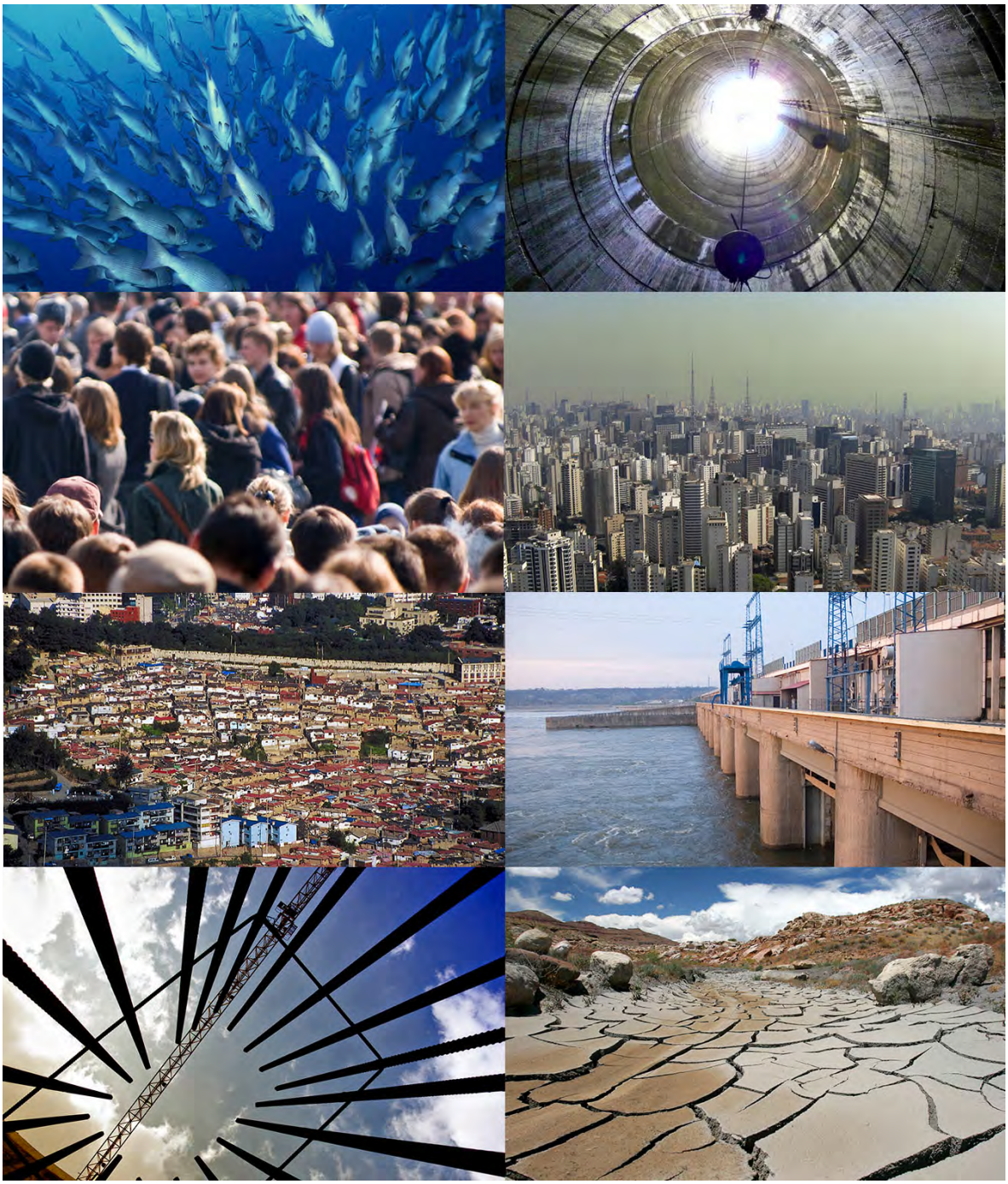
Water Technology:
Innovation Workshop



UK Israel Tech HUB

British Embassy Israel

ARUP

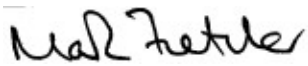
Foreword

Globally, the water sector faces many challenges in delivering safe, sustainable water for the needs of mankind whilst minimising its impact on the environment. These challenges include scarcity, growing demand, increasing energy costs and the impact on water use on the environment.

Arup is active in the water sector worldwide and recognises the need to provide innovate solutions to fast growing and developing countries through to industrialised countries with different requirements. In order for Arup to meet its aspiration to '*To Build a Better World*', we actively seek new and innovative ways of delivering engineering solutions.

We recognise Israel as one of the leading countries innovating in the water sector and therefore initiated this Innovative Water Workshop to help build UK – Israeli partnerships to deliver better value in the water sector globally.

Mark Fletcher
Global Water Leader, Arup



The British Government is convinced that the creativity of Israeli innovation, partnered with the strength and reach of the UK's companies, can be a world-beating combination. Together we can offer solutions to some of the world's most important problems - new therapies for diseases, new systems for harnessing energy, new ideas for exploiting the internet, and new ways to address the world's rising demand for safe, clean water.

This is why we have invested in the UK Israel Tech Hub, an innovative new team based at the British Embassy in Israel tasked with building partnerships in between the two countries.Water technology is one of our priority sectors, and the economic logic of a UK/Israel partnership in water is compelling. Israeli water tech can go global by partnering with leading British companies, like Arup, who have expertise in delivering major infrastructure projects worldwide. And those British companies can gain a global competitive advantage from partnering with Israeli water companies who have world-beating expertise in overcoming water scarcity and making every last drop count.

I am grateful to Arup for hosting this workshop and for their visionary approach to innovation in the global water industry. I am absolutely convinced that their model of combining in-house capabilities and expertise with the best solutions coming out of Israel is a powerful one that will yield exciting results, and one from which other British companies can learn.

Matthew Gould
HM Ambassador

Overview

On the 4 March 2013, Arup hosted a delegation of 14 Israeli water technology companies and a number of their UK counterparts at an innovation workshop, to share their expertise and market knowledge and to identify opportunities to collaborate globally. The event was organised in partnership with the UK Israel Tech Hub, whose mission is to strengthen technology partnerships between the two countries. The representatives of the water industry in the UK and Israel shared with the group the structure of the industry, the challenges they face and the innovations that help address both global and local needs.

Although the water technology sectors of the UK and Israel share many similarities, it was obvious that there are a number of key differences which are driven by factors such as local governance and regulations, water availability/water scarcity, and their impact on the 'value' of water.

As well as providing an opportunity to get to know each other through a series of interactive sessions, the output of the workshop identified specific collaboration opportunities, some of which are outlined in this report.

Mark Fletcher,
Global Water Leader, Arup
4 March 2013

About the sponsors

ARUP

About Arup

Arup is an independent firm of designers, planners, engineers and technical specialists offering a diverse range of professional services to clients around the world. The firm provides expertise in all aspects of water engineering, management and technology, covering the entire water cycle in temperate, arid and tropical environments. In 2011 Arup was named by the Infrastructure Journal as the Global Technical Adviser of the Year, acknowledging our position as the pre-eminent technical advisor in the infrastructure market. Arup has a great history of research, foresight and innovation, working with clients to explore drivers of change, to generate innovative ideas about business futures, and to evaluate new technology.

UK Israel Tech HUB

About UK Israel Tech Hub

The UK Israel Tech Hub at the British Embassy Israel helps drive economic growth in both countries by helping British companies partner with the best of Israeli innovation. The goal is to create partnerships in which British companies help Israeli innovation go global, and Israeli innovation gives British companies a global competitive edge.

The Hub was launched in October 2011 as an initiative of Ambassador Matthew Gould, and focuses its activities within sectors identified as having unique synergies between the UK and Israel, including Digital, Biomed, Cleantech, Arabic Internet, Government IT and Finance.

British Embassy Israel

About British Embassy Israel

The British Embassy Israel develops and maintains relations between the United Kingdom and Israel, and supports Britain’s security, prosperity and well-being, and regional peace, through partnership with Israel.

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Agenda

The agenda was developed in collaboration with UK Israel Tech Hub based at the UK Embassy in Israel.

The purpose of the workshop was to identify opportunities for companies to collaborate in the water technology sector. These opportunities were discussed in a series of facilitated workshop sessions which helped to highlight a number of areas of interest and future collaboration between the water sectors of the two countries.

08.30	**Arrivals, refreshments**
09.30	**Welcome and introduction** *Mark Fletcher, Arup* *Yoni Dolgin, UK Israel Hub*
09.40	**Water innovation: Necessities, realities and priorities** *David Owen, Envisager Ltd*
	Global Water Investment *Jonathan Yates, Arup*
	Water foresight – key drivers for the water sector *Workshop session*
10.45	**Coffee break**
11.15	**Current Water Challenges** *Short thought-provoking inputs from UK and Israel water tech companies*
12.15	**Lunch**
13.15	**'Speed Dating' on Water Issues** *Open discussions in small groups*
14.30	**Tea break**
15.00	**Opportunities for collaboration: Local to Global** *Workshop session*
16.00	**Plenary discussion & feedback**
	Final remarks
17.00	Followed by **Drinks and canapés**

Workshop delegates

UK and Israeli companies were selected and invited to the workshop based at Arup's London office.

Name	Company	Contact details
James Kitson	Yorkshire Water	James.Kitson@yorkshirewater.co.uk
Prof Roy Kalawsky	Loughborough University	r.s.kalawsky@lboro.ac.uk
David Lloyd Owen	Envisager	david@envisager.co.uk
Phil Henry	Polypipe	Phil.Henry@polypipe.com
Matthew Axford	Polypipe	mathew.axford@polypipe.com
Mark Fletcher	Arup	mark.fletcher@arup.com
Martin Shouler	Arup	martin.shouler@arup.com
Jennifer Schooling*	Arup	jennifer.schooling@arup.com
Justin Abbott	Arup	justin.abbott@arup.com
Peter Edwards	Arup	peter.edwards@arup.com
Jonathan Yates	Arup	jonathan.yates@arup.com
Siraj Tahir	Arup	siraj.tahir@arup.com
Mark Tindale	Arup	mark.tindale@arup.com
Ori Ainy	Applied Cleantech	ori@actsrs.com
Refael Aharon	Applied Cleantech	refael@actsrs.com
Ezra Barkai	RWL Nirosoft	EBarkai@nirosoft.com
Yossi Yaacoby	Mekorot	yyaacoby@mekorot.co.il
Moshe Sela	AGM Communications& Control	selamo@cabri.org.il
Danny Handler	Top-It-Up	goldan18@gmail.com
Marc Krieger	Aqwise - Wise Water Technologies	Marc@aqwise.com
Zeev Fisher	Mapal Green Energy	zeev@mapal-ge.com
Yoni Dolgin	UK Israel Tech Hub	Yoni@UKIsraelHub.com
Naomi Krieger	UK Israel Tech Hub	naomi@ukisraelhub.com
Simon Spier	Israeli Embassy London	simon.spier@israeltrade.gov.il

* Facilitator

UK and Israeli delegates

Water Innovation and Global Water Investment

Two presentations were given to help stimulate the opportunities in the water sector:

Water innovation:
Necessities, realities and priorities

Keynote presentation by Dr David Lloyd Owen, CEO of Envisager Ltd

Dr David Lloyd Owen presented the key drivers for the UK Water Industry since privatisation. As well as the situation in the UK, David highlighted how investment in water supply and drainage can lead to an increase in a nation's GDP.

See Annex A for David Lloyd Owen's presentation.

Global Water Investment

A presentation by Jonathan Yates, Associate Director, Arup

Jonathan Yates, Arup covered the global investment treads in the water sector. He shared work with group, identifying where the money was coming from and to where it was going in the global water market.

See Annex B for Jonathan Yates' presentation.

Water foresight:
key drivers for the water sector

Workshop session

A facilitated workshop was held to consider the global challenge for the water sector. The Arup Drivers of Change (Water) cards (www.driversofchange.com) were used to get the participants reflect on specific water-related issues and how they impact on the environment, economy and society. Groups were asked to select the three most important issues affecting water globally and consider how the opportunities and challenges for the water technology sector.

The results highlighted the following shared view of the key drivers for the water sector:

- Water security (availability)
- Growing global population
- The pricing of water and its real value
- Opportunities for water re-use
- Food production and water use

Water Drivers

Current water challenges

Short water bursts of information from UK and Israel water tech companies

Seven speakers from a wide range of experience were selected to give a five minute presentation on 'front of mind' issues which they were working on.

Presenter	Company	Presentation title
1. **Booky Oren**	Booky Oren Global Water Technologies	Building a Global Water Innovation Hub
2. **Ezra Barkai**	RWL Nirosoft	Global drive and demand for water treatment and desalination
3. **Ori Ainy**	Applied Cleantech	Transforming wastewater: from burden to commodity
4. **Marc Krieger**	Aqwise	Retrofit and upgrade of wastewater treatment facilities - the need of the hour
5. **Matt Axford**	Polypipe	Opportunities Local and Global
6. Professor Roy Kalawsky	Loughborough University	Innovation in Water Technology
7. James Kitson	Yorkshire Water	A view from Yorkshire Water

See Annex C for presentations from the 'Water Burst' sessions.

Opportunities for collaboration: local to global

Workshop session

Four key areas were identified for discussion. These were:

01 Buildings & Districts – decentralised water systems

02 Developed Markets

03 Emerging Markets

04 Water Efficiency

Delegates were asked to contribute potential opportunities from both a local and global perspective under each of the above headings. Links to other organisations were also identified.

See Annex D for a summary of the discussions in these four sessions.

Opportunity for collaboration: Action plans

In the final session of the day delegates discussed specific opportunities that might arise, based on the day's discussions. These were developed in response to the following questions:

What is the opportunity?

Why is this important?

Who should be involved?

How will they cooperate?

When?

Opportunities: Arising during the workshop

Opportunity 1: Extend Nirosoft's partial water purification capability

What	Extend Nirosoft's partial water purification capability to embrace the entire purification cycle, including pre-treatment.
Why	High global demand exists for an end-to-end capability (particularly applicable to water treatment for industry).
Who	Nirosoft to work with Aqwise and others, facilitated by Arup.
How	Generate a partnership to address a broader spectrum of contamination types and levels than Nirosoft is able to do alone. Through technical liaison with Arup engineers, a full-range treatment services architecture could be created and offered to the market and to Arup clients.
When	Research can begin immediately.

Opportunity 2: Promote waste water retrofits and upgrades capability

What	Promote waste water retrofits and upgrades capability.
Why	A large population of end-of-life or over-capacity treatment plants exists. This is a limiting factor in urban development.
Who	Aqwise to work with appropriate utilities, together with suitable engineering consultancies (e.g. Arup) to develop the service.
How	Aqwise could provide the technology component and this could be marketed as a particular feature of the retrofit package ('Aqwise inside' akin to 'Intel inside'). The package could be presented as a de-risked financial, functional and business model to utilities. A systems architecture is needed, to show how the various functional components inter-relate; this can be facilitated by Arup's water engineers.
When	Can begin immediately.

Opportunity 3: Further Arup-Israeli industry and clients liaison

What	Further Arup-Israeli industry and client liaison.
Why	A mutually valuable cross-pollination opportunity exists. The liaison could help Arup better to understand the technologies that are available from Israeli companies and to develop consulting and design business in Israel.
Who	Arup; Nirosoft; Aqwise; other workshop participant companies.
How	Discussions and evaluation of opportunities with prospective Arup clients. The work should be underpinned by a suitable industry taxonomy, to structure the services and capabilities offered by the industry participants involved.
When	Next quarter.

Opportunity 4: Retrofit floating fine bubble aeration for wastewater treatment

What	Retrofit floating fine bubble aeration for wastewater treatment.
Why	It can be installed 'live', rather than installing with draw-down. It can save up to 70% in energy costs and up to 80% in O&M costs.
Who	Arup/Mapal. To UK water utilities.
How	Demonstration project? (reference project). Facilitate discussions with UK water utilities and Arup process experts.
When	To be confirmed.

Opportunities: Arising subsequently from contacts provided

Opportunity 5: *AGM communication and control* – interfaces to legacy control and monitoring systems

What	AGM provides comms and control solutions for SCADA and other legacy systems, to facilitate their connection and interoperation with more modern IT systems.
Why	The interface provided by AGM is particularly relevant to retrofit work of the type that is particularly necessary in upgrading and improving developed countries' water (and other utilities) infrastructure.
Who	AGM (www.agm.co.il) and Arup.
How	Further liaison regarding technical solutions offered, global capability, pricing structures, future development plans.
When	Q2 2013.

Opportunity 6: TaKaDu – Cloud-based water network monitoring

What	TaKaDu provides Software-as-a-Service solutions for monitoring water distribution networks, to provide real-time control and visibility over network events. The firm offers advanced statistical and mathematical algorithms to provide alerts, in real-time, on leaks, bursts, in efficiencies and other anomalies.
Why	The application of advanced analytics offers substantial promise in water service providers efforts to improve operations through innovation. However, the capital cost of installing in-house equipment is high and this makes difficult the preparation of a compelling business case. TaKaDu's service-based offering transfers the load from Capex to Opex and this may make more palatable to many providers the initial exploration of such innovative technology.
Who	TaKaDu, Arup and potentially Arup's existing water provider customers (e.g. United Utilities, Yorkshire Water, Welsh Water).
How	Potential for evaluation projects leading to practical case studies.
When	Q2 2013.

Opportunity 7: Whitewater – water network management

What	Whitewater offers smart water network management software, intended to help water services providers to increase operational efficiency. The company's products facilitate knowledge sharing, managing workflows, optimizing plant and distribution operations by better exploiting data that already exists in utilities' IT and operational technology environments.
Why	Services that are proven in the 'smarter water' space are an attractive component of a 'smart city' programme and are also relevant to water services providers seeking to optimise their operations and to assure regulatory compliance. Hence, Whitewater's offering may provide a useful element in Arup's strategic advice and designs.
Who	Arup, Whitewater, potentially existing clients for evaluation and possible demonstration.
How	Further evaluation of Whitewater capabilities by Arup specialists, potentially followed by practical demonstration and proof of concept work.

When	Q2-Q3 2013.

Opportunity 8: *Booky Oren Global Water Technologies* – 'Global Water Partnership Hub'

What	Booky Oren is involved with numerous water services providers and associated industries and plays a facilitating and integrating role.
Why	Booky may be able to offer useful introductions both of Arup to potential clients and of firms whose products and services may be of interest to Arup and its clients.
Who	Direct liaison Arup staff with a focus on water, and Booky Oren GWT.
How	Arup to provide the 'Smarter Water' capability statement to Booky when it is ready for circulation.
When	Q2 2013.

Opportunity 9: *IOSight* - infrastructure facility management and water data management

What	IOSight provides FM and data management services to several utilities sectors, including water, energy and manufacturing. Their focus is on data collection, analysis and reporting.
Why	Analytics applied to the water industry will underpin many of the innovative changes that will be required to improve operational performance, resilience, energy efficiency and regulatory compliance. An awareness of IOSight's capabilities will be important to Arup, with potential for collaborative work on behalf of clients.
Who	Arup, IOSight, potentially existing Arup clients with innovation programmes.
How	Initially liaison to increase awareness of service and product offerings. Potentially evaluation including practical demonstrators.
When	Q2-Q3 2013.

Summary

The workshop provided representatives from the UK and Israeli water sector to build new relationships and understand the challenges, as they see them in, both local and global water markets.

Collaborative ideas were developed through a series of facilitated workshops. These and other opportunities will be pursued in order to bring new and associated industries.

The workshop also provided an opportunity to strengthen relationships between the UK and Israel.

Annexes

Annex A:
Water innovation: Necessities, realities and priorities

Keynote presentation by Dr David Lloyd Owen, CEO of Envisager Ltd

Annex B:
Global Water Investment

A presentation by Jonathan Yates Associate Director, Arup

Annex C:
Presentations from the short 'Water Burst' sessions:

C.1 Building a Global Water Innovation Hub
A short burst by Booky Oren, Booky Oren Global Water Technologies

C.2 Global drive and demand for water treatment and desalination
A short burst by Ezra Barkai, RWL Nirosoft

C.3 Transforming wastewater: from burden to commodity
A short burst by Ori Ainy, Applied Cleantech

C.4 Retrofit and upgrade of wastewater treatment
facilities - the need of the hour
A short burst by Marc Krieger, Aqwise

C.5 Opportunities local and global
A short burst by Matt Axford, Polypipe

Innovation in Water Technology
A short burst by Professor Roy Kalawsky, Loughborough University

Annex D:
'Speed Dating' on water issues

D.1 Buildings and Districts: Facilitated by Martin Shouler, Arup

D.2 Developed marketing: Facilitated by Peter Edwards

D.3 Emerging markets: Facilitated by Jonathan Yates

D.4 Water efficiency: Facilitated by Justin Abbott

Annex A

Water innovation:
Necessities, realities and priorities

Keynote presentation by Dr David Lloyd Owen, CEO of Envisager Ltd

Innovation: Necessities, Realities & Priorities

Water Tech Hub, Arup
4th March 2013

Dr David Lloyd Owen
Envisager Limited

Necessities: Threats to water security and biodiversity

Vörösmarty (Nature, 2010) looked at the impact of climate change and population growth globally at the 50x50 Km level

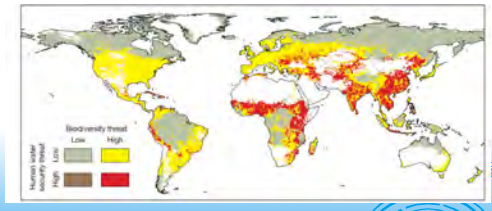
"What we're able to outline is a planet-wide pattern of threat"

Data used is 5-10 years old…the reality is worse

Water security will not come cheap

3.4 bn people highlighted as being under threat

Prevailing patterns of threat to human water security & biodiversity



CJ Vörösmarty et al. Nature 467, 555-561 (2010) doi:10.1038/nature09440

nature

Necessities: Millennium Development Goals targets versus outcomes

% of people without safe drinking water

	2000	2010	2015 Proj.	2015 Target
MDG 'unimproved'	23%	12%	9%	12%
Unsafe (water quality)	37%	28%	26%	18%
Unsafe (water & sanitary risk)	53%	42%	46%	26%

Int. J. Environ. Res Public Health, 2012, 9, 880-894

Millennium Development Goals Who really has safe drinking water ?

Status of access to 'safe' drinking water in 2010

	Million people	Range
Low sanitary risk	3,180	2,510-3,220
Elevated sanitary risk	1,260	740-2,130
Unsafe	1,020	746-1,610
Unknown safety	380	380
Unimproved	780	780
No data	300	300
Global Total	6,900	

Int. J. Environ. Res Public Health, 2012, 9, 880-894

Necessities: The domestic agenda

Leakage reduction is coming up the agenda

Coping with floods and droughts

Competition as an ideological tool?

Water Framework Directive trundles on to 2029

Bathing Water Directive – a real time world in 2015

Ofwat opens to innovation and efficiency

But wants the sector to share the price pain

Necessities: The energy cost crunch

Electricity as a cost factor in England & Wales

% of operating costs	2003-04	2009-10
Water & sewerage	8%	13%
Sewerage	14%	24%
Sewage treatment	27%	38%
Sludge treatment	10%	6%

Responses: Mobile Communications and water

In 2008, Kenyan subscribers spent 17% of household income on mobile phones

They choose this because of the benefits

People unhappy with water services but no change

African networks are offering mobile bill paying

World Bank's water and sanitation 'hackathons'

Upraisemyloo – real time logging of household sanitation data…a bottom up approach

Mobile Communications and water: An Indian Summer

% with	2000	2008	2010
Piped water	20%	22%	23%
'Improved' sanitation	25%	31%	34%
Fixed line phones	1%	1%	1%
Mobile phones	0%	22%	63%

Something happens when you have a choice

Innovation has its disruptive charms

Responses: Smart Water

The addressable market covers advanced metering, monitoring, automation, testing, communications, data management and advanced irrigation systems

Global smart water revenues $0.5-1.0 bn in 2010 (0.5-0.9% of addressable market)

Forecasts for 2020 market size range from $5-16 bn (2.9-9.4% of addressable market)

Water and CleanTech VC

$998 m of $35,210 m CleanTech VC funding in 2007-11 went to water companies

$80 m out of $3,910 m smart Cleantech VC funding in 2007-11 went to water companies

Average investment is for $5.0 m

Shift away from early stage since 2006

Water is seen as a peripheral element

Only one dedicated fund (XPV Capital)

Responses: Singapore

Water security recognised as a priority issue

Public Utilities Board – charged with making Singapore self-sufficient by 2060 via its 'Four National Taps' project

Smart grid to monitor all inland water quality

294 private sector R&D projects supported in 2002-10, one improved wastewater recovery energy efficiency by 300% over seven years

PUB uses PSP when it is more efficient

Responses: Israel

- Mekorot: 2004, set up the Water Technologies Entrepreneurship Centre in 2004 for trialling new ventures via its technological standards
- New Efficiency Water Technologies program has attracted $700 m in private funding for 26 water technology incubators, underwriting the innovation installation risk
- Utilities have financial incentives to minimise leakage and to maximise water recovery

Responses: Malta

- Severe water shortages and dependence on desal (energy accounts for 75% of its opex)
- National utility smart metering plan drawn up in 2008-09 supporting demand management
- Every household to have an integrated smart water and electricity meter
- Field trial of 5,000 meters in 2010
- National roll out 2011-13 at €163 per meter

Responses: England & Wales perceived

- Contradictory policy development, especially between Ofwat and Defra creates an incoherent framework for innovation
- Water ignored except in flood or drought
- No high profile framework for assisting the financing, mentoring, benchmarking and commercialisation of UK water innovation
- Testing and benchmarking still perceived to be at a utility rather than a national level

Priorities: Spending money – Capex needed for universal access by 2050

$190-225 bn pa capex is needed against current capex spend of $170 bn

($ billion)	OECD	ROW
Urban water	843-845	1,373-1,934
Urban sewage	1,496-1,479	2,704-3,768
Rural watsan	93-97	392-467
Global total	2,434-2,441	4,776-6,169

Source: 2CEWWT / Envisager, 2011

Priorities: Infrastructure & GNI per capita (atlas method, current US$)

Year	Singapore	Korea	Malaysia	UK
1962	450	110	300	N/A
1970	960	270	400	2,230
1980	1,910	1,810	1,830	8,510
1990	12,050	6,000	2,390	16,600
2000	23,350	9,910	3,450	25,910
2009	37,220	19,830	7,350	41,370

90% of urban population with:
Red = water, Green = sewerage, Brown = WW treatment

Priorities: UK water policy

- Make our water management policy coherent – An asset intensive industry needs predictability
- Accelerate the metering programme – Ofwat will allow 64-80% by 2020 and 90% by 2030
- Get smart – appreciate the role smart water has in driving innovation, sustainability and efficiency
- Tariff Flexibility – Tendring Hundreds per capita use is 80% of E&W norm
- Develop a formal set of water consumption targets on a river basin basis

Priorities: Enabling innovation

- Water & wastewater will always be Cleantech's 'poor cousin' – there's no new dawn looming
- This also means the need for innovation is greater than ever – that will be our golden age
- Unless your offering is both better and cheaper than what's out there, who should be excited?
- Are you getting your message across? Do potential customers understand your offering?
- Management isn't about bringing a new idea to the table, it is about managing the entire process

Towards a smarter water policy

- Across the world, water as a sector is often seen as a proxy for a variety of political debates
- Moving from a supply management led paradigm to a demand management model is essential for securing supplies in an affordable way
- Linkages between water and energy will play a major role in encouraging efficiency
- Innovators can thrive when management can get the message across

Annex B

Global Water Investment

A presentation by Jonathan Yates Associate Director, Arup

Global Water Investment

Innovation in water technology – 4 March 2013

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Global Water Investment: what does that mean for governments, technology companies and investors? This presentation will focus on recent trends in the water sector in the context of the need for global investment.

Global Water Investment

- What type of investments?
- What is the global need for water investment?
- What are the recent trends?
- How do we facilitate this investment?

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What type of investment?

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Start-up funding

Clean Tech

SME's

Corporate finance

Project finance

Leveraged M&A deals

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Start-up funding

Clean Tech

SME's

Corporate finance

Project finance

Leveraged M&A deals

HSBC

3i

JICA

IFC International Finance Corporation

European Investment Bank

Marubeni Corporation

Goldman Sachs

KKR

GIC

Morgan Stanley

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What is the global need for water investment?

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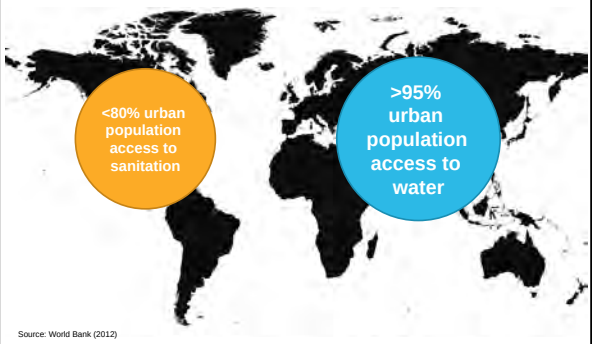
- Global access to clean water and sanitation/



Source: World Bank (2012)

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- Significant increase in urbanisation

50%

% of World Population living in Cities (2012)

75%

% of World Population living in Cities (2050)

Vietnam – Ho Chi Minh City

Source: Arup/ C40 UrbanLife - Water Resilience for Cities Report, January 2011

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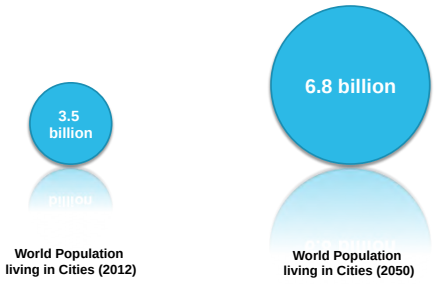
- Real impact on population living in cities/



World Population living in Cities (2012)

World Population living in Cities (2050)

Source: Arup/ C40 UrbanLife - Water Resilience for Cities Report, January 2011/ World Bank/ United Nations

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This could mean that 4-6 billion more people will need access to water and sanitation by 2050. Conservatively, this might cost $400 billion in capex. In size, this is approximately 1/3 of UK Government spending in 2011/12.

Source: Arup estimate/ Guardian

What are the recent trends?

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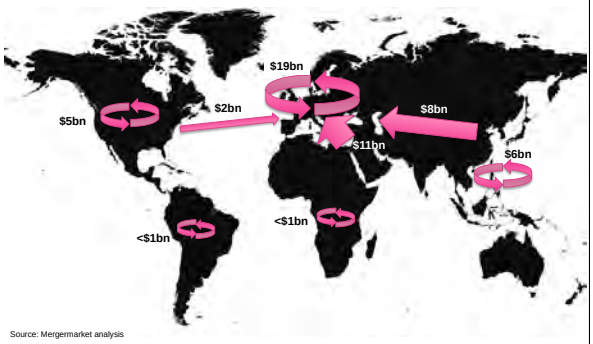
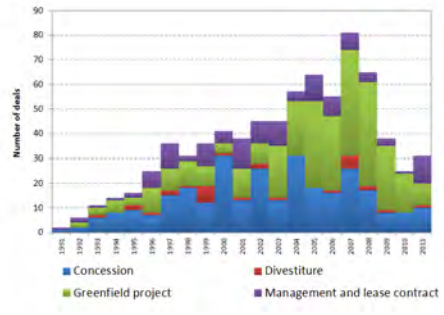
- Global investment flows (M&A)/



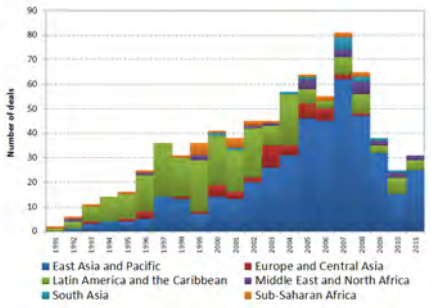
Source: Mergermarket analysis

- Private Sector delivery – by project type



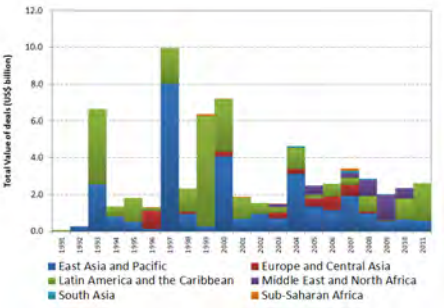
Source: World Bank

- Private Sector delivery – by geography



Source: World Bank

- Private Sector delivery – by value



Source: World Bank

How do we facilitate this investment?

- What can facilitate private sector investment?
- IFC: "3 R's"
  - Risk
  - Reward
  - Regulation
- Stable political environment
- Stable economy/ demand
- Sustainable tariffs
- Public (or government) willing to pay

Catchment Highland PPP, Scotland

Arup recent experience is that there is an continuing appetite amongst the infrastructure investment community for high-quality assets in the water sector. These can only succeed if they meet the basic investment criteria and provide balance of risk and reward.

Annex C

Presentations from the short 'Water Burst' sessions:

C.1 Building a Global Water Innovation Hub

A short burst by Booky Oren, Booky Oren Global Water Technologies

C.2 Global drive and demand for water treatment and desalination

A short burst by Ezra Barkai, RWL Nirosoft

C.3 Transforming wastewater: from burden to commodity

A short burst by Ori Ainy, Applied Cleantech

C.4 Retrofit and upgrade of wastewater treatment facilities - the need of the hour

A short burst by Marc Krieger, Aqwise

C.5 Opportunities local and global

A short burst by Matt Axford , Polypipe

C.6 Innovation in Water Technology

A short burst by Professor Roy Kalawsky, Loughborough University

Annex C.1

Presentations from the short 'Water Burst' sessions:

Building a Global Water Innovation Hub

A short burst by Booky Oren, Booky Oren Global Water Technologies

The Global Water Technologies Partnership Hub

Booky Oren Global Water Technologies LTD.
March 2013

Booky Oren – Bio

- Over the past 28 years, **Booky Oren** has been active in a variety of global and local industries and markets;
- Turned from the high-tech industry to the water industry and served as **CVP - Business Development at Netafim**, the world's largest drip irrigation company;
- **Executive Chairman of Mekorot**, Israel National Water Company. Initiated and implemented **WaTech™** – utilizing the Mekorot's facilities as beta sites for external innovation;
- **Co-Founder, President and CEO**, later became the **Executive Chairman of Miya**, which became the world leader in the field of urban water losses;

Booky Oren – Bio

- **Chairman of WATEC Israel**. The events (2007, 2009 and 2011) were leading global water events.
  In **Watec 2011** there were over **28,000 participants** from **104 countries**, and more than **1,000 international entities;**
- In 2011, Oren initiated – **Booky Oren Global Water Technologies Ltd.** focuses on implementation of innovative water solutions and operates the: "**Global Water Partnership Hub**".

The Innovation Catch

- The existing players cope with the challenge of **i2i - innovation To implementation;**
- Challenges in identifying **relevant technologies and solutions;**
- Challenges in defining the proper **business mechanism.**

The will is there … the way is yet to be clear!

A New Approach - Global Water Partnership Hub

- **Initiation of new collaborations** between the existing market players;
- **Leveraging** relevant **technological solutions;**
- **Creating** sustainable business mechanism based on partnerships.

The Global Water Partnership Hub – Win-Win-Win-Win Solution

Currently Dozens of Entities are Involved

And it is continuously expanding in ALL dimensions…

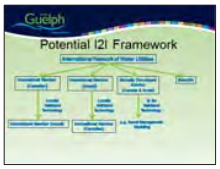
The Global Water Partnership Hub Turns to Reality

CITY OF AKRON & MEI NETANYA

SOUTHERN NEVADA WATER AUTHORITY (SNWA) & MEKOROT

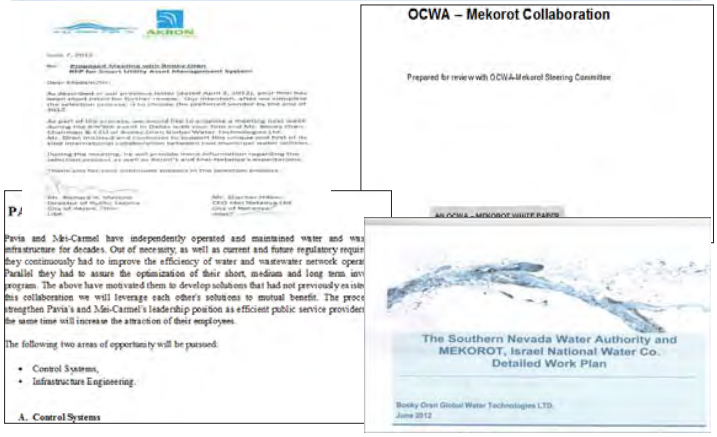
ONTARIO CLEAN WATER AGENCY (OCWA) & MEKOROT

PAVIA ACQUE & MEI CARMEL



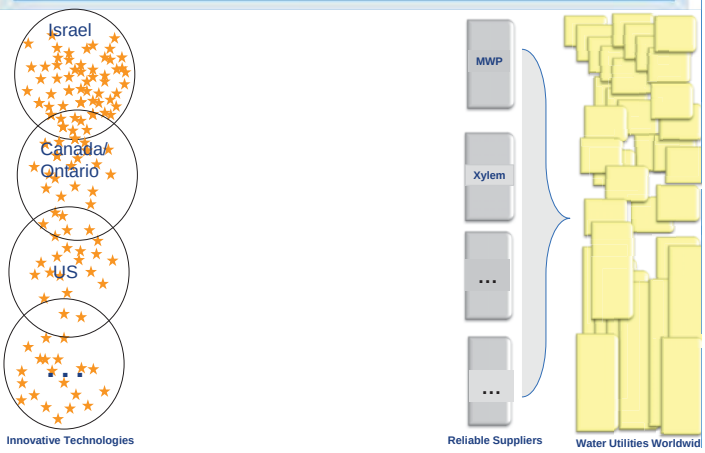
THE CITY OF GUELPH & MEI NA

And it is a Continuous Process

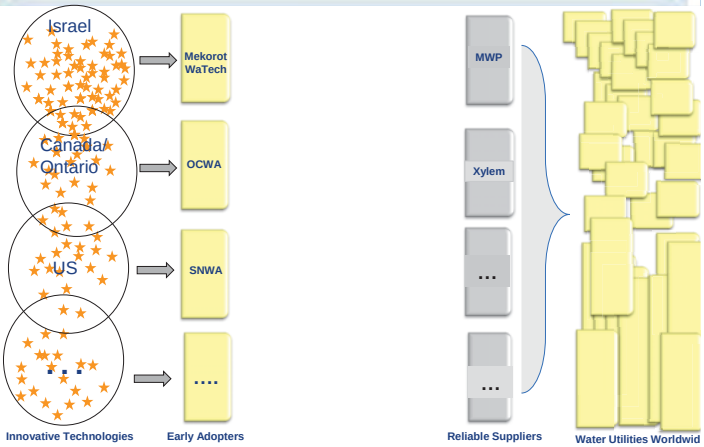


Herzliya, Israel ,September 12, 2012

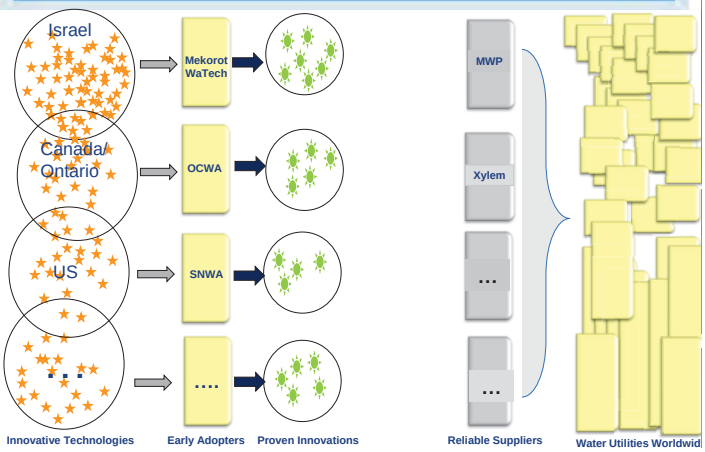
Connecting the Dots 1

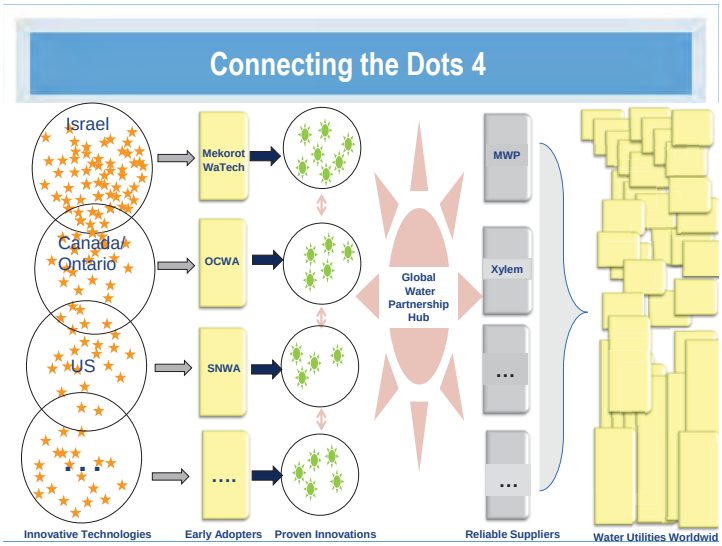


Connecting the Dots 2



Connecting the Dots 3





Thank You

Booky Oren Global Water Technologies Ltd.
Chairman &CEO
M:+972 54 6667077
T:972-72-2224008/3 F:972-72-2224005
89, Medinat Hayehudim St., Bldg. E, 8th Fl.
Herzliya, Israel 46766

Annex C.2

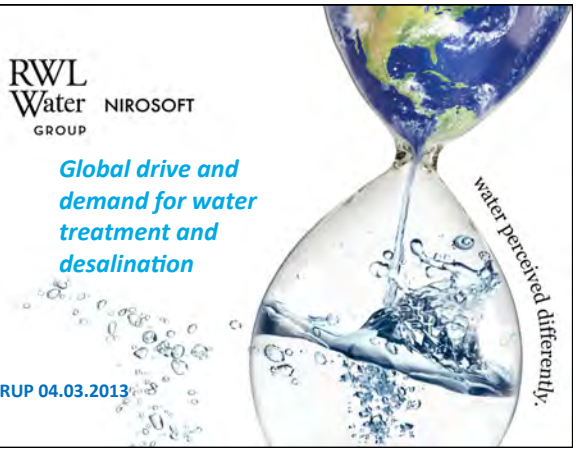
Presentations from the short ‘Water Burst’ sessions:

Global drive and demand for water treatment and desalination

A short burst by Ezra Barkai, RWL Nirosoft

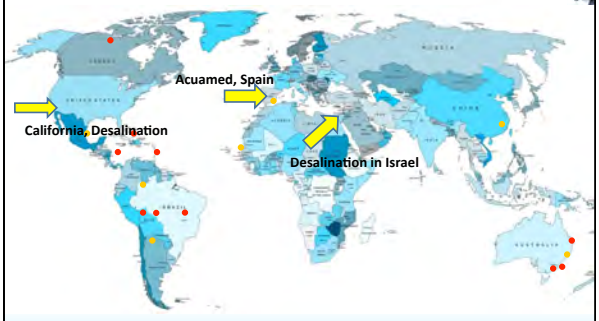
RWL Water NIROSOFT GROUP

Global drive and demand for water treatment and desalination



ARUP 04.03.2013

Typical Worldwide Demand



Israel water resources

California SW desalination

Acuamed - Major desalination plants

Typical Seawater Desalination

Project Name:	**Episkopi Desalination Plant**
Location:	**Cyprus**
Capacity:	**50,000 m³/day**
Market:	**Municipal**
Delivery:	**2012**

Project Description

- Open intake
- Pre-treatment by ultrafiltration
- Seawater reverse osmosis
- IX Boron removal
- Remineralization
- Product pumping station and storage

Supply of desalination island
BOT for 20 years
Dual membrane system (UF & RO) offers smaller footprint and higher reliability

Seawater Desalination

Project Name: Moni Desalination Plant
Location: Cyprus
Capacity: 22,000 m³/day
Market: Municipal
Delivery: December 2008

Project Description
- Open intake
- Pre-treatment by ultrafiltration
- Seawater reverse osmosis
- Remineralization
- Product pumping station and storage

Moni was built in a record time of eight months
Short-term BOT for three years
EPC

Annex C.3

Presentations from the short ‘Water Burst’ sessions:

Transforming wastewater: from burden to commodity

A short burst by Ori Ainy, Applied Cleantech

Transforming WWTPs

Wastewater Treatment

Wastewater Recycling

Applied CleanTech

What is Common Between These?

Applied CleanTech

The Sludge Problem

Typical WWTP : 12,000 tonnes/year of sludge

- Environmental and economic burden
- 50% operation costs
- 30% capital investment of new plant
- Limiting factor to increase capacity

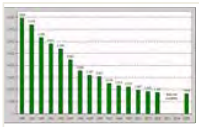
Applied CleanTech

Applied CleanTech
New Business for WWTPs in Old Market

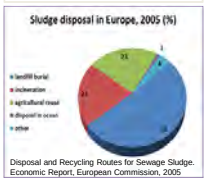
Ori Ainy - VP Marketing and Sales, March 2013

Sludge "Solutions"

- **Landfill Disposal**
  - GHG emissions
  - Seepage
- **Agriculture "Fertilizer"**
  - Costly process
  - Contaminates
- **Incineration**
  - Costly
  - Huge capital investment
  - Harmful air pollution
  - Requires ash disposal



Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2005



Disposal and Recycling Routes for Sewage Sludge. Economic Report, European Commission, 2005

Applied CleanTech

Transforming Wastewater

Burden

Valuable Commodity

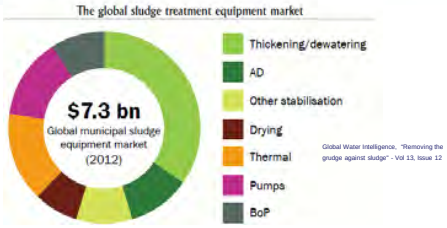
Applied CleanTech

Sewage Recycling

- **Sewage mining system**
- **Traps suspended solids from the influent and turns it into a new commodity:**
- **Recyllose™: Dry, Sterilized , Odorless and Clean**

Applied CleanTech

Sludge Treatment Equipment Market



- Sludge management reduce its volume
- The smaller the volume the lower the costs

Applied CleanTech

Applied CleanTech's Framework

Applied CleanTech

Out-Of-The-Box Approach

- ***Prevent sludge formation rather than treat it***
- ***Recycle trapped solids into usable commodity***
- ***In a new profitable business model***

Applied CleanTech

What is Common Between These?

Applied CleanTech

Annex C.4

Presentations from the short 'Water Burst' sessions:

Retrofit and upgrade of wastewater treatment facilities - the need of the hour

A short burst by Marc Krieger, Aqwise

Aqwise
Clear and Simple

Extending Nature's Capacity

Retrofit and Upgrade of Wastewater Treatment Facilities – Need of the Hour

Wastewater Treatment – Main Trends

- Environmental awareness
- Regulation (Nutrients & odors)
- Energy costs
- Sludge disposal costs
- Chemicals costs
- Price of fresh water

- Infrastructure quality - aging
- Land availability for treatment plants - limited
- New fresh water sources – limited / non-existent

Municipal Utilities

Municipal WWTPs

New Plants

- Small Footprint
- Future Expansion

Existing Plants

- Expansion for increased flows
- Retrofit for improved quality

Industrial Sectors

Industrial WWTPs

- Need to adapt existing WWTPs to increased loads resulting from plant expansion
- Significant space limitations – need for reduced footprint
- Pre-treatment to effluent reuse systems / ZLD

Pulp and Paper

Food and Beverage

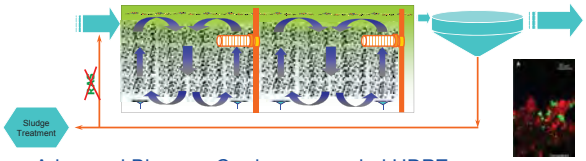
Oil & Gas, Petrochemical

Pharmaceutical

The AGAR® Advantage

Small Footprint	• For both new applications and upgrades
Cost Effective (CAPEX & OPEX)	• Smaller reactors = less civil works • Shorter project life cycle • Lower maintenance costs (operation and energy)
Flexibility & Scalability	• Simple upgrade of existing plants • Enables gradual expansion – "just-in-time" CAPEX • Deals with inflow peaks
Stability & Durability	• Improved resistance to hydraulic shock loads • Shorter recovery time after toxic loads • Extended carrier life time
Environmental Friendly	• Use of recycled materials • Smaller footprint, scenery obstruction and odors • Simpler process control = minimal O&M problems

The Unique AGAR® Technology



- Advanced Biomass Carriers – recycled HDPE
- Increased effective surface area – 650 m^2/m^3
- Unique aeration design (airlift double role)
- Software simulation based design
- Patented process

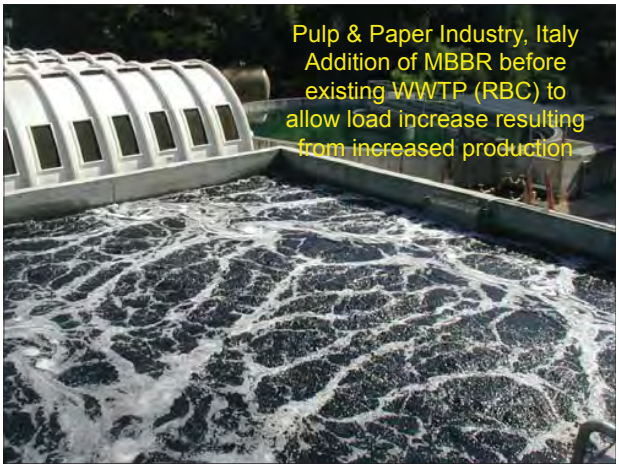
DANA – Dynamic Anaerobic-Aerobic Solution

- An integrated solution for complete wastewater treatment and efficient energy recovery
- Targeting high organic load industrial applications
- Small footprint
- **2 systems, 1 reactor, 1 in-line process**
- Unique and proprietary process

Aqwise
Proprietary and Confidential

Case Studies

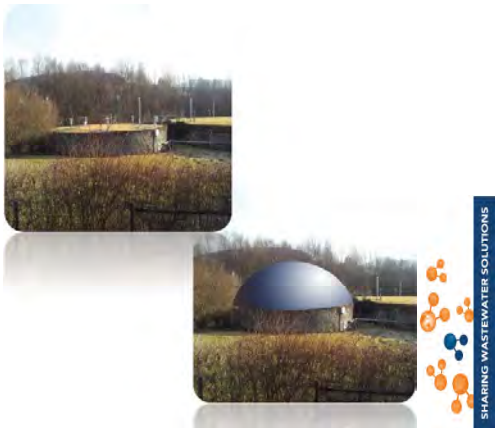
Aqwise
Proprietary and Confidential



DACS Retrofit

Retrofit of an Existing Underground Aerobic Reactor

Brewery



SHARING WASTEWATER SOLUTIONS

DACS Retrofit

Why anaerobic treatment

Brewery

Actual System : aerobic treatment 65% BOD removal

- 3600 m³/d waste water
- 12 ton COD/d
- 6.500 kWh/d electrical energy ; 1,4 Mio. kWh/a
- 4.0 t TS/d Biomass ; 860 t TS/a

Retrofit System: anaerobic treatment 90% BOD removal

- 3.000 m³ Methane gas per day; 800.000 m³/a
- 0,7 t TS/d Biomass ; 150 t TS/a
- 1.800 kWh/d electrical energy ; 0,375 Mio. kWh/a

Result: saving 1,0 Mio. kWh/a + 1,0 Mio. m³ biogas/a + 710 t TS/a + CO_2 credits + savings on discharge costs

ROI : 1,5 M Euro = 20 months

SHARING WASTEWATER SOLUTIONS

Annex C.5

Presentations from the short ‘Water Burst’ sessions:

Opportunities local and global

A short burst by Matt Axford, Polypipe

Mathew Axford

Market Development Director

TERRAIN

Polypipe

1

Opportunities local and global

- Water Conservation
  - Local and global drivers include
    - Climate change
    - Legislation
    - Cost
    - Planning
    - Urban development

- Water conservation - Polypipe solutions
  - Rainwater Harvesting
  - Greywater Harvesting
  - Blue roof technology
  - Attenuation
  - Combined systems a holistic approach

TERRAIN

Polypipe

2

Opportunities local and global

- Carbon reduction
  - Local and global drivers include
    - Legislation – Kyoto - 2020 (1.2 million tonnes pa) and 2050 (80% reduction)
    - Commercial issues – carbon offsetting
- Polypipe solutions
  - Twin wall pipes negating the need for concrete surrounds as we as reducing soil away and reducing transportation impacts
  - Manufacturing excellence – Only UK company to be awarded carbon standard.
- Materials substitution
  - Plastics are lighter, stronger, thinner than traditional materials
  - New materials – Bio-plastics made from biomasses such as vegetable fat or oil
- New sales Channels
  - Internet based sales such a ''Screwfix''
  - Smart phone apps -Internet Webinar
- Export
  - Driven by depressed global credit crunch

TERRAIN

Polypipe

3

Annex C.6

Presentations from the short 'Water Burst' sessions:

Innovation in Water Technology

A short burst by Professor Roy Kalawsky, Loughborough University

Innovation in Water Technology

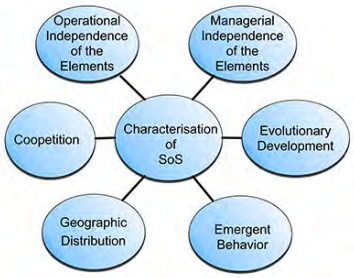
Systems of Systems

Prof Roy S. Kalawsky
Email: r.s.kalawsky@lboro.ac.uk
Tel +44 (0)1509 635678

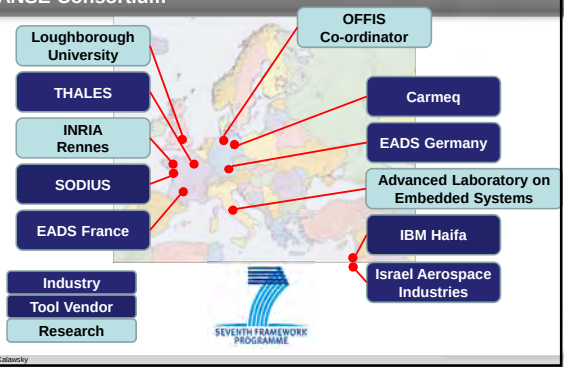
Designing for Adaptability and evolutioN in System of Systems Engineering

€12m Project

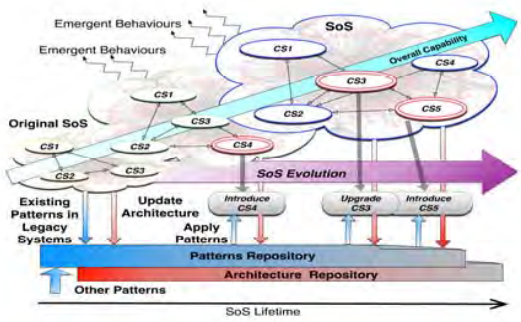
Characteristics of a System of System



DANSE Consortium



Evolutionary SoS Architecture

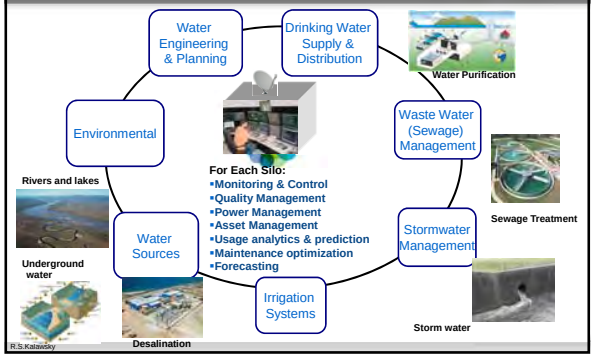


Test Case 1: Integrated Water Treatment and Supply

SYSTEMS ENGINEERING @ Loughborough

Loughborough University

Integrated Water Treatment and Supply

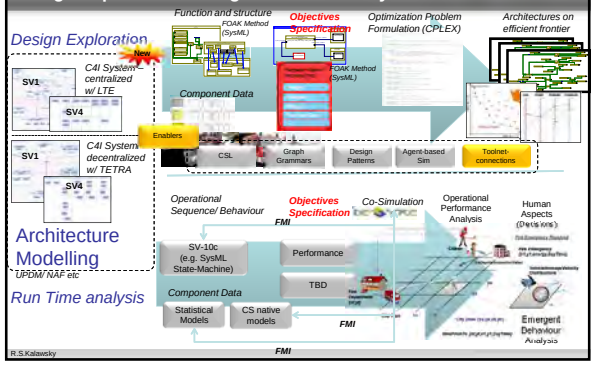


R.S.Kalawsky

SYSTEMS ENGINEERING @ Loughborough

Loughborough University

Design Exploration through Run Time analysis



R.S.Kalawsky

SYSTEMS ENGINEERING @ Loughborough

Loughborough University

Goals: Integrated water treatment and supply (IWTS)

- Optimization of water supply based on pre-determined priorities
- Energy consumption optimization
- Regulation of overall water quality by balancing of inputs and outputs of the constituent systems:
- Enhancement of the water supply system resilience in an integrated net of water supply sources as structural changes occur over time
- Enhancement of the water supply system robustness in emergency situations

R.S.Kalawsky

SYSTEMS ENGINEERING @ Loughborough

Loughborough University

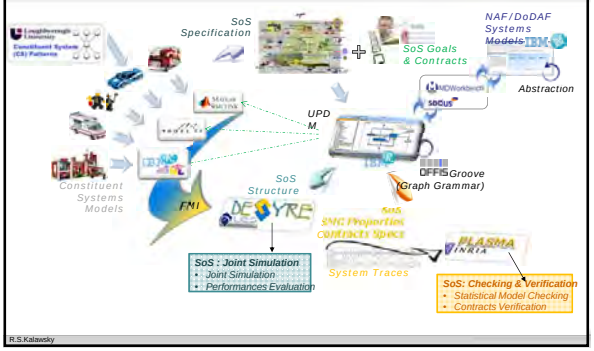
SoS Integrated Modelling & Simulation Environment

R.S.Kalawsky

SYSTEMS ENGINEERING @ Loughborough

Loughborough University

SoS Architecture Analysis & Optimisation



R.S.Kalawsky

Annex D

‘Speed Dating’ on water issues

D.1 Buildings and Districts

Facilitated by Martin Shouler, Arup

D.2 Developed marketing

Facilitated by Peter Edwards, Arup

D.3 Emerging markets

Facilitated by Jonathan Yates, Arup

D.4 Water efficiency

Facilitated by Justin Abbott, Arup

Annex D.1

‘Speed Dating’ on water issues

Buildings and Districts

Facilitated by Martin Shouler, Arup

Annex D: Buildings & Districts

Buildings & Districts

Issues

- Behaviour Change
- Peer pressure (Psychological pressure)
- Awareness
- Perception (Acceptability?)

Decentralised Systems

Non-potable water systems

Residential: Difficult to organise

Commercial: Easier than residential

Industrial: Used to this type of decision making

Global

Need to identify areas of water scarcity

Water Scarcity

Water Footprint

Return on Investment

Easier to demonstrate to a private commercial user than to a water utility

New Build → Easier to Innovate

Existing Build →Retrofitting →No incentive

Water Quality

-Sub Quality (Non Potable)
- Need for water quality standards

Technology to enable Decentralisation is now available

Governance

- Who is responsible?
- Who has ability to deal with strategic issues?
- Risks?

Technology

1. Water reuse
2. Separation
3. Natural systems
4. Energy recovery

Florida is an example of centralised non-potable water supply (e.g. Conserv II)

Needs

1. Water supply
2. Water Re-use
3. Energy use
4. Carbon Intensity

Water ←→ Energy relationships

Scale

- What is the appropriate scale of decentralised systems?
- Why, Who What

Costs

Incentives/ Disincentives:

1. Lack of competition
2. Should be 30% cheaper than supplied mains water
3. Wastewater should be considered as a resource

- Martin Shouler – Arup (Facilitator)
- Danny
- Marc
- Derendran
- Yoni
- HJK
- Ori
- Roy K – Loughbourgh University
- Matt Axford –Polypipe
- Siraj Tahir
- Refal Aharon –Applied Cleantech
- RSimons

Is there sufficient Infrastructure Capacity?

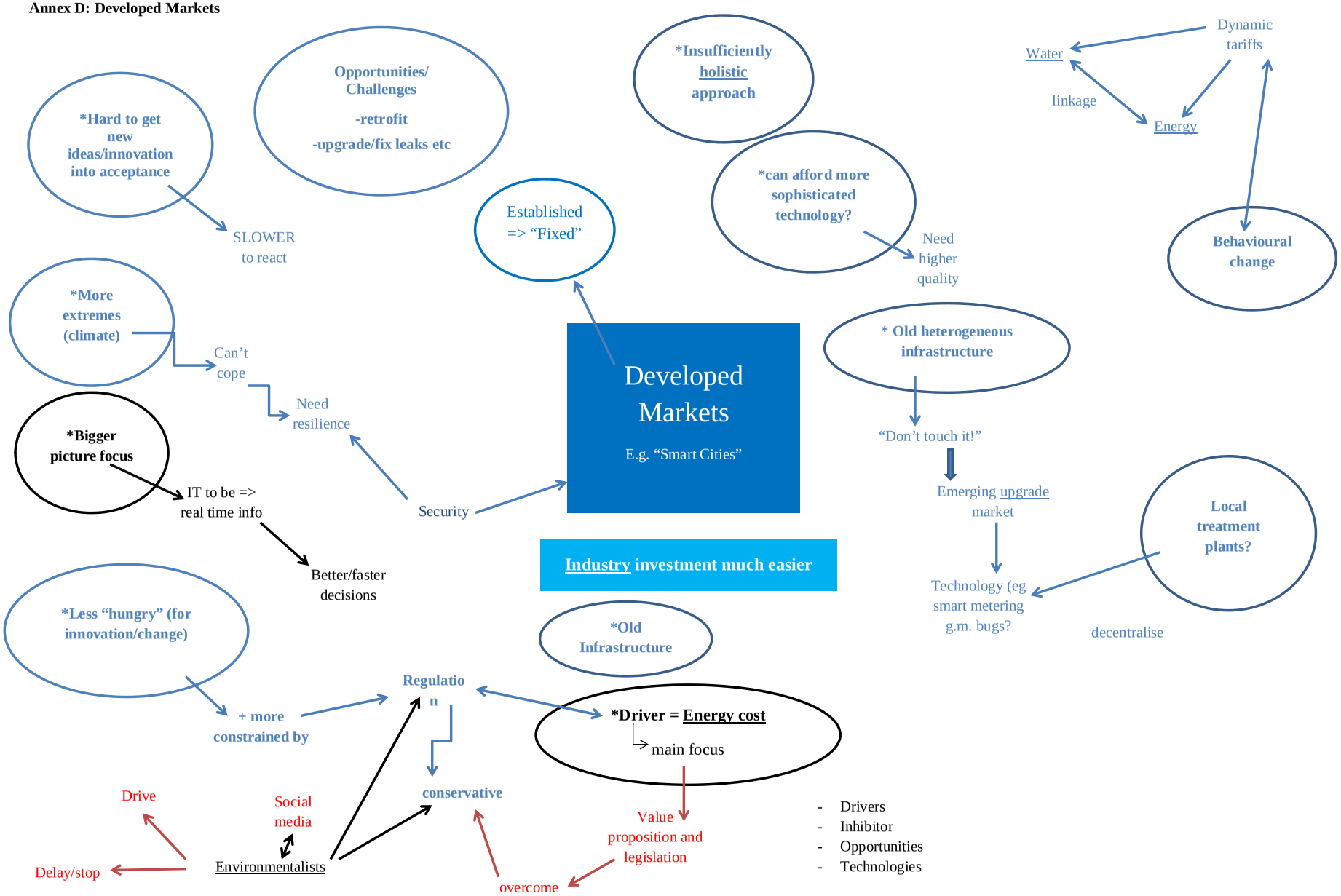
Annex D.2

‘Speed Dating’ on water issues

Developed marketing

Facilitated by Peter Edwards

Annex D: Developed Markets



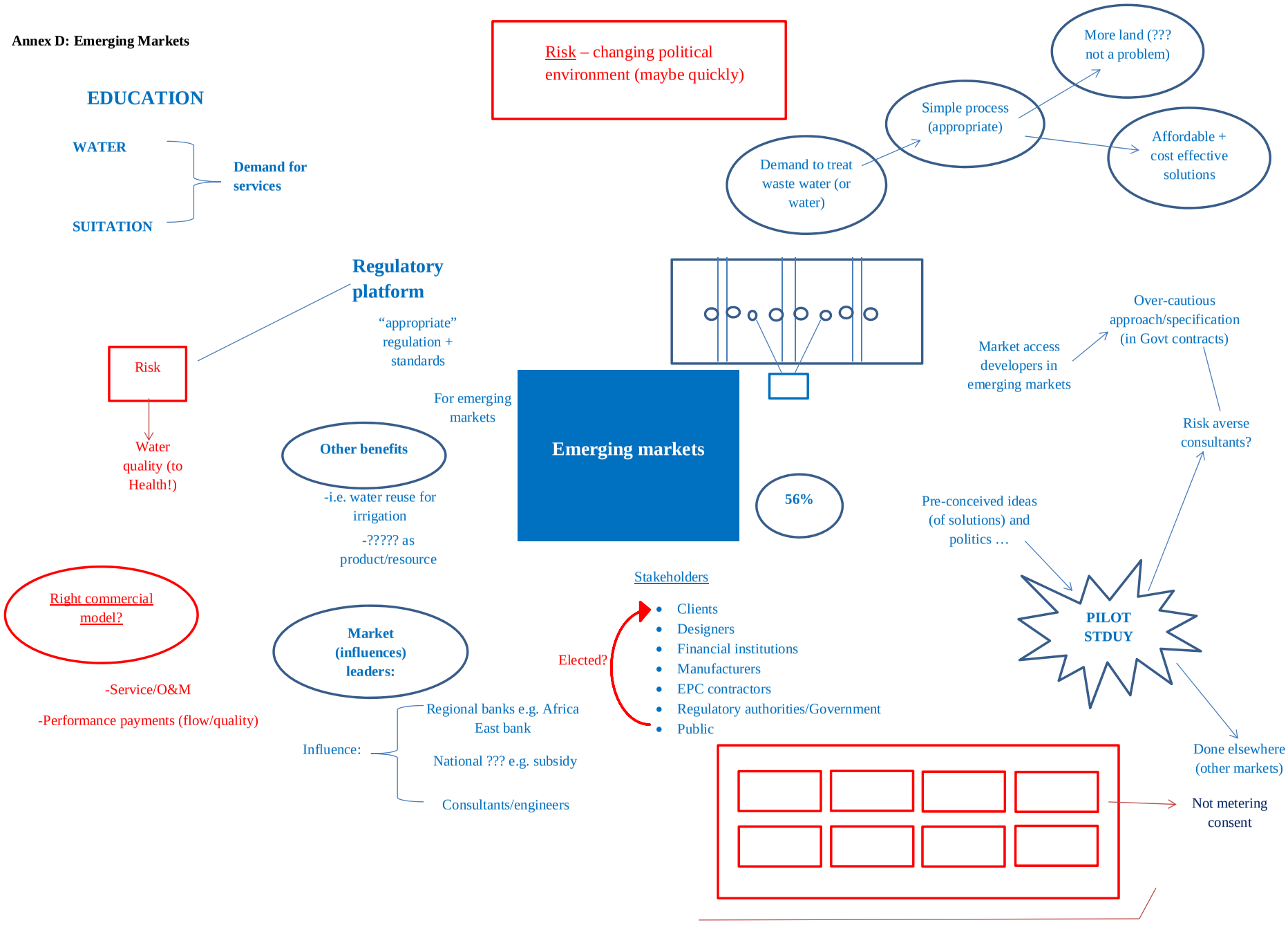
Annex D.3

‘Speed Dating’ on water issues

Emerging markets

Facilitated by Jonathan Yates

Annex D: Emerging Markets



Annex D.4

‘Speed Dating’ on water issues

Water efficiency

Facilitated by Justin Abbott

Annex D: Water efficiency