Summary Report

Singapore – July 10th, 2018

SPACE-O has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 730005.

Disclaimer

The research leading to these results has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No 730005 for the research project SPACE-O (Space Assisted Water Quality Forecasting Platform for Optimized Decision Making in Water Supply Services).

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Background

Performance efficiency in water utilities is usually associated with ensuring good water quality and reliability in providing a continuous supply of safe and clear water. Environmental and financial impacts have often been underestimated. More sustainable and efficient use of energy and chemicals in water treatment is an ongoing challenge, together with intensifying water resources protection and management into sectoral policies.
Technological innovation is instrumental in addressing our increasingly complex and multidisciplinary water challenges in a way that ensure sustainability while supporting economic growth. Space technology is part of promoting and supporting innovation by providing environmental information which can be used to improve preparedness and planning by water utilities and other end users.
SPACE-O (http://www.space-o.eu/) aims to integrate state of the art satellite technology for water quality monitoring and advanced hydrologic and water quality modelling using ICT tools for generating real time, short to medium term forecasting of water flows and key water quality parameters (e.g. turbidity, algae) in reservoirs, that in turn will be used to support decision making in water supply services.

Workshop overview

Title of workshop: Use of Earth Observation Data for Improved Performance in Water Supply Services
Time: 10th July 2018, 12h30 until 18h00 pm
Location: Sands Expo & Convention Centre, room Cassia 3205, Marina Bay Sands, Singapore.

The workshop was organized as part of a consultation process within the development of Space-O technology and methods that are targeted to drinking water treatment plants and reservoir managers. The inputs of potential end users have been crucial to ensure the development of functional and user friendly tools. The purpose of this event was to introduce the SPACE-O concept to end users in Asia. The event explored the needs and current approaches of water supply providers in the region to further improve decision support systems and operations and identify potential areas for innovation.

The event included presentations of key features and components of SPACE-O's risk-based decision support system (DSS) that aims to enable cost-effective and environmental sustainable operation of Water Treatment Plants (WTP). The DSS integrates Earth Observation data to provide information such as water quality forecasting, in-situ monitoring data and data collected through SCADA (Supervisory control and data acquisition) systems in WTP for operation control.
The workshop included opportunities for discussions and interactive exercises aimed at gathering information on the application and economic viability of the decision support system and its potential benefits for water utilities dealing with algal blooms and turbidity in their surface water sources.

Objectives

- Identify main challenges of water service providers' operations;
- Identify applications of satellite technology and in-situ monitoring for forecasting of water flows and quality in reservoirs;
- Share experiences on the use of various data sources for optimizing performance of water service providers

Participants:

Participants represented seven countries, with a total of 18 attendees, including high level management and technical staff in utilities and water management organizations. The participants list is included in Annex II.

Workshop outcomes

This report summarises the results obtained from the end-user validation workshop, help on July 10th in Singapore. For each session during the workshop (see agenda in Annex I), the key results are briefly described. Next to feedback obtained during the workshop, this report further contains the analysis of feedback questionnaires, filled out by external participants of the workshop.

Part I – Overview of Priorities and Challenges for Asia

This section provides an overview on how problems like algal blooms and high turbidity events affect operations of water treatment plants and reservoir managers in the provision of drinking water in Asia. Interactive discussions with participants provided the SPACE-O consortium with a better understanding of the economic impact of these problems in utility operations, and investments being undertaken to moderate or mitigate these impacts.

1. **Economic impact of algal blooms and turbidity on operations:**
   Participants in this workshop come from water utilities or regulatory authorities in Myanmar, Hong Kong, Malaysia, Chinese Taiwan, and Thailand (see Annex II participants list). The experiences with algae blooms and high turbidity events are diverse. Where those pressures are relevant to water networks/resources, they underlying seasonal variability with turbidity being problematic during rainy seasons (table 1, group 1; 3; 4). Respectively, the risk for algae blooms is greater during dry, summer periods (table1, group 4).

   Concerning the impacts of algae blooms and turbidity, again, experiences are diverse. Where Hong Kong does not have a lot of problems with both pressures, and coping mechanisms in place, other regions report the need of using significantly larger amounts of chemicals during high turbidity events for drink water treatment (table1, group 4). Clogging of filters and degradation of recreational water bodies are among the impacts of algae blooms. Both high turbidity and algae blooms can have (although not toxic) negative effects on odour and taste of drinking water.

2. **Investments to reduce or deal with algal blooms and/or turbidity:**
   Two groups of participants have early warning systems in place for high turbidity events, for one to three days in advance (table1, groups 4 and 5). In all cases, the coping strategy for turbidity and/or algae blooms is switching to an alternative water source, or blending of water. The degree to which water quality monitoring (in laboratories or using sensors) is in place is diverse, and several groups of participants reported ongoing efforts to improve data availability and institutional capacity to utilise monitoring data for decision making (table 1).

Feedback from each group

During roundtable discussions participants organised in five groups according to their regional expertise. These discussions where guided by questioning regarding their experiences with algae bloom and turbidity, their current resources for decision making, as well as where they see potential use for the application of SPACE-O tools for their specific context. Below table 1 one summarised key discussion results for each group.

Table 1 Feedback on SPACE-O relevance from each group of participants

Group	Organization/Participants	Pressures	Impacts	Current practice for decision making	SPACE-O Opportunity
1	**Directorate of Water Resources and Improvement of River Systems** **Myanmar**	• Turbidity seem to be the most impacting pressure (compared to algae) - Turbidity might reach over 500 times the WHO standards • They experience algae in the drainage systems and they have constructed new systems to address this problem • Salt water intrusion in dry season in fresh water ponds	• A main pond used for recreation when affected (by algae) has direct implication on the tourism and consequently in economy	• Reactive - The Decision making responses ad hoc to events • Meteorological stations are deployed - They belong to different agencies - There is an ongoing project for integration of the meteorological stations up to 2020 • Water quality monitoring needs are high, particularly for the Yangon River • No tools for water quality are used • There is a future perspective with the WB to establish a hydro-informative center for dealing with data and decision making • WB funds efforts for the collection of data	• Seasonal forecast for water levels in respect of the navigation of ships on the river (lower the carry over capacity of ships at low water levels) • Seasonal forecast could be used for estimating sea water intrusion in the ponds and impact • EO could be used for addressing illegal mining - Run off from mines are washed off in the river contributing significantly to turbidity
2	**Water Supplies Department** **Hong Kong**	• The main source of water is from mainland China. • No particular pressure from Turbidity and algae is identified • Occasionally algae problems occur, without	• If there are issues or algal blooms then the water is diverted and discharged and an alternative source is used.	• Decisions are based on sampling and lab analysis - when MIB concentrations detected above certain thresholds action is triggered for blending water from other sources or adding activated carbon • The algal bloom is not toxic but does cause issues with taste and odor.	• SPACE-O could assist in practicing blending water more efficiently • There might be interest for similar forecasting services for algae bloom in the coastal front (fisheries,

		causing any significant problem to water supply			desalination)
3	**The Malaysian Water Association** **Malaysia**	• Algae in dams • High turbidity in the raining season	• High turbidity might result in water supply disruption for few days. When this is happening they have to pump water from groundwater supplies or bring water from other areas	• Decision making is based on experience • There is no central organization for water management and data acquisition • Water management is implemented on a regional (states) basis • There is no policy for algae blooms - For turbidity there are standards	• There are prospects for being predictive at the big treatment plans
4	**Metropolitan Waterworks Authority** **Thailand**	• The two basic river systems (Chao Phraya and Mae Klong) experience significant pressures mainly turbidity (Chao Phraya also has problems with algae). • Turbidity issues are mostly present during the intense period for 3 months during winter • Sometimes turbidity values are up to 3000 NTUs • Algae blooms are mostly present during summer months	• Algal blooms are a problem, especially resulting in clogging filters • For dealing with increased turbidity concentrations in the plant they use increased dosages of Alum • During raining season the cost of chemicals increases significantly	• The Chao Phraya river is very well monitored (a lot of monitoring stations) • MWA has a raw water forecasting system of 3 days (mostly for salt intrusion) • The Royal Irrigation Department operates the upstream reservoirs • Based on upstream monitoring stations they can forecast 2 days earlier if an turbidity event is going to happen so they can prepare chemicals • Water authority is familiar with advanced ICT tools like Machine Learning techniques, but satellite data is not used	• There are very good prospects for SPACE-O services for the Mae Klong River
5	**Taipei Water Department** **Chinese Taiwan**			In Taipei, there is an early warning system which is upstream. There are turbidity meters upstream which are used by the water utility. The system provides a 1 hour warning period as provides real time information.	If information was available ahead of time (10-15 days) then the chemicals required could be stockpiled.

Part II - Presentation of DSS Components:

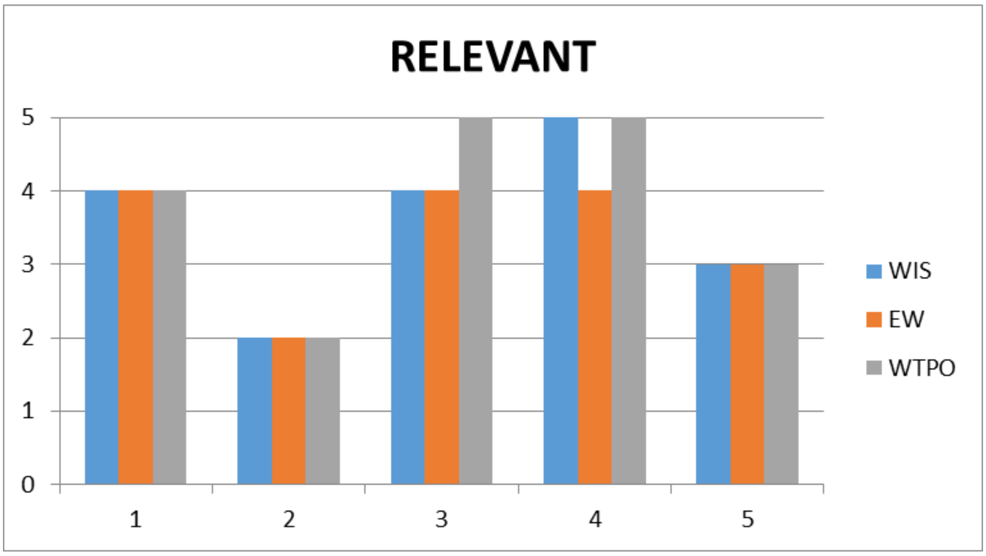
Workshop participants were guided through the Space-O tools to review the Environmental Information system; the Early Warning System; and the component for optimizing performance in water treatment plants.
Feedback on these components of the SPACE-O portal was afterwards collected through hardcopy questionnaires, of which five participants provided answers. All components of the SPACE-O portal were rated as useful. The Water Information System scored highest in in the categories 'Understandable' and 'Usefulness' and 'Willingness to pay'. Overall, the results show that the SPACE-O portal has a good resonance with potential end-users. The following chapter provides elaborated results of the feedback questionnaire.

Feedback from questionnaire

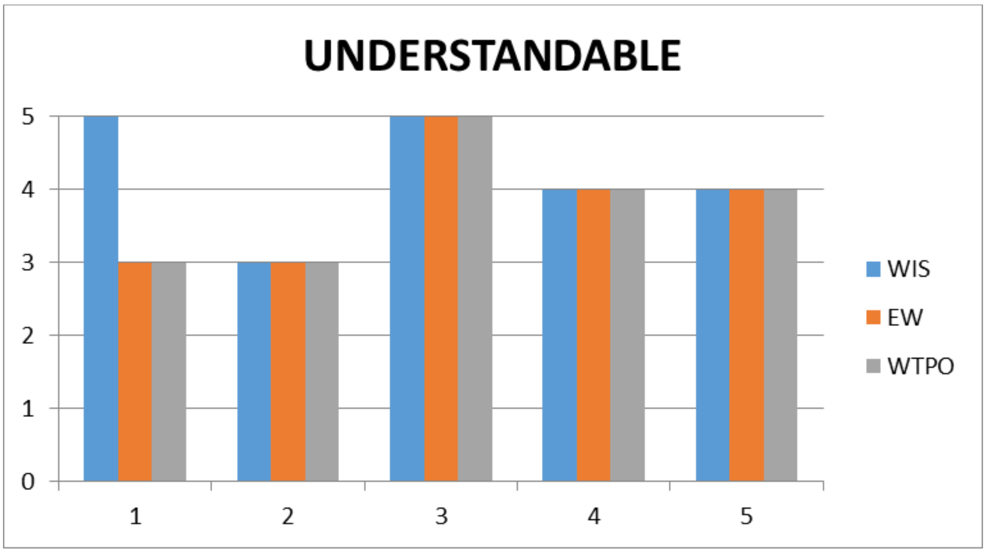
After the end of the Workshop in Singapore, an evaluation questionnaire was distributed to the participants to express their views and add their comments from the testing sessions. The questionnaire was structured in eight distinct sessions with questions for each prototype product of the SPACE-O.

In total five participants completed the questionnaire, which were collected and assessed and the main conclusions are presented below.

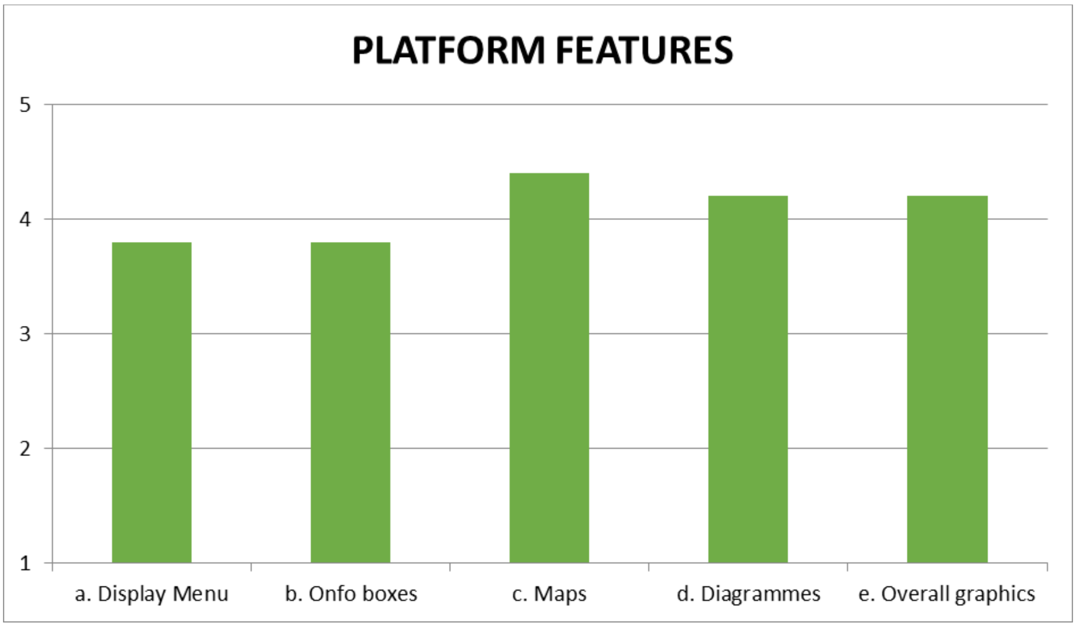
- In the question on whether the activity given during the testing sessions was relevant to the participants' work and understandable, all products received satisfactory average grades above 3.4 in each query. Water Information System and the Treatment Plant Optimization Tool components received the higher score.



Products overall assessment



- The overall assessment of the platform's features received high score of approximately 4 (on a 1 to 5 scale, 5 - Very easy to use/understand…1 - Not at all easy to use/understand) in all different elements in question: a. Display Menu, b. Info boxes, c. Maps, d. Diagrammes and e. Overall graphics.

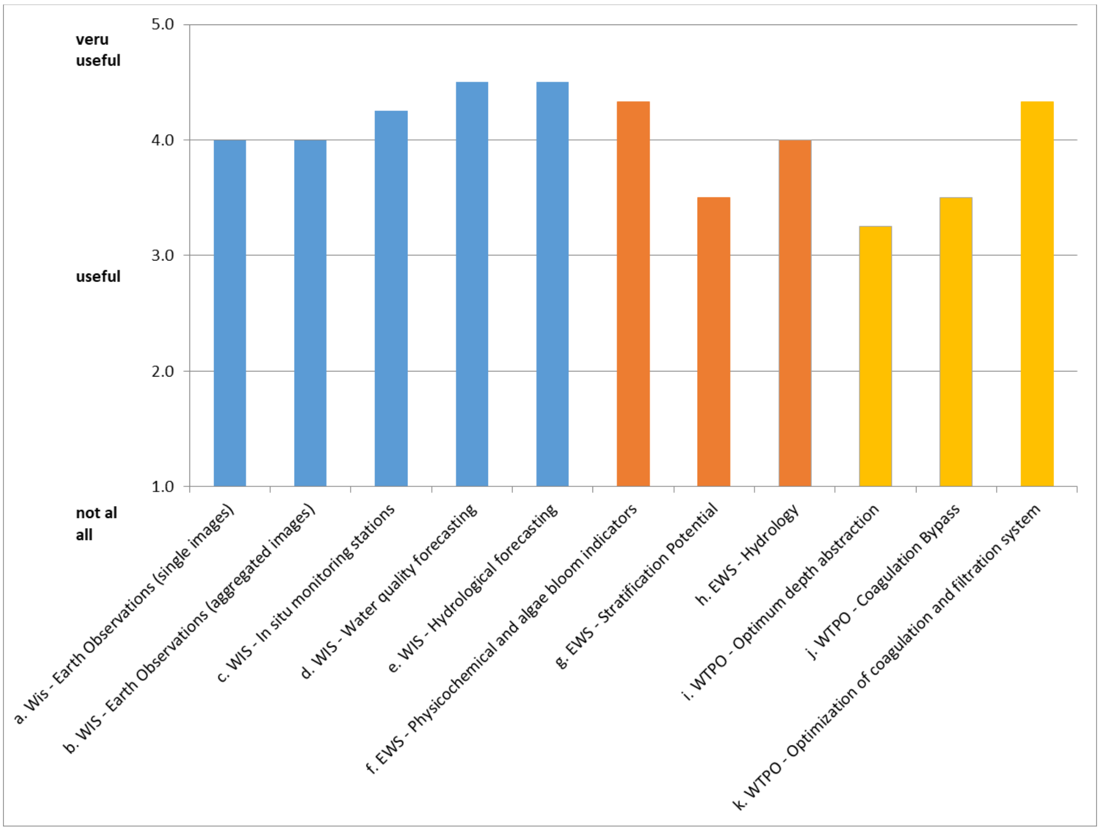


Platform features evaluation

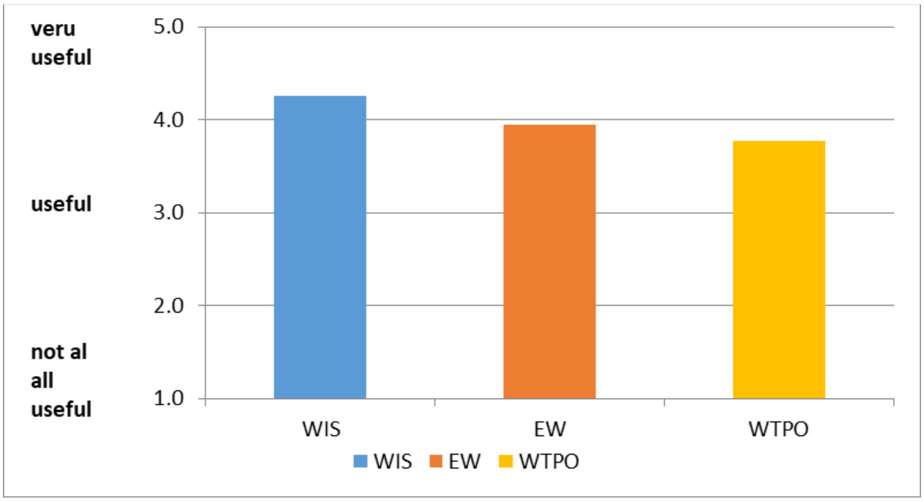
- The different components of SPACE-O were also assessed according to the different functionalities offered and their usefulness based on the participants' views. Group questions were prepared for each component: WIS, EW, WTPO and the usefulness of each functionality was rated at a 5 to 1 scale (5: Very useful…. 1: Not at all useful). The results are presented in the figures below.

  - ✓ All functionalities offered are rated as useful with average grade over 3.7 and in the case of WIS the score was even higher (4.3).

- ✓ WIS was evaluated with the highest score, with forecasting (water quality and hydrological) receiving a score of 4.5 while EO functionality was rated with 4.0.
- ✓ EW through water quality indicators was also positively evaluated with Algae Bloom and Hydrological indicators receiving the highest score.

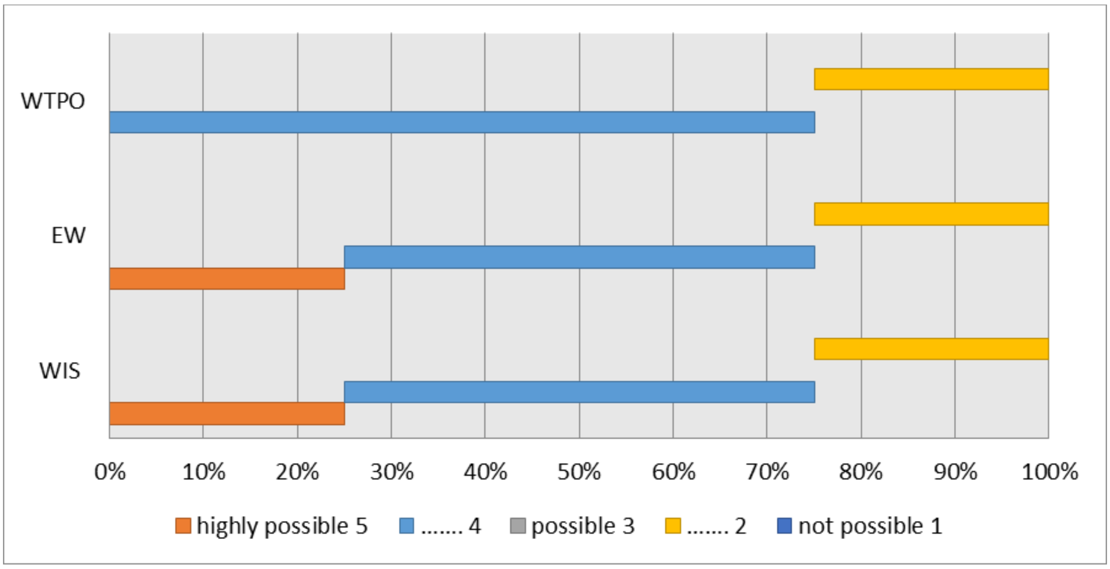


Functionalities' usefulness of SPACE-O components



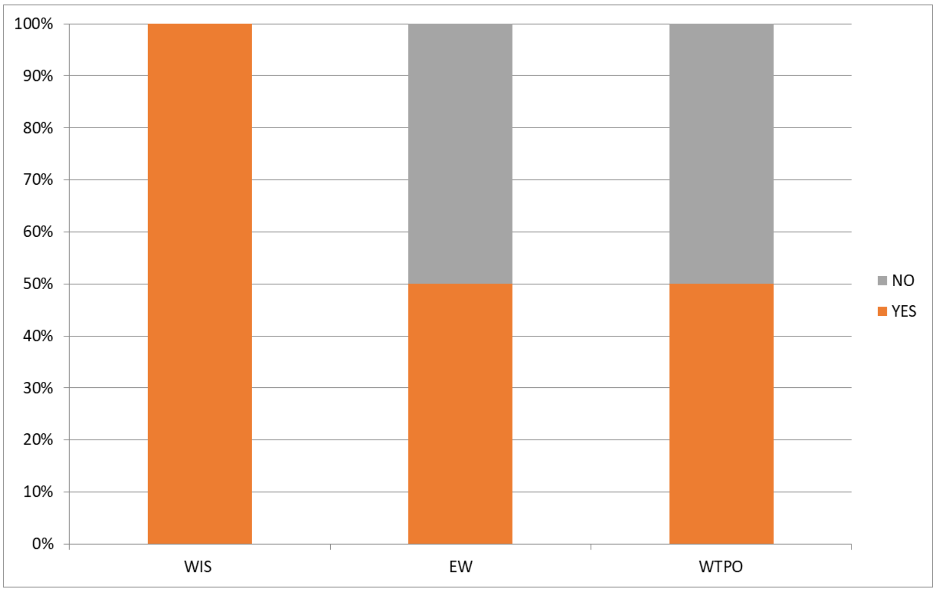
Overall functionalities' usefulness of SPACE-O components

- The comparison of the three SPACE-O platform components revealed a high interest of the participants in all products.
- The applicability of the developed tools and willingness of the participants to use them in their everyday workflow was rated at a scale from 5 to 1 (5: Highly possible.... 1: Not possible). Based on the findings of the research most of the participants found it possible to use the tools and especially the EW and WIS.



Willingness to use the SPACE-O components

- The YES/NO question on willingness to pay was targeting to the first reaction of the participants to allocate a portion of their budget to SPACE-O services, however only two participants responded this question. Again the WIS received the highest willingness to pay.



Willingness to pay for SPACE-O services

ANNEX I Workshop Agenda

Session	Time	Agenda Items
LUNCH	**12:30-13:50**	Invitees are welcome to join a private buffet lunch at the venue
Part I **Room 3205**	**14:00-15:30**	• Welcome and introduction • **Overview of Priorities and Challenges for Asia** 1. How problems like algal blooming and high turbidity affect operations of water treatment plants and reservoir managers in the provision of drinking water; 2. The economic impact of these problems in utility operations, and investments being undertaken to moderate or mitigate these impacts • Group discussions to share experience guided by the following questions: 1. What type of economic impact have algal blooms and turbidity had on operations? 2. What type of investments have been undertaken to reduce or deal with algal blooms and/or turbidity? • Feedback from each group
	15:30-16:00	Coffee break
Part II **Room 3205**	**16:00-18:00**	• ***Presentation of DSS Components:*** 1. Environmental Information system 2. Early Warning System 3. Optimizing performance in water treatment plants – sharing experiences • Group discussions guided by the following questions: 1. How would you use the information provided by the tools in practice? Who would find it useful and how would they apply it? 2. What information is useful, what is missing? 3. What forecasting information do you need, how would the information be used to make decisions? 4. How do you determine your upstream risks, where do you get information from? • Feedback from each group • Plenary Q&As and closing remarks
END	**18:00-19:00**	**Cocktail reception**

ANNEX II Participants list

No.	**Name**	**Organization, Country**
1	Mr U Htun Lwin Oo	Directorate of Water Resources and Improvement of River Systems, Myanmar
	Mr U Aung Kyaw Hmuu	Directorate of Water Resources and Improvement of River Systems, Myanmar
2	Ms Shirley Chau	Water Supplies Department, Hong Kong
3	Ms Irene Tong	Water Supplies Department, Hong Kong
4	Mr Kuo-Hsin Chang	Taipei Water Department, Chinese Taiwan
5	Mr Ming-Fwu Wang	Taipei Water Department, Chinese Taiwan
6	Mr Fwu-Lih Chiou	Taipei Water Department, Chinese Taiwan
9	Mr Marcos de Jesus	Maynlland Water Services, The Philippines
10	Mr Roel Espiritu	Maynlland Water Services, The Philippines
11	Mr Greg Antonio	Maynlland Water Services, The Philippines
12	Mr Ryan Jamora	Maynlland Water Services, The Philippines
13	Ms Lydia Sáez García	Canal De Isabel Segunda, S.A, Spain
14	Mr Nipon Leelaruji	Metropolitan Waterworks Authority, Thailand
15	Mr Wichai Arayasettakron	Metropolitan Waterworks Authority, Thailand
16	Mr Lee Koon Yew	THE MALAYSIAN WATER ASSOCIATION (MWA)
17	Dr. Sasha Koo-Oshima	U.S. Environmental Protection Agency (EPA), USA
18	Mr Abelardo Basilio	Manila Water Company Inc., The Philippines
19	Ms Katharine Cross	International Water Association
20	Mr Apostolos Tzimas	EMVIS
21	Mr Evangelos Romas	EMVIS
22	Dr. Ilias Pechlivanidis	Swedish Meteorological and Hydrological Institute (SMHI)