendoorn@deltares.nl)

Context

What are relevant trends?

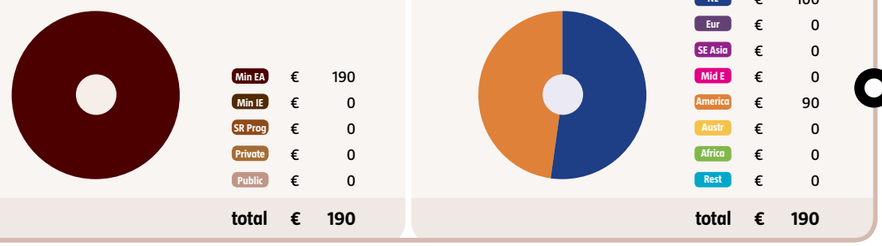
- The growing and developing world population is increasing demand for resources.
- The supply of resources is decreasing because of the reduced resource availability and accessibility.
- The relevance of the subsurface below artificial levees has become clear, resulting in increasing demand for knowledge.
- The risks of levee breaches have increased leading to greater demand for knowledge on the subsurface of artificial levees.
- Lower societal acceptance of levee breaches is leading to greater demand for knowledge on the subsurface of artificial levees.

Which issues from the public and private sector and scientific world will be addressed?

- How can academic geophysical methods be implemented in the real world?
- How can uncertainties in the estimates of resources be reduced in the Netherlands and abroad?
- How can subsurface imaging techniques be made better applicable?
- How can levee breaches be estimated on the base of tremendous amounts of data?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Status

What are the programme lines and what are they about?

- **Characterising submarine soil properties:** Experiments using acoustic signals (‘Scholte’ waves) to characterise the stiffness of the seabed.
- **1D interferometry on levees:** Experimental validation of geophysical processing theory using field data of the Hondsbossche sea wall.

What is the mixture of activities in the present programme portfolio?

- The majority of activities consist of specialist consultancy (about 60 per cent of the revenue).
- Other activities consist of development of knowledge (about 40 per cent of the revenue).

What are the most important results so far, who uses them and how do they apply them?

- Rijkswaterstaat calculates the risks for pipelines regarding levee failure, using output of subsurface data analyses.
- Deltares excecuted extensive applied research to assist Boskalis in finding resources along the coast of Kenya.
- Deltares assisted BASF to determine the location, size and nature of a polluted surface so appropriate and inexpensive remediation could be carried out.

In which parts of the world is Deltares active?

- Deltares is active worldwide within this field, for example in 2012 in India, France, Nigeria and Iraq.

Which role does Deltares play in the international field of expertise?

- Deltares has high level expertise on collecting, processing and interpreting geophysical data.
- Deltares’ focus is on delivering a solution for clients and not to just delivering data.

Ambition

What are the ambitions for 2016?

- Users of tools are aware of the added value of methods and data that characterise and visualise the subsurface. ⟷
- Dutch companies use visualisation and characterisation techniques for quantifying resources in the subsurface and determining the quality of levees. ⟷
- Dutch companies work with Deltares more closely on consultancy regarding visualisation and characterisation. ★
- Deltares works in delta cities in South East Asia, Australia and New Zealand.
- Deltares’ activities are funded by a mix of public applied research funding and consultancy projects.
- The number of programme lines is expanded from two to four, related to the demands of major stakeholders.

Which results does Deltares want to achieve in 2013?

- First results of the experiment with the ‘Scholte’ waves. ▞
- Application of an improved design in a second test of the experimental validation of 1D interferometry on levees. ▞
- Consolidate the current position and increase the client base.
- Ensure the continuation of knowledge development by finding financing for multi-annual projects.

▞ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

Project in practice

Software development for the future fresh-water supply

One of the social issues of our time is the availability of enough water of the right quality for agriculture, the public and industry, sharing the water when there are shortages, and preventing damage and nuisance when there is too much water. Policy decision making concerning these complex issues has to be well informed, for example in relation to infrastructure. Infrastructure like river barrages for water management are large investments with long lasting consequences.

Deltares was commissioned by the Dutch government to develop the Delta Model, a suite of software instruments supporting these policy decisions. In the past, dozens of different models were used by different parties, leading to different results and generating unnecessary discussions. Over one hundred specialists of Deltares have worked together to create the redesigned Delta Model which was finalised in 2012. A large amount of technical expertise was combined with the most recent knowledge on fresh water supply issues and flood risk. Due to the fact that the calculation results are widely accepted as 'independent', discussions and decision making have been greatly simplified. The result is a model that is regarded internationally as 'unique and innovative'. The model has been applied already to assess several Delta Programme policy options.

erik.ruijgh@deltares.nl

What is the theme 'Delta infrastructure'?

Basic information

What is the focus of this theme?

The theme focuses on efficient, safe and sustainable design, construction and maintenance of infrastructure in deltas.

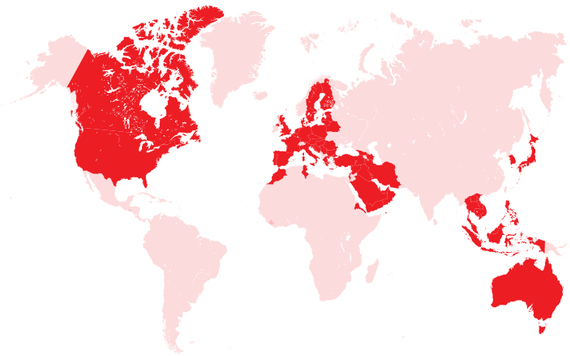
Who is the theme leader?

Peter van den Berg (peter.vandenberg@deltares.nl)

Which programmes are included in this theme?

- Ports and waterways
- Offshore engineering
- Coastal and river structures
- Underground construction in urban areas
- Roads and railroads in delta areas
- Subsidence
- Industrial systems and infrastructure
- Coastal developments

In which parts of the world is Deltares currently active and which will have been added by 2016?



Europe, the Netherlands, the Middle East, South East Asia, the United States, Canada, Australia, Africa. — countries and regions

Deltares increases its activities in all regions outside of Europe. — 2016

Context

What are relevant trends?

- The world population is growing and is increasingly concentrated in deltas.
- Delta areas are increasingly threatened by climate change, rising sea levels and land subsidence.
- Rising prosperity leads to higher mobility and more attention for sustainability.
- People are becoming more risk averse regarding building processes.
- People are increasingly demanding that infrastructure designs include the use of natural processes.
- The Dutch government is giving more responsibility to the private sector with respect to design, construction and maintenance of infrastructure.

Which issues from the public and private sector and scientific world will be addressed?

- How can the costs and risks of construction and maintenance of infrastructure be minimised?
- How can existing infrastructure be adapted to deal with climate change, sea level rise and land subsidence?
- How can infrastructure be incorporated in the environment in a socially acceptable way?
- How can the facilities, software and humans' capabilities regarding hydraulic and geotechnical design be improved?

Ambition

What are the goals until 2016?

- Deltares will reduce costs and risks related to construction in coastal areas, soft soil conditions and offshore.
- Deltares will optimise the design of infrastructure in deltas, focusing on hydraulic and geotechnical aspects.
- Deltares will incorporate knowledge of natural processes in the design of infrastructure.
- Deltares will develop strategies for adapting infrastructure to climate change, sea level rise and subsidence.
- Deltares will develop innovative, sustainable solutions to minimise environmental impact of construction in deltas.

What is Deltares' position, now and in 2016?

- Deltares is a national leader and internationally prominent in hydraulic and (soft) soil engineering.
- In 2016, Deltares will be one of the internationally leading institutes in hydraulic and (soft) soil engineering.

Results

What are the benefits for the public sector?

- Public authorities construct harbours, waterways, roads and railroads in an environmentally friendly manner.
- Construction of coastal, harbour, hydraulic, offshore and underground structures by public authorities is efficient, with minimised risks.
- Local governments gain insight in the potential risks and the possible solutions of land subsidence.
- Public authorities decrease the impact of infrastructure on environment and society by incorporating natural processes into the design.
- Public authorities innovate their infrastructure solutions, by improvement of software, facilities and humans' capabilities in hydraulic and geotechnical design.

What are the benefits for the private sector?

- The (inter)national oil and gas industry, contractors and consultants gain access to knowledge, software and facilities in order to improve their international competitiveness.
- Dutch companies and knowledge institutes improve their international position by cooperation in focus areas, such as water and energy (within the governmental 'top sector approach').

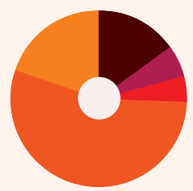
Facilities

Which facilities and (experimental) field locations are used?

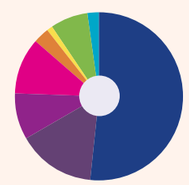
- Deltares uses all wave flumes, all basins, geotechnical laboratories and the geocentrifuge.
- Deltares uses pilot projects for measurements and monitoring, like the new North/South subway in Amsterdam.

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x € 1.000)
Min EA	€ 3.200
Min IE	€ 1.200
SR Prog	€ 1.000
Private	€ 11.500
Public	€ 4.100
total	**€ 21.000**



World	(x € 1.000)
NL	€ 10.900
Eur	€ 3.150
SE Asia	€ 1.850
Mid E	€ 2.250
America	€ 650
Austr	€ 250
Africa	€ 1.500
Rest	€ 450
total	**€ 21.000**

What are the revenue ambitions for 2016?

- Deltares will increase its overall revenue by 10 per cent, to be primarily realised outside of Europe.
- Deltares will double the current amount of programme financing, especially via Joint Industry Projects (JIP).

What is the programme ‘Ports and waterways’?

Basic information

What is the main goal of this programme?

Deltares contributes to efficient, safe and sustainable construction and use of nautical infrastructure.

Who does Deltares work with?

Arcadis, Autema Marine, Boskalis, Caldic, Cavotech, Chevron, Conoco Phillips, Delft University of Technology, Delta Marine Consultants, ECT, Exxon, Ghent University, UNESCO-IHE, Lankhorst, Linesmen Rotterdam, Mampaey, MARIN, Moffat and Nichol, OMC International, Petrobras, Pilots Rotterdam, Project Management Holland BV, Ports of Amsterdam, Antwerp and Rotterdam, Rijkswaterstaat, Royal HaskoningDHV, Shell, Siport, Smit, Svasek, TKVeerhaven, Van Oord and Woodside.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: river and port engineering.
- MARIN: hydrodynamics and nautical requirements.
- UNESCO-IHE: port engineering.

Who are the programme leaders?

Martijn de Jong (martijn.dejong@deltares.nl) and Erik Mosselman (erik.mosselman@deltares.nl)

Context

What are relevant trends?

- New ports are increasingly constructed as reclamations out at sea, combined with a dredged entrance.
- In the Netherlands navigation locks and hydraulic structures are reaching the limits of their capacity and lifetime.
- Intensified traffic and vessel dimensions are increasing impacts on port operations, beaches, shores and river banks.
- Increasing mining of natural resources is stimulating development of rivers as new waterways.

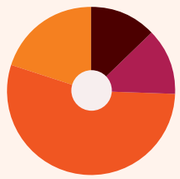
Which issues from the public and private sector and scientific world will be addressed?

- How can more vessels, including larger ones, be facilitated in existing port and river infrastructures?
- How can existing ports and waterways meet modern requirements regarding safety and the environment?
- How can the accuracy of predictions of environmental conditions be improved for nautical infrastructure design?
- What information is required for nautical and hydraulic design of hydraulic structures to optimise safety and cost effectiveness?

Revenue

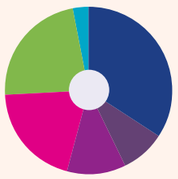
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x € 1.000)



Min EA	€	450
Min IE	€	450
SR Prog	€	0
Private	€	1.900
Public	€	700
total	**€**	**3.500**

World (x € 1.000)



NL	€	1.200
Eur	€	300
SE Asia	€	400
Mid E	€	700
America	€	0
Austr	€	0
Africa	€	800
Rest	€	100
total	**€**	**3.500**

Status

What are the programme lines and what are they about?

- **Ports:** Forecasting environmental conditions in and around ports and their influence on vessels.
- **Waterways:** Forecasting fairway dimensions for nautical requirements.
- **Hydraulic structures:** Maintaining and developing knowledge on hydrodynamics related to design and operation of port and river structures.

What is the mixture of activities in the present programme portfolio?

- The focus is on development of knowledge, in specialist consultancy projects and via cooperation in Joint Industry Projects (JIP).
- Knowledge is transferred via presentations, JIP meetings, software and conference papers.

What are the most important results so far, who uses them and how do they apply them?

- River managers optimise vessel traffic by forecasting water depths.
- JIP partners determine the influence of passing ships on moored vessels and on shorelines.
- Water authorities use tools to assess the effects of large scale river developments on river navigability.
- An expert group is in place for developing guidelines and software and for providing advice to meet governmental issues on hydraulic structures.

In which parts of the world is Deltares active?

Deltares works in the Netherlands, Europe, the Middle East, Australia, Asia and the Americas.

Which role does Deltares play in the international field of expertise?

- Deltares develops and transfers knowledge via consultancy and research on complex infrastructural problems related to ports and waterways.
- Deltares connects researchers and engineering companies to jointly solve clients’ problems.

Ambition

What are the ambitions for 2016?

- Deltares develops its insights, tools, numerical models and its capabilities for scale model testing. ▪▪▪
- Deltares transfers its results by project meetings, papers, conferences, software and a seminar dedicated to the programme. ⟷
- Deltares strengthens its position as specialist consultant, particularly in Africa. ★
- Deltares consolidates its revenue from consultancy, and increases revenue from applied research and JIPs.
- Deltares further develops its programme lines to form a consistent programme.

Which results does Deltares want to achieve in 2013?

- New insights on the influence of waves at port entrance channels. ▪▪▪
- Validated numerical model for passing ship effects. ▪▪▪
- Navigability forecast tool to optimise vessel traffic on rivers. ▪▪▪
- Improved numerical modelling capability for calculating detailed flows around locks. ▪▪▪
- Rapid assessment tool for navigability of remote rivers. ▪▪▪
- Various presentations of papers at conferences and JIP meetings. ⟷
- New software on hydraulics in navigation locks and a guideline on design parameters for locks. ⟷
- Support Rijkswaterstaat and its consultants in projects concerning hydraulic structures like locks. ★
- Maintain the current national and international distribution of clients and research partners.
- Exploring business opportunities for this programme in Africa.

▪▪▪ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme ‘Offshore engineering’?

Basic information

What is the main goal of this programme?

Deltares develops knowledge and tools for safe, cost-efficient design and construction of offshore energy infrastructure.

Who does Deltares work with?

Aibel, Ballast Nedam, Bolding & Burchard ApS, Boskalis, Delft University of Technology, DHI, Diamond Drilling, DNV, DONG Energy, ECN, Eneco, EON, Exxon Mobil, Germanischer Lloyd Noble Denton, GustoMSC, Institute of Marine Research, HGO InfraSea Solutions, Hortimare, Hyundai Heavy Industries, IMARES, Istituto Superiore per la Protezione e la Ricerca Ambientale, LeTourneau, KeppelFels, Maersk, MARIN, Musholm AS, Nederlandse Aardolie Maatschappij BV, Noble Drilling, Norwind, Royal HaskoningDHV, Ramboll, RWE, Saipem, Savannah River National Laboratory, Seaway, Shell, Siemens, Statkraft, Statoil, STX Offshore & Shipbuilding, Swire Blue Ocean, Transocean, Technical University of Denmark, Tennet, Universidad de Cantabria, University of Twente, Utrecht University, University of Bologna, Athens University, University of Dundee, Istanbul Technik Üniversitesi, Van Oord, Vattenfall, Vlaams Instituut voor de Zee, Vuyk, Wartsila and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: offshore technology.
- MARIN: wave modelling.
- Technical University of Denmark: offshore technology.

Who are the programme leaders?

Tim Raaijmakers (tim.raaijmakers@deltares.nl)

Context

What are relevant trends?

- The demand for reducing downtime of offshore workability during construction and operation is increasing.
- The total length of line infrastructure, such as pipelines, electricity and communication cables, is increasing.
- The increasing demand for a constant supply of raw materials is making deep sea mining more important.
- The European Union has set goals to increase the share of sustainable energy in the total energy supply.
- A mix of energy sources will be required, because individual sources will not be able to meet the total energy demand.
- To maintain the current supply of offshore oil and gas, the demand for expanding to deeper water and into arctic locations is increasing.

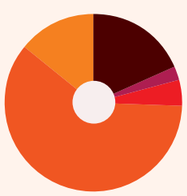
Which issues from the public and private sector and scientific world will be addressed?

- How can innovative wind turbine foundations result in more cost efficient wind energy production?
- What are possibilities for using offshore wind parks for multiple purposes?
- How can the risks of and damage to offshore line infrastructure be decreased?
- How can the safety of offshore operations be guaranteed in harsh environments, like the arctic and deep seas?
- How can the workability of offshore operations, and the predictability of it, be increased?

Revenue

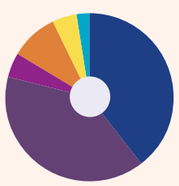
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x € 1.000)



Min EA	€	400
Min IE	€	50
SR Prog	€	100
Private	€	1.300
Public	€	300
total	**€**	**2.150**

World (x € 1.000)



NL	€	850
Eur	€	850
SE Asia	€	100
Mid E	€	0
America	€	200
Austr	€	100
Africa	€	0
Rest	€	50
total	**€**	**2.150**

Status

What are the programme lines and what are they about?

- **Stability of offshore foundations:** Developing knowledge and tools for designing stable and safe offshore foundations in a hostile environment.
- **Operational workability predictions:** Developing software for workability predictions by combining different Metocean data sources and models.
- **Combined geotechnical and hydraulic approach:** Optimising offshore design by combining geotechnics and hydraulics.

What is the mixture of activities in the present programme portfolio?

- Development of knowledge is primarily based on demand driven research and specialist consultancy.
- Research is demand driven, which renders development of knowledge and specialist consultancy activities.
- Deltares transfers its knowledge via assignments and presentations at conferences and an in-house seminar.
- In Joint Industry Projects (JIP) Deltares combines development and transfer of knowledge, and consultancy.

What are the most important results so far, who uses them and how do they apply them?

- Offshore oil and gas companies make operational scour forecasts for their drilling operations.
- A method to determine irregular wave loads on offshore structures is used by the offshore industry.
- Optimisation of scour protection designs for offshore wind turbine foundations.
- Offshore oil and gas companies work with guidelines, a model test database and software for scour prediction for offshore drilling rigs.
- Open Filter Design against erosion around cylindrical piles is used by the offshore industry.
- A numerical model to predict sand wave growth, decay and migration for the designers of offshore line infrastructure and foundations.
- A method to predict the risk on cyclic liquefaction caused by irregular wave loads.

In which parts of the world is Deltares active?

- The focus is on those countries where the offshore industry is most active.
- For offshore wind this mainly involves the North Sea, the Baltic Sea and Irish Sea.
- For the oil and gas market, this mainly concerns companies based in Houston, Singapore, Aberdeen and the Netherlands.

Which role does Deltares play in the international field of expertise?

- Deltares is a specialist consultant, from tender phase to construction, maintenance, operation and decommissioning.
- Deltares initiates and participates in JIPs, in which a knowledge gap is bridged in combination with industry partners.
- Deltares can benefit from the worldwide activity of the well established Dutch offshore industry.

Ambition

What are the ambitions for 2016?

- Deltares increases its hybrid modelling capabilities, by combining the strengths of physical and numerical models and field measurements. (Development of knowledge)
- Deltares develops a Metocean Dashboard and Condition-Based Monitoring System for offshore wind parks. (Development of knowledge)
- Deltares is leading in combining hydraulic and geotechnical knowledge by modelling wave-current-structure-soil-interaction. (Development of knowledge)
- Deltares develops validated numerical models for local morphology on simplified cases for offshore structures. (Development of knowledge)
- Deltares gradually increases its already strong position in Europe, and the North Sea in particular, and extends its activities in Australia, Middle East, Singapore and Houston.
- Deltares prioritises involvement in the development of the important offshore projects.

Which results does Deltares want to achieve in 2013?

- Papers on irregular wave loads on offshore structures and on wave-induced cyclic liquefaction. (Transfer of knowledge)
- Journal paper on numerical modelling of sand waves. (Transfer of knowledge)
- Extension of software to predict scour and design scour protection for various offshore structures applicable for offshore wind, oil and gas. (Development of knowledge)
- Metocean dashboard system for wind parks for planning, maintenance and residual strength determination. (Development of knowledge)
- Numerical model, validated against lab model measurements, to calculate breaking wave impact against complex offshore structures. (Development of knowledge)
- Model for geotechnical impact of spud can footings of wind turbine installation vessels. (Development of knowledge)

Development of knowledge · Transfer of knowledge · Specialist consultancy

What is the programme 'Coastal and river structures'?

Basic information

What is the main goal of this programme?

Deltares develops knowledge and tools to assess the design of coastal and river structures, such as breakwaters and storm surge barriers.

Who does Deltares work with?

Aker Solutions, Arcadis, Ballast Nedam, Boskalis, Chevron, CURNET, Delft University of Technology, DNV, Force Technology, Gusto/SBM Offshore, Port of Rotterdam, Hydralab, Hyundai, Lloyds, MARIN, Petrobras, Royal HaskoningDHV, Rijkswaterstaat, Shell, Statoil, Stichting Fonds Collectief Onderzoek GWW, Tauw, University of Groningen, Van Oord and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: measurement techniques and coastal and harbour structures.
- MARIN: numerical wave modelling, measurement techniques and wave generation.
- University of Groningen: numerical wave modelling.

Who are the programme leaders?

Ivo Wenneker (ivo.wenneker@deltares.nl)

Context

What are relevant trends?

- The number of people living in coastal areas is growing, increasing the demand for coastal and river structures.
- The increasing importance of the environment, risk assessment and public support is making design and construction of infrastructure more complex.
- The market is strongly tending towards low costs for infrastructure, which increases the demand for innovation.
- Detailed numerical and experimental modelling is becoming increasingly feasible thanks to faster PCs and cheaper equipment.

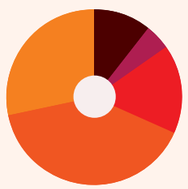
Which issues from the public and private sector and scientific world will be addressed?

- How can the hydraulic performance of a structure be assessed with maximal accuracy and minimal uncertainty?
- How can local hydrodynamics (computed and measured) be utilised to optimise the design of a structure?
- How can structures be designed more cost-effectively without compromising design requirements?

Revenue

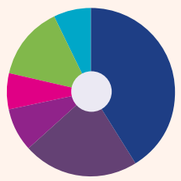
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x € 1.000)



Min EA	€	450
Min IE	€	200
SR Prog	€	700
Private	€	1.700
Public	€	1.200
total	**€**	**4.250**

World (x € 1.000)



NL	€	1.750
Eur	€	950
SE Asia	€	350
Mid E	€	300
America	€	0
Austr	€	0
Africa	€	600
Rest	€	300
total	**€**	**4.250**

Status

What are the programme lines and what are they about?

- **Design guidelines:** Developing design guidelines for assessing the response of coastal and river structures under hydraulic loads.
- **Wave loads on structures:** Simulating extreme wave impacts on structures with a numerical model (ComFLOW).
- **Synoptic measurement techniques:** Developing techniques to obtain synoptic data of hydrodynamics and response during physical experiments.

What is the mixture of activities in the present programme portfolio?

- Specialist consultancy, private and public, national and international, concerns most activities.
- Development of knowledge occurs through making design guidelines, the prediction of hydraulic loads and improving measurement techniques.
- Transfer of knowledge occurs through projects, contributing to international standards and conferences.

What are the most important results so far, who uses them and how do they apply them?

- Van Oord and Boskalis (together in PUMA) work with Deltares on a cost-effective design of Maasvlakte 2.
- Deltares makes an innovative design of the breakwater in Cape Verde: an armour layer consisting of single layer cubes.
- Jointly with public and private partners Deltares develops guidelines for application of geometric open filters.
- Deltares proves the added value of detailed wave simulations with ComFLOW, for example for a jetty design for Royal HaskoningDHV.

In which parts of the world is Deltares active?

- Deltares works mainly in Europe and the Middle East, and has recently started activities in Africa and Australia.

Which role does Deltares play in the international field of expertise?

- Deltares provides, as one of the leading institutes, guidelines and design verification of coastal and river structures through physical and numerical experiments.
- Deltares adds specific hydraulic knowledge to software and hardware for wave simulations and synoptic techniques getting detailed structure information.

Ambition

What are the ambitions for 2016?

- Deltares expands its leading position on modelling with new measurement techniques and detailed numerical modelling. (Development of knowledge)
- Deltares ensures transfer of knowledge via projects and joint cooperations, papers, courses and software. (Transfer of knowledge)
- During specialist consultancy, Deltares focuses more on numerical modelling regarding hydraulic loadings and structural response. (Specialist consultancy)

Which results does Deltares want to achieve in 2013?

- Design of guidelines focusing on the stability of toe constructions. (Development of knowledge)
- Completion of measurement equipment and analysis techniques for the Delta (wave) flume. (Development of knowledge)
- Presentation of new measurement techniques at conferences ICE2013 and IAHR2013. (Transfer of knowledge)
- Publications on open filters and oblique wave incidence on breakwaters. (Transfer of knowledge)
- A feasibility study combining ComFLOW and Plaxis to determine stability of structures under wave loading. (Development of knowledge)

Development of knowledge · Transfer of knowledge · Specialist consultancy

What is the programme 'Underground construction in urban areas'?

Basic information

What is the main goal of this programme?

Deltares reduces the environmental impact and risks related to underground construction in urban areas.

Who does Deltares work with?

Arcadis, A.Hakpark, Ballast Nedam, Boskalis, Breijn, CRUX Engineering, CURNET, Delft University of Technology, Dura Vermeer, Fugro, Gasunie, Geo Reseach Institute Osaka, Grontmij, Heijmans Beton- en Waterbouw, Herrenknecht, Huesker, KIVI NIRIA, Leiden University, Mobilis, Movares, municipalities, Plaxis, ProRail, provinces, Railway Technical Research Institute, Royal HaskoningDHV, Ruhr Universität, Strukton, Tauw, TNO, University of Cambridge, University of Twente, Van Hattum & Blankevoort, Van Oord, Vereniging Van Waterbouwers, VWS Geotechniek, Witteveen+Bos and World Bank.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: geo-engineering.
- TNO: geodynamics and groundwater.
- University of Cambridge: geo-engineering.

Who are the programme leaders?

Hans Brinkman (hans.brinkman@deltares.nl)

Context

What are relevant trends?

- Densification of urban areas is leading to more interaction between new and existing underground structures.
- People's acceptance of the vast impact and long duration of underground construction methods is decreasing.
- People are demanding better predictions of risks and impacts of underground constructions.
- Governments are reducing their investments in innovation and construction.
- The current economic situation is reducing the number of assignments for consultants and constructors.

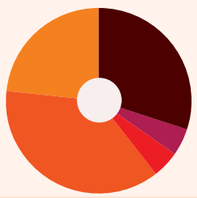
Which issues from the public and private sector and scientific world will be addressed?

- What are cost-effective ways to achieve sufficient reliability on pile bearing capacity?
- How can damage due to imperfections in diaphragm walls be prevented?
- How can hindrance and damage due to underground construction be reduced for the surroundings?
- How can the reliability of existing structures be assessed?
- How can the effects of installing underground structures be incorporated in the design process, in order to improve hindrance predictions?

Revenue

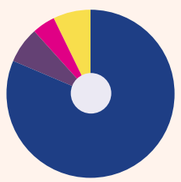
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x € 1.000)



Min EA	€	650
Min IE	€	100
SR Prog	€	100
Private	€	800
Public	€	500
total	**€**	**2.150**

World (x € 1.000)



NL	€	1.750
Eur	€	150
SE Asia	€	0
Mid E	€	100
America	€	0
Austr	€	150
Africa	€	0
Rest	€	0
total	**€**	**2.150**

Status

What are the programme lines and what are they about?

- **Optimising design and construction methods for foundations, construction pits and tunnels:** Enhancing sustainability, minimising construction risks and enhancing safety, for the lifetime of the structure.
- **Quality of in situ-built foundation elements:** Reducing failures by production improvements, geophysical detection techniques and in situ-built techniques.
- **Reduction of negative impact to society and the environment:** Reducing hindrance and damage for the surroundings and improving the predictability of it.

What is the mixture of activities in the present programme portfolio?

- Knowledge development is required to keep up with market demands, for example, on new subway tunnels.
- As a specialist consultant, Deltares is involved in projects with the Dutch private sector and the government.
- Transfer of knowledge occurs in assignments and through software, courses and publications.

What are the most important results so far, who uses them and how do they apply them?

- Contractors mitigate imperfections in diaphragm walls by applying two geophysical detection methods.
- The foundation industry uses guidelines to execute faster and cheaper rapid load testings on piles.
- An increasing number of clients use an implementation methodology for geotechnical risk management.
- Universities use the improved FEM code (MPM) for research, and the code is available for practical application.

In which parts of the world is Deltares active?

Deltares is mainly active in the Netherlands, and in Europe, the Middle East and Australia.

Which role does Deltares play in the international field of expertise?

- Deltares acts as an independent adviser and arbitrator in court cases and conflicts.
- Deltares participates as a reviewer and adviser in committees for the development of guidelines.

Ambition

What are the ambitions for 2016?

- Deltares maintains its independent postion and reputation.
- Deltares is a international knowledge hub, with workshops, training courses, seminars and up-to-date software. ⟷
- Deltares keeps the allowable bearing capacity of piles high, limiting costs increases to under 30 per cent.
- Deltares increases the reliability and applicability of in situ foundation elements.
- International firms profit from Deltares' strengthened reputation and increased knowledge. ⟷
- Deltares continues to focus on Europe; large cities elsewhere make more frequent use of Deltares.
- Project clusters and Joint Industry Projects (JIP) finance research for the development and usability of knowledge.
- The research focus changes from building of new structures to reuse and lifetime extensions of existing structures.
- Deltares shifts its focus towards sustainability, urban water management and climate change.

Which results does Deltares want to achieve in 2013?

- Testing the feasibility of centrifuge tests on the safety of pile design.
- Contribution to a handbook on integral tunnel design for the Dutch Centrum voor Ondergronds Bouwen. ⟷
- PhD thesis on response of piled buildings to the construction of deep excavations.
- PhD thesis on the applicability of rapid load testing on piles for various pile installation methods.
- Online toolbox for construction pits. ⟷

Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme ‘Roads and railroads in delta areas’?

Basic information

What is the main goal of this programme?

Deltares contributes to reliable, robust and sustainable design, construction and asset management of roads and railroads in deltas.

Who does Deltares work with?

Arcadis, Ballast Nedam, BAM, Boskalis, Bouwend Nederland, CURNET, CROW, CRUX, Delft University of Technology, Dragados, Dura Vermeer, EDF, Egis, Fehrl, Fugro, GeoBorn, Grontmij, Heijmans, HR Wallingford, Huesker, Institut français des sciences et technologies des transports, KIVI NIRIA, KWR Watercycle Research Institute, KWS, Movares, municipalities, NAUE, Nea-Panteia, Norwegian Geotechnical Institute, provinces, Port of Rotterdam, ProRail, Royal HaskoningDHV, Royal Netherlands Meteorological Institute, Rijkswaterstaat, STOWA, Strukton, Swedish Geotechnical Institute, Tauw, Tecnalia, Ten Cate, TNO, Unican, University of Ulster, Van Hattum & Blankevoort, Van Oord, VTT Technical Research Centre of Finland, VU University Amsterdam, Wiertsema and partners and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

Delft University of Technology: geotechnics and policy analyses.
TNO: built environment.

Who are the programme leaders?

Joris van Ruijven (joris.vanruijven@deltares.nl)

Context

What are relevant trends?

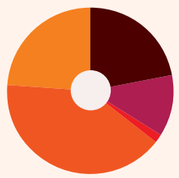
- The risks of failure of roads and railroads are increasing due to heavier loading.
- People are requiring permanent availability of (rail)roads, also in case of floods, heavy precipitation and subsidence.
- As Dutch roads and (rail)road networks have (mostly) been built, focus is shifting from building to asset management.
- The demand for infrastructure with minimal environmental impact during its life cycle is increasing.
- Increasing availability and accessibility of data is enabling more reliable (real-time) analyses of the behaviour of infrastructure.

Which issues from the public and private sector and scientific world will be addressed?

- How can a 50 per cent reduction in the costs of infrastructure failure related to soil be achieved?
- How can the long term impact of subsurface deformations on infrastructure be predicted?
- How can roads and railroads be built and maintained to be more resilient to the effects of climate change?
- How can eco-engineering solutions make infrastructure more sustainable and beneficial to ecology?

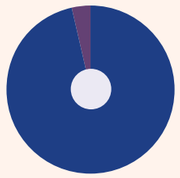
Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources (x € 1.000)

Min EA	€	650
Min IE	€	350
SR Prog	€	50
Private	€	1.200
Public	€	700
total	**€**	**2.950**



World (x € 1.000)

NL	€	2.850
Eur	€	100
SE Asia	€	0
Mid E	€	0
America	€	0
Austr	€	0
Africa	€	0
Rest	€	0
total	**€**	**2.950**

Status

What are the programme lines and what are they about?

- **Reliable models and instruments for design and asset management:** Quantifying geotechnical risks using geological knowledge, (geophysical) measurements and reliable subsoil and deformation models.
- **Robust and resilient infrastructures:** Quantifying the impact of climate change on infrastructure and assessment of adaptation measures.
- **Eco-engineering solutions:** Employing natural processes for functional use in infrastructure.

What is the mixture of activities in the present programme portfolio?

- Activities entail both development and transfer of knowledge and specialist consultancy assignments.
- Development of knowledge and specialist consultancy occurs through cooperation with operators of infrastructure and industry partners.
- Knowledge is transferred via research reports, Geonet, conferences, peer reviewed journal papers, industry guidelines and software.

What are the most important results so far, who uses them and how do they apply them?

- Rijkswaterstaat applies tools and procedures to determine vulnerabilities in the Dutch highway network.
- Rijkswaterstaat and regional water authorities use a tool to determine the effects of groundwater changes on infrastructure and flood risks.
- Rijkswaterstaat and contractors use procedures to quantify the impact of geotechnical uncertainties on cost estimates for road construction.
- Results from the rewarded paper (IGS award) on piled embankments are used within the scientific world, engineering firms and geotextile suppliers.

In which parts of the world is Deltares active?

Deltares is active in the Netherlands, Europe and South East Asia.

Which role does Deltares play in the international field of expertise?

- Deltares is a global player in deformation models for soft soils, modelling of groundwater flow in embankments and piled embankments.
- Deltares contributes to science via research reports, conferences and peer reviewed journal papers.
- Deltares contributes to ecodynamic design processes via specialist consultancy.
- Deltares contributes to practice via software, workshops, courses, guidelines and specialist consultancy.
- Deltares combines its developed knowledge with that of partners in specialist consultancy assignments.

Ambition

What are the ambitions for 2016?

- Deltares develops software tools for more reliable (real-time) predictions of the impact of climate hazards and geotechnical risks on construction and asset management. (Development of knowledge)
- Deltares validates the application of acquired knowledge in consultancy assignments for contractors and infrastructure operators. (Specialist consultancy)
- Deltares puts more emphasis on asset management and system related issues both in Europe and South East Asia. (Development of knowledge)
- Deltares develops more activities on eco-engineering and research on microbiology. (Development of knowledge)

Which results does Deltares want to achieve in 2013?

- Report on procedures for reliable subsoil models. (Transfer of knowledge)
- Tool to determine the effects of groundwater changes on bearing capacity of road embankments. (Development of knowledge)
- Report with proposal for improvement of deformation models based on Weesp measurements. (Development of knowledge)
- Publication in a Dutch and a peer reviewed journal on the long term creep tests for the Dutch highway A2. (Transfer of knowledge)
- Publication in a Dutch journal on the pilot project on geophysical measurements of the Julianakanaal. (Transfer of knowledge)
- Report on green adaptation measures in Vietnam. (Development of knowledge)
- Preliminary study on the possibilities of ‘cleaning’ embankments and levees. (Development of knowledge)

Development of knowledge · Transfer of knowledge · Specialist consultancy

What is the programme ‘Subsidence’?

Basic information

What is the main goal of this programme?

- Deltares contributes to a better understanding of the causes and consequences of subsidence worldwide.
- Deltares provides technical and governance solutions to avoid or mitigate subsidence damage.

Who does Deltares work with?

Alterra, Asian Development Bank, Australian Aid International, CCOP, Delft University of Technology, Fugro, Hansje Brinker, Louisiana State University, Ministry of Infrastructure and the Environment, National University of Singapore, NL Agency, ProRail, Puslitbang Air, The Water Institute of the Gulf, TNO, Tulane University, UNESCO, United States Geological Survey, University of Helsinki, University of Leicester, University of Padua, Utrecht University, Wageningen University and Research Centre, Waternet, Witteveen+Bos and World Bank.

Who are the main research partners and in which field of expertise do they contribute?

- TNO Geological Survey of The Netherlands: subsidence modelling and subsurface characterisation.
- United States Geological Survey: geology and software development.
- Utrecht University: geology, peat and compaction.

Who are the programme leaders?

Gilles Erkens (gilles.erkens@deltares.nl) and John Lambert (john.lambert@deltares.nl)

Context

What are relevant trends?

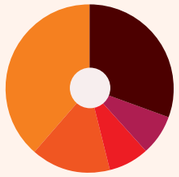
- Deltas around the world are rapidly urbanising and are increasingly densely populated.
- There is an increase of assets in low-lying areas.
- Resources (groundwater, oil and gas) in urbanising areas are more and more intensively used.
- Low-lying areas are facing rising sea level and less predictable climate patterns.

Which issues from the public and private sector and scientific world will be addressed?

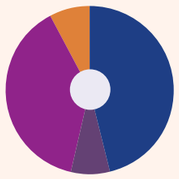
- Which (global) area is experiencing subsidence, now and in the future?
- How can subsidence be measured adequately, monitored by using remote sensing, and predicted?
- How can the consequences of subsidence be quantified worldwide?
- Which component of subsidence is caused by human activities?
- What are possible solutions and strategies to mitigate or adapt to subsidence?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x € 1.000)
Min EA	€ 200
Min IE	€ 50
SR Prog	€ 50
Private	€ 100
Public	€ 250
total	**€ 650**



World	(x € 1.000)
NL	€ 300
Eur	€ 50
SE Asia	€ 250
Mid E	€ 0
America	€ 50
Austr	€ 0
Africa	€ 0
Rest	€ 0
total	**€ 650**

Status

What are the programme lines and what are they about?

- **Groundwater extraction-related subsidence:** Improving the modelling of subsidence caused by groundwater extraction.
- **Subsidence in peatlands:** Assessing the relative contribution of consolidation and oxidation to subsidence in worldwide peatlands.
- **Subsidence damage estimations:** Providing insight in consequences of policy decisions by estimating damage to (infra)structures related to subsidence.

What is the mixture of activities in the present programme portfolio?

- Deltares focuses on the development of knowledge and applies this in specialist consultancy projects.
- Deltares meets the demand of clients by developing innovative solutions to cope with subsidence.

What are the most important results so far, who uses them and how do they apply them?

- The occurrence of secondary settlement is included in subsidence packages that are coupled with groundwater models.
- Deltares’ research contributes to the sustainable future of tropical peatlands.
- Deltares contributes to the inclusion of land subsidence in the UNESCO-IHP VIII Programme.
- Deltares initiates an European stakeholder network (COST initiative) to facilitate, for example, subsidy requests.

In which parts of the world is Deltares active?

- Deltares works in the United States, Indonesia, Vietnam, Thailand, Bangladesh and European countries.

Which role does Deltares play in the international field of expertise?

- Deltares develops innovative solutions and strategies to cope with subsidence.
- Deltares initiated a subsidence taskforce to coordinate the rapid developments in the field of subsidence.
- Deltares tries to raise awareness of the importance of subsidence among stakeholders.

Ambition

What are the ambitions for 2016?

- Deltares further develops integrated geological, geotechnical, hydrological, damage, and design models.
- Deltares helps clients in coping with subsidence, providing them with insight and possible solutions.
- Deltares is an important member of formal and informal stakeholder networks.
- Deltares has a portfolio with projects in key areas like the Mississippi delta and South East Asia.
- Deltares continues to focus on three regions: the United States, Europe and South East Asia.
- Deltares is increasingly funded by governments in the United States, Europe and South East Asia.
- Deltares is increasingly funded by global (re)insurance companies to quantify subsidence risks.

Which results does Deltares want to achieve in 2013?

- Decision support system that includes (infra)structure damage estimates for governments.
- Improving the integration of oxidation in subsidence models including geological data in the groundwater coupled subsidence model.
- Implementation of the groundwater model in the Unites States together with the United States Geological Survey.
- Execution of a pilot project in the United States.
- Two scientific papers on the relative contribution of consolidation to subsidence in peatlands.
- Paper on the inclusion of secondary settlement in groundwater coupled subsidence models.
- Organisation of a workshop with the China Geological Survey on subsidence and related damage.
- Funding comes from national governments and (re)insurance companies.

Development of knowledge | Transfer of knowledge | Specialist consultancy

What is the programme 'Industrial systems and infrastructure'?

Basic information

What is the main goal of this programme?

Deltares decreases the energy consumption, improves the safety and minimises the impact of vital industrial systems and infrastructure, by optimizing design, planning and maintenance.

Who does Deltares work with?

A.Hakpark, Alliander, COB, Drillcon, Doosan, Fisia Italimpianti, DCA-Europe, Delft University of Technology, DNV KEMA, Evides, Fugro, Gasunie, GDF SUEZ, Hyundai, Joulz, Kiwa, KWR Watercycle Research Institute, KEPCO E&C, Lievense, National Energy and Water Research Centre, Netbeheer Nederland, N.V. Hubert, regional water authorities, Rijkswaterstaat, RioNed, Shell, Stedin, TNO, Vitens and Visser and Smit Hanab.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: industrial flows through pipelines and underground infrastructure.
- KWR Watercycle Research Institute: water distribution networks.
- TNO: pipelines and risk analysis.

Who are the programme leaders?

Bas van Vossen (bas.vanvossen@deltares.nl) and Henk Kruse (henk.kruse@deltares.nl)

Context

What are relevant trends?

- People are increasingly less accepting risks of construction activities.
- The demand for sustainable industrial systems and infrastructure is growing, from design to maintenance.
- Industrial and urban zones are getting more densely populated and require an integral approach to development.
- The demand for energy and water is increasing due to a growing population and an increasing living standard.
- The exisiting line infrastructure, such as the electricity grid, is increasingly requiring improvement due to age.

Which issues from the public and private sector and scientific world will be addressed?

- How can risks related to the installation of pipelines be minimised?
- How can recirculation studies be carried out more efficiently and accurately, so market and governmental demands are better met?
- How does erosion around a subterranean pipeline breach affect safety?
- How can improved visualisation techniques enhance pump testing?
- How can multi-phase flows in pipelines be computed to support design for low energy consuming pipeline systems and to improve safety?
- How can underground space be managed without causing harm to the environment?

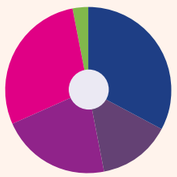
Revenue

How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x € 1.000)

Min EA	€	200
Min IE	€	0
SR Prog	€	0
Private	€	2.900
Public	€	400
total	**€**	**3.500**

World (x € 1.000)



NL	€	1.150
Eur	€	500
SE Asia	€	750
Mid E	€	1.000
America	€	0
Austr	€	0
Africa	€	100
Rest	€	0
total	**€**	**3.500**

Status

What are the programme lines and what are they about?

- **Optimising design and construction methods:** Enhancing sustainability, minimising construction risks and increasing safety for a lifetime.
- **Minimising impacts:** Minimising societal and environment impact of construction and operation.
- **Optimising maintenance:** Supporting asset management, effective monitoring and operations of industrial systems, and the optimal use of available space in densely populated areas.

What is the mixture of activities in the present programme portfolio?

- Focus is on specialist consultancy for the private sector, which often includes transfer of knowledge.
- Transfer of knowledge also occurs via software and training.
- Development of knowledge takes place during projects, and is necessary to keep up with market demands.

What are the most important results so far, who uses them and how do they apply them?

- Developers, operators and regulators justify their decisions using brine and thermal dispersion studies.
- Asset management system IJKnet is used by researchers to upgrade towards the proof-of-concept stage.
- The trench stability evaluation method is used by contractors to secure safety in pipeline installation projects.
- The designs of industrial systems are improved in terms of safety and costs, and enable developers to obtain the necessary construction and operation permits.
- A new method for design of the Direct pipe and HDD pipeline installation method is available and used by contractors and consultants in international projects.

In which parts of the world is Deltares active?

Deltares mainly works in the Netherlands, in most Middle East countries, South Korea and Europe.

Which role does Deltares play in the international field of expertise?

- Deltares advises on the world's most complex projects using numerical and physical modelling.
- Deltares develops knowledge of trenchless technology and soil and pipeline interaction.

Ambition

What are the ambitions for 2016?

- Deltares develops tools and methods for safe and cost-effective design, maintenance and operations.
- Deltares increases its international revenue by executing more geotechnical and hydraulic assignments for existing clients.
- Deltares extends its activities to Africa, North and South America.
- Deltares continues its leading role in the Middle East, Asia, Europe and the Netherlands.
- Deltares finances its research mainly via assignments by individual companies or Joint Industry Projects (JIP).

Which results does Deltares want to achieve in 2013?

- Determination of research objectives and best approaches to handle issues concerning pipeline networks.
- Extension of new and existing software by courses, workshops, conferences and journal papers.
- Performing activities in the Middle East, Asia and Europe.
- Increase of international revenue with ten percent.
- Proposals for research programmes financed by the industry and governmental organisations.
- Overview of combined geotechnical and hydraulic opportunities.

Development of knowledge · Transfer of knowledge · Specialist consultancy

What is the programme 'Coastal developments'

Basic information

What is the main goal of this programme?

Deltares stimulates sustainable development of coasts and estuaries by improving efficiency in ecodynamic design, construction and maintenance of coastal interventions.

Who does Deltares work with?

ASA Brasil, AECOM, Boskalis, CH2MHill, Delft University of Technology, Governments, Groningen Seaports, KEPCO, Ministry of Infrastructure and the Environment, municipalities, partners of consortium EcoShape, Port of Sohar, Royal Haskoning DHV, Technital, UNESCO-IHE, United States Army Corps of Engineers, University of Twente, Van Oord and Witteveen+Bos

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: impacts of coastal infrastructure.
- EcoShape: ecodynamic design and solutions.
- UNESCO-IHE: coastal morphology.

Who are the programme leaders?

Arjen Luijendijk (arjen.luijendijk@deltares.nl) and Bas van Maren (bas.vanmaren@deltares.nl)

Context

What are relevant trends?

- Rising sea level and changes in wave climate are altering the present dynamics of the coast.
- Clients are increasingly demanding insight into the uncertainties - the bandwidth - of model predictions.
- Research institutes are improving insight in uncertainties of the effects of climate change for the Netherlands.
- People and public authorities are increasingly demanding multifunctional coastal development.

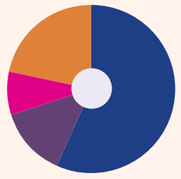
Which issues from the public and private sector and scientific world will be addressed?

- What is the added value of an ecodynamic design of coastal infrastructure?
- How can the efficiency and use of natural processes in design and construction of coastal infrastructure be improved?
- How can hydro- and morphological effects of construction and use of coastal infrastructure be predicted, determined and minimised?
- How can an ecodynamic design framework, with multiple indicators, be developed and evaluated?
- How can methods be developed for incorporating the bandwidths of uncertainties in advice?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources	(x € 1.000)
Min EA	€ 200
Min IE	€ 0
SR Prog	€ 0
Private	€ 1.600
Public	€ 50
total	**€ 1.850**



World	(x € 1.000)
NL	€ 1.050
Eur	€ 250
SE Asia	€ 0
Mid E	€ 150
America	€ 400
Austr	€ 0
Africa	€ 0
Rest	€ 0
total	**€ 1.850**

Status

What are the programme lines and what are they about?

- **Multidisciplinary design tool for coastal interventions:** Developing a design tool to enable multidisciplinary evaluations of interventions along coasts.
- **Embedding structures in a soft environment:** Developing knowledge and tools to investigate the effects of ecodynamic and hard structures on (soft) surroundings and vice versa.
- **Uncertainty in effects:** Developing knowledge and methods to structurally incorporate uncertainty bandwidths in modelling approaches and scenarios for effect computing.

What is the mixture of activities in the present programme portfolio?

- The focus, for this new programme, is on specialist consultancy and transfer of knowledge.
- Transfer of knowledge occurs via lectures, courses and on the job training in the use of software.
- Specialist consultancy consists of research commissioned by clients.

What are the most important results so far, who uses them and how do they apply them?

- Consultants use morphological models for measuring the impact of coastal interventions on their surroundings.
- Consultants use knowledge and tools on cohesive sediment dynamics around ports.

In which parts of the world is Deltares active?

- Deltares works on Africa's west coast, in the Middle East, the United States and in the Netherlands.

Which role does Deltares play in the international field of expertise?

- Deltares is a leader in designing and evaluating coastal interventions and ecodynamic solutions (Building with Nature).
- Through specialist consultancy, Deltares exchanges knowledge and tools with national and international consultants.
- Deltares contributes to science via PhDs, and cooperation in research programmes.

Ambition

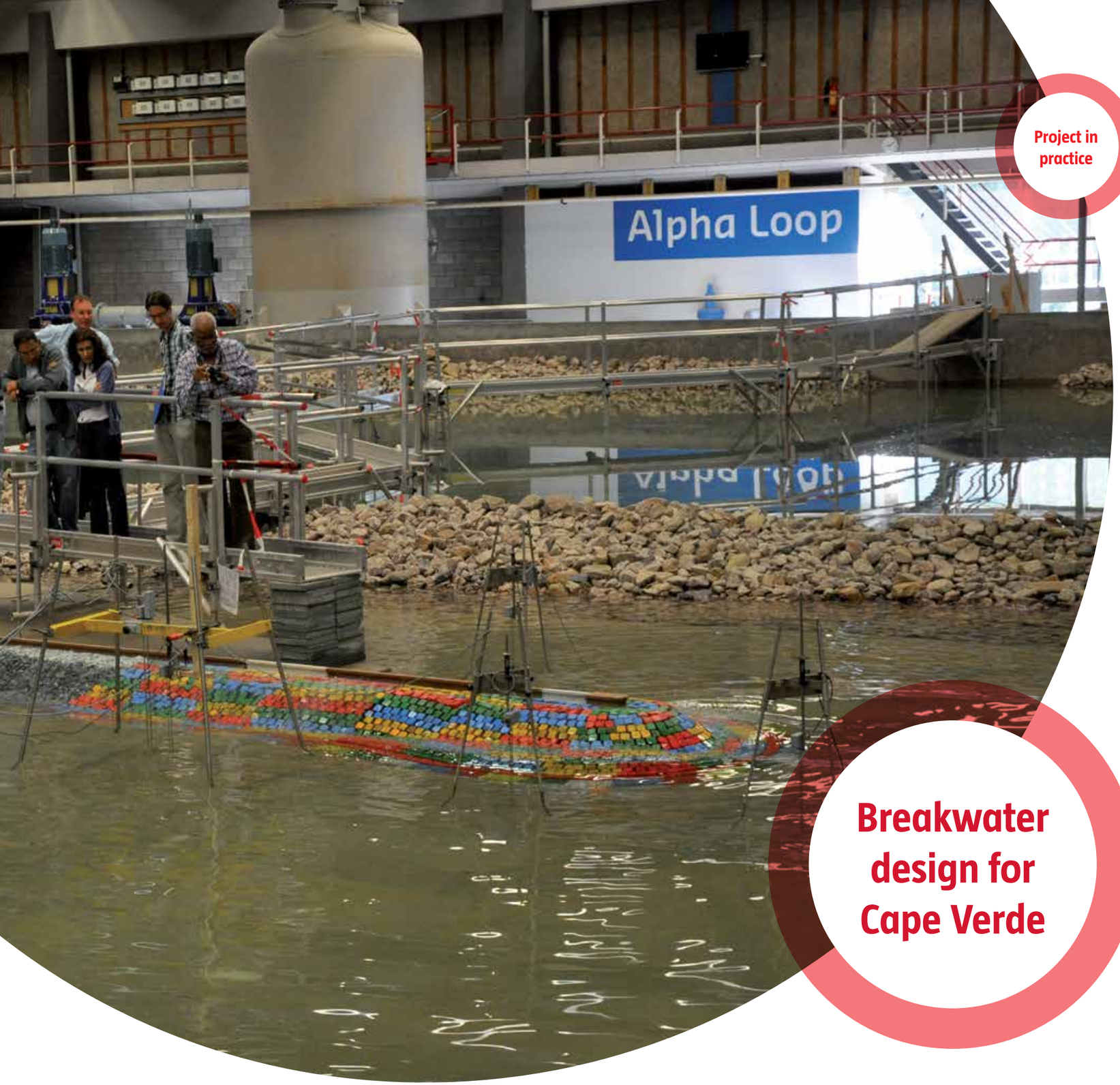
What are the ambitions for 2016?

- Deltares establishes its leading knowledge position by numerous journal publications with partner institutes. ⟷
- Deltares intensifies its transfer of knowledge by on-the-job-training and by cooperating with consultants. ⟷
- Deltares is a specialist consultant for international complex coastal dynamics, where appropriate in cooperation with consultants and dredging companies. ★
- Deltares extends its activities in Africa, the Middle East, North and South America.
- Funding comes increasingly from Joint Industry Projects (JIP), for example for developing prototypes.

Which results does Deltares want to achieve in 2013?

- Three to five published papers on coastal developments. ⟷
- The start of one or two PhD-students on coastal developments. ▞
- Continuation of on-the-job-training of consultants, software courses and lectures at universities. ⟷
- Optimising cooperation with consultants and dredging companies, via one or two specialist consultancy projects. ★
- Further improvement of the multidisciplinairy design tool. ▞
- Starting projects in Mozambique, Kenia and Angola.
- Prototype demonstrations of the design tool to attract new collaborative opportunities. ⟷

▞ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy



Project in practice

Breakwater design for Cape Verde

Breakwaters protect harbours against waves and ocean swell. The layout of the breakwater determines the wave propagation in the harbour. The armour layer of natural stones or concrete blocks protects the breakwater itself against waves and makes sure that the structure can withstand extreme waves. During the construction phase a newly designed breakwater of the Sal Rei harbour on the island Boa Vista (Cape Verde) proved to be insufficient in withstanding the waves generated by a passing storm.

Only after the breakwater was redesigned, Deltares was commissioned to test a number of cross sections for this redesigned breakwater in the wave flumes. The result of these essentially two-dimensional tests was that a single, flat layer of cubes performed better than all other alternatives. The contractor showed this innovative solution to be the most economic alternative. Finally the complete breakwater was modelled in the Delta Basin to verify and optimize the total design. The result of this modelling effort was that the single layer cubes were applied over the trunk and also on the roundhead. The tested structure is scheduled to be constructed in 2013.

marcel.vangent@deltares.nl

What is the theme ‘Sustainable delta planning’?

Basic information

What is the focus of this theme?

- The theme develops and tests concepts, methods and instruments to realise sustainability in deltas.
- The theme explores ways to integrate Deltares’ expertise on water and soil with knowledge about decision making.

Who is the theme leader?

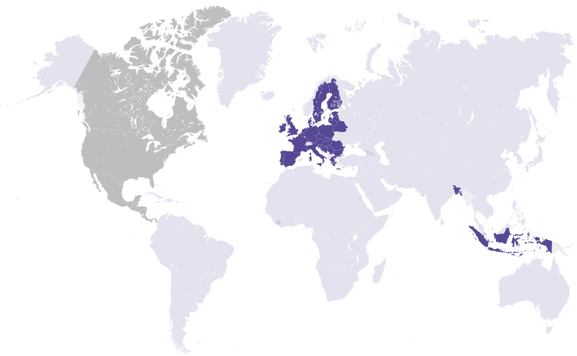
Hans Vissers (hans.vissers@deltares.nl) and Henriëtte Otter (henriette.otter@deltares.nl)

Which programmes are included in this theme?

- Delta governance
- Climate, water and spatial planning
- Concepts, methods and instruments for spatial planning and policy making
- Sustainable delta cities

International

In which parts of the world is Deltares currently active and which will have been added by 2016?



countries and regions	2016
Europe, Indonesia and Bangladesh.	Canada and North and Central America.

Context

What are relevant trends?

- Climate change is affecting flood risks and the distribution of water and therefore land use and spatial planning.
- Delta areas are becoming further urbanised due to international demographic and socio-economic changes.
- The increasing complexity of decision making processes regarding water, subsurface and infrastructure issues is increasing the public demand for integrated solutions.
- Stakeholders are increasing their demand for useable knowledge in decision making processes.

Which issues from the public and private sector and scientific world will be addressed?

- How can integrated methods and instruments accelerate design, improve quality and decrease costs of spatial planning?
- How can design and research be integrated to improve spatial development?
- How can public organisations use innovative policy arrangements to cope with uncertainty in decision making processes?
- How can Dutch expertise contribute to the realisation of national and European innovation ambitions?
- How can the subsurface be used more efficiently, especially in urban areas?

Ambition

What are the goals until 2016?

- Deltares will support decision making in spatial planning, through developing and integrating knowledge and sustainable practical solutions.
- Deltares will combine expertise from its themes, to make it applicable in policy making and spatial planning.

What is Deltares’ position, now and in 2016?

- Deltares is a national leader and internationally a well-known player on applied interdisciplinary research.
- In 2016 Deltares maintains its current national position and is more competitive internationally.

Results

What are the benefits for the public sector?

- National and local governments benefit from sustainable, cost-efficient solutions with optimal public support.
- Governments make better choices in water management, spatial planning and infrastructure because of better information.

What are the benefits for the private sector?

- Engineering consultants, urban designers and developers strengthen their competitiveness using methods and instruments for spatial planning issues related to water, subsurface and infrastructure.

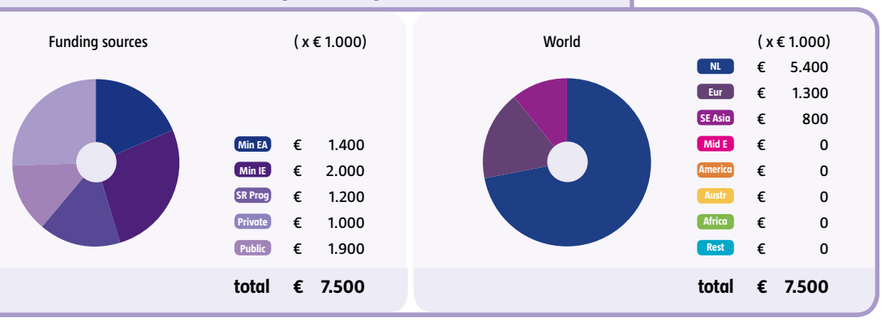
Facilities

Which facilities and (experimental) field locations are used?

- Deltares uses mainly pilot areas, for example in Bangladesh and via Knowledge for Climate in Rotterdam.

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



What are the revenue ambitions for 2016?

- Deltares will maintain its level of revenue, with governments remaining the most important funding party.
- Deltares will increase the share of European public funding, now that Dutch public funds are decreasing.

What is the programme 'Delta governance'?

Basic information

What is the main goal of this programme?

Deltares develops, disseminates, integrates and applies governance knowledge for safe and sustainable living in deltas, coastal zones and river basins.

Who does Deltares work with?

Delft University of Technology, Erasmus University of Rotterdam, Ministry of Infrastructure and the Environment, Ministry of Economic Affairs, partners of the Delta Programme, provinces, regional water authorities, Tygron Serious Gaming B.V., UNESCO-IHE, University of Amsterdam, University of Twente, University of Utrecht and Wageningen University and Research Centre.

Who are the main research partners and in which field of expertise do they contribute?

- Erasmus University Rotterdam: governance and public administration.
- Wageningen UR: governance arrangements, stakeholder involvement and participatory monitoring.
- University of Twente: interactive knowledge development.

Who are the programme leaders?

Gerald Jan Ellen (geraldjan.ellen@deltares.nl) and Henriëtte Otter (henriette.otter@deltares.nl)

Context

What are relevant trends?

- Delta areas are urbanising.
- Climate change is increasing the frequency and force of weather events in deltas.
- Governance of deltas is changing from public, centralised control towards private networks and initiatives.

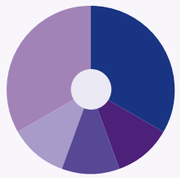
Which issues from the public and private sector and scientific world will be addressed?

- How can stakeholders deal with the increasing complexity of living and working in a delta?
- How can stakeholders deal with conflicts of interests on delta management issues?
- How can climate adaptation measures be implemented through innovation and flexible governance arrangements?

Revenue

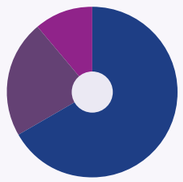
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources (x € 1.000)



Min EA	€	300
Min IE	€	100
SR Prog	€	100
Private	€	100
Public	€	300
total	**€**	**900**

World (x € 1.000)



NL	€	600
Eur	€	200
SE Asia	€	100
Mid E	€	0
America	€	0
Austr	€	0
Africa	€	0
Rest	€	0
total	**€**	**900**

Status

What are the programme lines and what are they about?

- **Governance system diagnostics:** Developing methodologies to diagnose governance arrangements.
- **Knowledge in decision making:** Developing innovative concepts, methods and instruments for production, quality control and use of knowledge in governance arrangements.
- **Governance tools:** Developing tools and methods on participation of stakeholders, division of costs and benefits and policy instruments.

What is the mixture of activities in the present programme portfolio?

- The focus is on development of knowledge, in collaboration with universities and governmental organisations.
- Development of knowledge occurs in scientific research projects and through case studies.
- Transfer of knowledge occurs in case studies and through publication of articles, presentations at conferences and development of apps.
- Specialist consultancy occurs through assignments for the Dutch government.

What are the most important results so far, who uses them and how do they apply them?

- Together with end user Waternet the participatory monitoring approach was developed, to increase acceptance among stakeholders of water management issues.
- A national symposium, attended by practioners, policy makers and researchers, was organised to present the programmes' ideas and ambitions.

In which parts of the world is Deltares active?

Deltares works in the Netherlands, Europe, Mozambique, Zambia, Colombia and South East Asia.

Which role does Deltares play in the international field of expertise?

- Deltares has the capacity to integrate natural and social science disciplines.
- Deltares links science to practice by using its extensive network.

Ambition

What are the ambitions for 2016?

- Delta governance is a well-known concept in the Netherlands and has expanded internationally. ⟷
- Deltares develops knowledge on governance of implementing and monitoring short and long term delta policy and measures. ▞
- Deltares publishes at least four articles in scientific journals on the subject of delta governance annually. ⟷
- Deltares organises an international symposium on delta governance. ⟷
- Deltares is a preferred partner when it comes to specialist consultancy on the subject of delta governance. ★
- Deltares works for regional and national governments, international research programmes and international financing institutions.

Which results does Deltares want to achieve in 2013?

- Governance strategies on how to deal with wicked problems. ▞
- Publication on participatory monitoring in the context of implementing climate adaptation strategies. ⟷
- Publication on the use of knowledge in decision making processes in the Delta Programme. ⟷
- Publication on a comparison between the Watertest in the Netherlands and the Watertest in Belgium. ⟷
- Insight into the potential impact of serious games on using knowledge in decision making. ▞
- Implementation of a methodology for climate adaptation strategies, using flexible policy arrangements and participatory monitoring. ▞
- Deltares' projects are always funded in cooperation with a cofunding partner.
- Regional focus is mainly on the Netherlands and Europe, a more international focus is being developed.

▞ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Climate, water and spatial planning?

Basic information

What is the main goal of this programme?

Deltares develops methods and tools to enable decision making in the face of uncertain climate, water and spatial developments.

Who does Deltares work with?

Delft University of Technology, International Institute for Applied Systems Analysis, Ministry of Infrastructure and the Environment, partners of Knowledge for Climate programme, partners of FP7-BASE consortium, provinces, regional water authorities, STOWA, UNESCO-IHE, Utrecht University, University of Twente, Maastricht University, VU University Amsterdam and Wageningen University and Research Centre.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: adaptive assessment frameworks.
- UNESCO-IHE: climate adaptation strategies.
- Knowledge for Climate programme: climate adaptation knowledge.

Who are the programme leaders?

Ad Jeuken (ad.jeuken@deltares.nl)

Context

What are relevant trends?

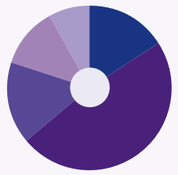
- Scientific understanding on climate change is progressing steadily but the effects will remain uncertain for a long time.
- Among Dutch companies, governments and research institutes awareness is growing that many deltas resemble Dutch deltas and therefore the same knowledge might apply.
- In science and policy making there is increasing agreement on robustness and flexible planning as proven concepts to cope with future uncertainty.
- The economic crisis is forcing decision makers to set priorities and to seek no regret investments.

Which issues from the public and private sector and scientific world will be addressed?

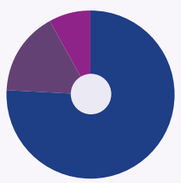
- How can future developments and needs be integrated in decisions in water management and spatial planning?
- How to cope with uncertain information in decision making processes in water management and spatial planning?
- How can the robustness of a flood or drought management system be quantified?
- How do local stakeholders, such as residents and entrepreneurs, adapt to perceived future risks?
- How can the effects of climate adaptation strategies be assessed rapidly?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x € 1.000)
Min EA	€ 400
Min IE	€ 1.200
SR Prog	€ 400
Private	€ 300
Public	€ 200
total	**€ 2.500**



World	(x € 1.000)
NL	€ 1.900
Eur	€ 400
SE Asia	€ 200
Mid E	€ 0
America	€ 0
Austr	€ 0
Africa	€ 0
Rest	€ 0
total	**€ 2.500**

Status

What are the programme lines and what are they about?

- **Policy adaptation pathways:** Developing knowledge and tools on how adaptation strategies can be designed, decided upon and executed.
- **Stakeholder adaptation pathways:** Developing knowledge and tools on how risks are perceived by local stakeholders, what preferred actions are and how policy can influence these.
- **Policy evaluation:** Developing knowledge and tools to assess different policy options for climate adaptation in deltas.

What is the mixture of activities in the present programme portfolio?

- The focus is on transfer of knowledge, mainly through publications and cooperation with partners.
- Transfer of knowledge takes place through cooperation with research partners and publications.
- Specialist consultancy on policy adaptation pathways occurs on a national level.
- Tools are developed to apply Deltares' knowledge in specialist consultancy.

What are the most important results so far, who uses them and how do they apply them?

- A rapid flood damage assessment model is used to derive adaptation strategies for the Delta Programme.
- Researchers, consultants and policy makers assess climate impact with an adaptation tipping points method.
- The Delta Programme applies the adaptive delta management concept for developing strategies to cope with future uncertainty such as climate change.
- The improved concept of system robustness is used within the Knowledge for Climate and Delta Programme to evaluate different measures to reduce risks.
- Knowledge on location-specific flood insurance premiums was deduced using new modelling techniques under various climate change scenarios and policy options.

In which parts of the world is Deltares active?

Deltares is active in the Netherlands, Europe, Bangladesh, Vietnam and Indonesia.

Which role does Deltares play in the international field of expertise?

- Deltares develops knowledge and makes Dutch knowledge applicable internationally.
- Deltares is one of the key institutes connecting scientific insights in water management to practical problems.
- Deltares connects different organizations and disciplines.

Ambition

What are the ambitions for 2016?

- Deltares applies its knowledge and expertise on dealing with uncertainty in a broad range of applications. ▬
- Deltares shifts from knowledge development, via pilot projects, towards tool application in specialist consultancy. ★
- Deltares uses scientific cooperation to improve its delta management knowledge and its scientific visibility. ▬
- Deltares focuses on international application of tools through the Delta Programme. ★

Which results does Deltares want to achieve in 2013?

- Application of the rapid assessment tool for flood and drought risk strategies in at least two pilots. ▬
- Publication of at least four scientific papers on delta planning, system robustness, flood insurance and adaptation pathways. ⟷
- Presentation of questionnaire results on stakeholder perception and behavior concerning drought risks. ⟷
- Application of the policy adaptation pathway method for European sectors of key economic importance. ★
- Application of adaptive delta management concepts in international private projects in Bangladesh and Colombia. ★
- Preferred strategies for Rijnmond Drechtsteden and the fresh water Delta Programme in the Netherlands. ▬

▬ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme ‘Concepts, methods and instruments for spatial planning and policy making’?

Basic information

What is the main goal of this programme?

Deltares develops methods for a more effective and efficient use of scientific knowledge of water and subsurface issues in spatial planning processes.

Who does Deltares work with?

Alterra, Arcadis, Centre for Environmental and Geographic Information Services Bangladesh, Delft University of Technology, Erasmus University Rotterdam, Geocycli B.V., Geodan, GeoNovum, HKV Consultants, H+N+S Landscape Architects, MUST, partners of the Delta Programme, Partnership for Advanced Computing in Europe, PBL Netherlands Environmental Assessment Agency, Port of Rotterdam, Royal HaskoningDHV, Royal Netherlands Meteorological Institute, SURFSara, The Netherlands Organisation for Scientific Research, TNO, Tygron Serious Gaming B.V., VU University Amsterdam, Wageningen University and Research Centre and WWF.

Who are the main research partners and in which field of expertise do they contribute?

- Wageningen University and Research Centre: methodology of research by design.
- Alterra: tools and methods for touch table development.
- Delft University of Technology: spatial planning and design.

Who are the programme leaders?

Gerda Roeleveld (gerda.roeleveld@deltares.nl) and Kymo Slager (kymo.slager@deltares.nl)

Context

What are relevant trends?

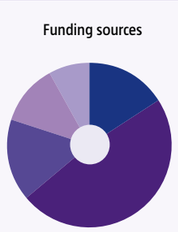
- Governments are making spatial planning processes more transparant for stakeholders
- Early participation by stakeholders in spatial planning has been shown to lead to faster implementation of plans.
- Governments are extending their time horizon for spatial policy making, approximately from fifty to hundred years.
- The increased availability of information is increasing people’s demand for knowledge in policy processes.

Which issues from the public and private sector and scientific world will be addressed?

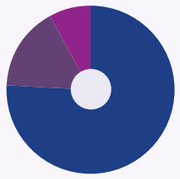
- How can research by design support worldwide planning processes for sustainable urban and rural development?
- How can the touch table toolbox support worldwide planning processes for sustainable urban and rural development?
- How can the touch table toolbox contribute to the development of stakeholder participation?
- How can the touch table toolbox enhance integration of knowledge from stakeholders, scientists and technical experts?
- How can the touch table toolbox evaluate the role and influence of knowledge in planning processes?
- How can new knowledge of water and subsurface systems and of management concepts be translated into input for the touch table toolbox?

Revenue

How is revenue for 2012 distributed among the funding sources and across the world?



Funding sources	(x € 1.000)
Min EA	€ 400
Min IE	€ 500
SR Prog	€ 300
Private	€ 300
Public	€ 600
total	**€ 2.100**



World	(x € 1.000)
NL	€ 1.500
Eur	€ 200
SE Asia	€ 400
Mid E	€ 0
America	€ 0
Austr	€ 0
Africa	€ 0
Rest	€ 0
total	**€ 2.100**

Status

What are the programme lines and what are they about?

- **Touch table toolbox for research and design:** Development of modules supporting different phases of spatial planning processes. Development of user friendly digital interfaces for participatory methods and guidelines.
- **Pilot cases:** Further development and application of site specific touch table methods and modules.

What is the mixture of activities in the present programme portfolio?

- Development of knowledge is increasingly complemented by transfer of knowledge activities.
- Combining development with transfer is realised via stakeholders, research institutes and the private sector.
- Specialist consultancy activities on touch table applications for public clients are growing.

What are the most important results so far, who uses them and how do they apply them?

- Urban and landscape designers improve their designs using guidelines on physical and ecological mechanisms, technical principles and requirements.
- Reports about how the touch table supports participatory problem analysis, strategy making and system model building in the initial phases of spatial planning processes.
- A first draft has been realised of a book on spatial processes and innovation, for researchers, policy makers, designers and engineers.
- Try out editions of online (touch table) tools have been published to demonstrate possibilities to potential clients.

In which parts of the world is Deltares active?

- Deltares is active in the Netherlands, Europe, Mozambique and Bangladesh.

Which role does Deltares play in the international field of expertise?

- Deltares cooperates with stakeholders in spatial planning processes to strengthen committed decision making.
- Deltares contributes to decision making with knowledge of water and soil systems and decision making processes.
- Deltares is a leader in developing digital participatory planning methods together with partners and (potential) users.

Ambition

What are the ambitions for 2016?

- The touch table tool box is commonly used by public and private clients of Deltares and consultants worldwide. ⟷
- Deltares’ knowledge on spatial planning processes is incorporated in all relevant Deltares’ work. ▟▙
- Deltares is continously being asked by clients to develop new specialised tools for touch tables. ▟▙
- Deltares sets the standard for what other parties contribute to the (open source) touch table. ⟷
- Worldwide, research by design is recognised and applied as a valuable process method in spatial planning. ⟷
- Deltares develops knowledge through pilot cases fully financed by clients.

Which results does Deltares want to achieve in 2013?

- Development and implementation of various new modules for the touch table toolbox. ▟▙
- Presentation of the touch table toolbox functionalities at two or three showcases for potential users and clients. ⟷
- Further development of the application of the touch table for the Climate Atlas Bangladesh. ▟▙
- Second international pilot project with the touch table.
- Publication of the book ‘Integrated planning and design for the delta, theory and methods’. ⟷
- Publication of scientific articles about knowledge exchange in spatial planning processes. ⟷
- Monitoring and evaluation of knowledge exchange processes in experimental research by design workshop with designers and Deltares’ experts. ▟▙
- Report on the serious game experiment for the Delta Programme southwest delta. ⟷
- Business case on the development and exploitation of an interactive spatial planning platform.

▟▙ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

What is the programme 'Sustainable delta cities'?

Basic information

What is the main goal of this programme?

Deltares develops concepts and applies suitable solutions for sustainable urbanisation in delta areas.

Who does Deltares work with?

Acciona, AGH-University of Science and Technology Cracow, AT Osborne, Bureau de recherches géologiques et minières, Dechema, Environmental Technology Ltd UK, Lawaetz Foundation, Ministry of Infrastructure and the Environment, municipalities, PN Studio, Ramboll Polska, Stadt+, Tecnalia-LABEIN, Transumo, TNO, UNESCO-IHE, University of Amsterdam, University of Copenhagen, University of Rome Tor Vergata, University of Nottingham, University of Sheffield, University of Utrecht and Vlaamse Landmaatschappij.

Who are the main research partners and in which field of expertise do they contribute?

TNO: integral assessment of urban environments.
Utrecht University and University of Amsterdam: sustainable development and management of the shallow subsurface.

Who are the programme leaders?

Marco Hoogvliet (marco.hoogvliet@deltares.nl)

Context

What are relevant trends?

Continuing urbanisation is increasing natural resource scarcity in deltas.
Continuing urbanisation in deltas has profound impact on the environment, because more people live on increasingly vulnerable land.
People are increasingly demanding integrated solutions for urbanisation issues in deltas.

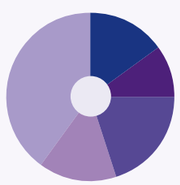
Which issues from the public and private sector and scientific world will be addressed?

How can obsolete, disused industrial areas (brownfields) and urban areas be redeveloped?
How can subsidence damages in urban areas be prevented and dealt with?
How can models rapidly assess how human activities influence the deltaic system and the urban fabric?
How can concepts about sustainable urban design and spatial urban planning be put into practice?

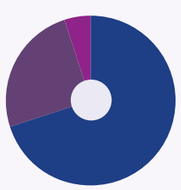
Revenue

How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources	(x € 1.000)
Min EA	€ 300
Min IE	€ 200
SR Prog	€ 400
Private	€ 300
Public	€ 800
total	**€ 2.000**



World	(x € 1.000)
NL	€ 1.400
Eur	€ 500
SE Asia	€ 100
Mid E	€ 0
America	€ 0
Austr	€ 0
Africa	€ 0
Rest	€ 0
total	**€ 2.000**



Status

What are the programme lines and what are they about?

Prevention and settlement of damage and nuisance: Gaining knowledge about the emergence, prevention and settlement of subsidence damage to structures.
Integrated urban assessment models: Developing and applying rapid assessment tools to assess how human activities and the urban environment interact with the physical deltaic system.
Sustainable design and spatial planning in practice: Implementing innovative concepts in the field of urban design and spatial planning in case studies.

What is the mixture of activities in the present programme portfolio?

The focus is on the development of knowledge, in collaboration with other research institutes.
Development and transfer of knowledge occurs in case studies in collaboration with stakeholders.

What are the most important results so far, who uses them and how do they apply them?

The programme started on January 1st 2013.

In which parts of the world is Deltares active?

Deltares works in the Netherlands, Poland, Romania, Italy, Germany, Canada and Indonesia.

Which role does Deltares play in the international field of expertise?

Deltares generates solutions for delta cities by integrating knowledge of water and subsurface systems, urban design and governance.
Deltares combines its own knowledge with knowledge from other parties.

Ambition

What are the ambitions for 2016?

Deltares knows how to implement solutions for sustainable delta cities, and assists clients in realising this. ★
Deltares will shift its focus from research on urban systems to assessment, selection, configuration and realisation of solutions in complex cities. ★
Deltares excels internationally in the field of sustainable delta cities because of its broad and integral expertise.

Which results does Deltares want to achieve in 2013?

Introduction of the Brownfield navigator tool in the Dutch market. ⟷
Book on sustainable development and management of the shallow subsurface.
Scientific publication on how an ecosystem service approach can meet global water challenges in urban areas. ⟷
Report on methods for sustainable harbour constructions based on a case study in Indonesia. ⟷
Report on pros and cons of subsurface constructions in cities from an energy point of view.
Wiki about Deltares' progress in the field of rapid assessment tools for urban areas. ⟷

Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

Project in practice

Adaptive strategies for unembanked areas

Rotterdam is vulnerable to both tidal and pluvial floods. Most of the city is protected by a network of primary flood defences, but like most other harbour cities, Rotterdam has highly developed urban areas outside the primary water defence system that are to a greater or lesser extent vulnerable to flooding. Which adaptive measures are promising in terms of implementation, financial feasibility, climate resilience and contribution to spatial quality?

Together with a range of partners, Deltares studied the flood risks in the unembanked areas Noordereiland and Feijenoord in Rotterdam. Deltares introduced its Adaptation Pathway method as a way to deal with the uncertainties in climate and urban development. The basis for the pathways is an assessment of the effectiveness of possible measures in the coming century, gained through a tipping point analysis. The method provides insight into the urgency to adapt to climate change and insight into the effectiveness over time of the possible measures. Additionally, the method visualizes the link between long term policy approaches and possible measures.

marco.hoogvliet@deltares.nl

What is the programme ‘Software innovation’?

Basic information

What is the main goal of this programme?

- Deltares contributes to innovation and integration of software for the simulation of (ground)water flow, transport of substances, waves and morphology in deltas.
- Deltares develops innovative instruments for the presentation and exchange of knowledge and data.

Who does Deltares work with?

Alten, Arcadis, Delft3D open source community, Grontmij, HKV Lijn in Water, Nelen+Schuurmans, regional water authorities, Royal HaskoningDHV, Tauw, Van Oord, Vortech and Witteveen+Bos.

Who are the main research partners and in which field of expertise do they contribute?

- Delft University of Technology: numerical mathematics, morphology, hydrodynamics and serious gaming.
- UNESCO-IHE: hydrodynamics and morphology.
- University of Colorado: dynamic deltas.

Who are the programme leaders?

Joost Icke (joost.icke@deltares.nl)

Context

What are relevant trends?

- The demand for integrated modelling suites is increasing because governments are asking for an integrated approach to water and subsurface issues.
- Governments, universities and research institutes are increasingly demanding open source modelling suites.
- Due to the increasing demand for open source software, software is increasingly developed by communities.
- New technologies for knowledge and data exchange, such as mobile devices with online access, are becoming increasingly available.
- The amount of available data is increasing rapidly because of open data policies and technological progress.

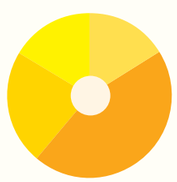
Which issues from the public and private sector and scientific world will be addressed?

- How can several hydro software products be integrated into one software suite?
- How can information exchange between models be improved by means of a software framework that operates on the basis of open standards?
- How can new knowledge of water and soil related processes in deltas be incorporated into hydro software?
- What new products and services can be developed when governmental data on water, subsurface and the environment becomes available to the private sector?
- How can sharing of innovative knowledge increase attention of stakeholders for water and soil issues in urban areas?

Revenue

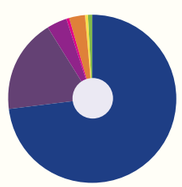
How is revenue for 2012 distributed among the funding sources and across the world?

Funding sources



	(x € 1.000)
Min EA	€ 1.300
Min IE	€ 3.600
SR Prog	€ 0
Private	€ 1.800
Public	€ 1.300
total	**€ 8.000**

World



	(x € 1.000)
NL	€ 5.850
Eur	€ 1.450
SE Asia	€ 300
Mid E	€ 50
America	€ 250
Austr	€ 50
Africa	€ 50
Rest	€ 0
total	**€ 8.000**

Status

What are the programme lines and what are they about?

- **Next generation hydro software:** Integrating simulation software for hydrodynamics, waves, morphology and water quality on the basis of a new computational core (D-Flow Flexible Mesh).
- **Integrated modelling frameworks:** Developing integrated environmental modelling frameworks for coupling of simulation models for water and soil processes.
- **Innovative information tools:** Exploring and applying hardware and software developments that enhance the sharing of data and knowledge.

What is the mixture of activities in the present programme portfolio?

- Focus is on development and transfer of knowledge by means of software development.

What are the most important results so far, who uses them and how do they apply them?

- The public and private cost of water management software has decreased due to integrated software.
- The hydro software community has thousands of members worldwide.
- The research version of D-Flow Flexible Mesh is applied by Deltares, research institutes and engineering companies worldwide, to simulate hydrodynamics in complex water systems.
- Deltares uses the framework Delta Shell as the basis for the next generation hydro software.
- Rijkswaterstaat accepted SOBEK 3.0 for 1D simulation of hydrodynamics and real-time control of structures.
- A case study has proved the potential of applying augmented reality for visualisation of subsurface cables and pipes.
- A software module for land subsidence has been developed and coupled to the groundwater model MODFLOW.

In which parts of the world is Deltares active?

- The software community has members all over the world.
- Software is being used worldwide, mainly in Europe, the Middle East, Asia, Australia and the United States.
- Deltares researchers and consultants apply the software in their activities worldwide.

Which role does Deltares play in the international field of expertise?

- Deltares is an international leader in the field of integrating knowledge of hydrodynamics, water quality, morphology and soil in software.
- Deltares’ software gives researchers and engineers access to knowledge on water and soil related issues.
- Deltares is leading the open source community on hydro software where third parties share their knowledge and software code.

Ambition

What are the ambitions for 2016?

- Regional water authorities, engineering companies and researchers worldwide, use D-Flow Flexible Mesh 1.0. ⟷
- The open architecture of the software enables future deepening and broading of the functionality. ▩
- The next generation software strengthens Deltares’ position for specialist consultancy projects worldwide. ★
- Stakeholder meetings are being supported by interactive use of simulation software (the touch table). ⟷
- Knowledge transfer intensifies by distributing software and training. ⟷
- The software community is increasingly sharing source codes and good modelling practices. ⟷
- The scope of the programme broadens to subsurface and geotechnical software, and development of tools to analyse large data sets. ▩
- Deltares expands its research activities and software distribution in the United States.
- Deltares attracts additional research funds from the European Union and the United States.

Which results does Deltares want to achieve in 2013?

- Ready-to-use research version of D-Flow Flexible Mesh for the 1D-2D-3D simulation of hydrodynamics. ▩
- Release of software modules to simulate rainfall runoff, water quality, morphology, combined with SOBEK. ▩
- Release of Delta Shell environmental modelling framework. ▩
- Development of an interactive modelling tool to simulate water and soil related issues in urban areas. ▩
- Start of additional open source communities for DELWAQ, Delta Shell and D-Flow Flexible Mesh. ⟷
- Courses to train modellers in the use of the new SOBEK and D-Flow Flexible Mesh software. ⟷
- Additional funding for urban hydro software (sewer systems and rainfall runoff) from the Dutch public sector.
- Contract research and cooperation with universities and research institutes in the United States.

▩ Development of knowledge ⟷ Transfer of knowledge ★ Specialist consultancy

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