STOP-IT

Deliverable 2.2:
Annual technical and policy brief based on the results of each CoP

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stop-it-project.eu

TITLE OF THE REPORT

D2.2: Annual technical and policy bried based on the results of each CoP

SUMMARY

This deliverable is designed as a brief overview of activities carried out in the Communities of Practice (CoPs) within the STOP-IT project, together with summarizing the feedback of the participants and facilitators, and providing recommendations for future CoP activities. These feedbacks have guided the Work Package 2 (WP 2) team in delivering high-quality information and support to the CoPs and their members and participants throughout the project. In developing this brief, all feedback and evaluation forms provided by the CoPs facilitators over the four years of STOP-IT have been taken into consideration, as well as feedback from the facilitators of the workshops and work meetings from the first year. 29 workshop reports and feedback from all facilitators were used in developing this brief, six from the first year, three reports for the second year, 10 for the third year, and 10 in the fourth year. The evaluation by both the participants and facilitators of the workshops was summarized and consolidated in order to avoid duplication of information. Each year this report has been updated with the results of the last project year. This has resulted in a complete overview of the results of all CoPs. In this final brief, lessons learned for future CoPs are formulated as a result of the feedback and recommendations provided by participants and facilitators regarding STOP-IT perspectives.

DELIVERABLE NUMBER	WORK PACKAGE
D2.2	WP2

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Table of contents

List of Figures

List of Tables

List of Acronyms and Abbreviations

AdB	Aigües de Barcelona
BSI	Bundesamt Sicherheit in der informationstechnik
BTO	Bedrijfstakonderzoek
BWB	Berliner Wasserbetriebe
CERIS	Community of European Research and Innovation for Security
CO	Confidential
CoP	Community of Practice
CoU	Community of Users on Secure
CPS4CIP	Cyber-Physical Security for Critical Infrastructures Protection
D	Deliverable
EC	European Commission
EU	European Union
EASME	European Agency for Small and Medium-Sized Enterprises
ECSI	European Cluster for Securing Critical Infrastructures
ENISA	European Union Agency for Cybersecurity
ERNCIP	European Reference Network for Critical Infrastructure Protection
ESORICS	European Symposium on Research in Computer Security
FL	Follower
FR	Frontrunner
ISAC	Information Sharing and Analysis Center
KPI	Key Performance Indicator
L-CoP	Local Community of Practice
P-CoP	Project Community of Practice
PSB	Project Steering Board
PU	Public
QA	Quality Assurance
RIDB	Risk Identification Database
SAB	Security Advisory Board
T-CoP	Trans-Project Community of Practice
TG	Thematic Groups
WP	Work Package
CSF	Critical Success Factor

SLO   Social Learning Outcomes

Over the years, STOP-IT has applied the concept of Communities of Practice to facilitate co-learning on cyber physical security in the water sector, and stakeholder involvement at different project levels. This document provides an aggregated overview of the yearly monitoring results. Deliverable 2.2 is developed as four different briefs combined into one. The document has been updated every 12 months, spanning the entire duration of STOP-IT. The current brief, the fourth and last in this series, builds on the workshop reports provided by the Community of Practice (CoP) facilitators after each workshop during all four years of the project. Despite the inclusion of some external stakeholders, their involvement in the local CoPs (L-CoPs) was still limited. Therefore, this brief was developed as a technical brief rather than a policy brief. Through the Trans-Project CoPs (T-CoP) activities there is a link to the policy arena and the policy issues will be addressed in D2.3. Over the years, these briefs provided actionable advice to WP 2 as well as to CoP facilitators and managers based on the workshops that were held so far, in order to ensure the success of the project workshops. This final brief will provide input for the final deliverable of WP 2, deliverable 2.3.

Reaching the end of the project, six P-CoP activities were carried out with Frontrunner (FR) and Follower (FL) utilities, and three specifically targeting FL utilities, while the T-CoP at an increasing pace integrated the STOP-IT project into research and policy networks dedicated to cybersecurity and infrastructure protection, thus becoming more consolidated and visible.

The gradual development of the CoPs, from meetings to familiarize participants with the project and the CoP setting, towards more project content meetings, and eventually demonstration and testing, is documented. In total, 28 L-CoPs have been held, eight P-CoPs and several T-CoP activities were undertaken. Especially the T-CoP activities connected STOP-IT to other research and stakeholder groups or demonstration initiatives over Europe. This is expected to continue after the end of STOP-IT. Focused on the project STOP-IT, participants, namely CoP leaders, managers and facilitators agree that the objectives set for the CoPs were realistic and have been achieved successfully during the workshops, or as follow up activities. From March 2020 onwards, the CoPs have been held in a virtual format due to the COVID-19 pandemic. During the final year there have been more experiments with virtual CoPs and online engagement tools.

Throughout the project, the CoPs have been well established within the project, receiving good scores on the three key dimensions of CoPs: community, domain and practice. Key performance indicator (KPI) 8 (community involvement) has a satisfactory score. The participants value CoPs as a platform for knowledge exchange and networking. Throughout the project, WP 2 has monitored the CoPs' progress and implemented the yearly lessons learned. The work in the last year of the project focused mainly on facilitating online CoPs and trying to increase engagement. The engagement tools and gamification elements were

highly appreciated by the participants, but do require an extensive introduction or training for the CoP organizers. The inclusion of external stakeholders in L-CoPs remained an issue throughout the project. Due to the highly technical nature and development stage of the tools in the STOP-IT project, the CoPs were not ready yet to engage with external stakeholders, which were mainly reached out through the T-CoP activities. The lack of readiness to include external stakeholders in the L-CoPs and their varying frequency provides lessons learned for future projects including CoPs as a knowledge exchange tool. These lessons learned are described in D2.3 'Best practices for CoPs'.

One of the goals of the STOP-IT project is to create and facilitate vibrant communities developed by the FR utilities and research organizations in relation to cybersecurity in critical water infrastructure. Communities of Practice (CoPs) are designed to serve this purpose within the STOP-IT project, and also encouraged to continue to operate after the project ends in 2021. Within STOP-IT, a three-level CoP approach is applied, (i) local level (FR water utility case), (ii) project level (STOP-IT project group; learning across locations, work packages, FRs and FL water utilities) and (iii) trans-project level (Research communities and associations dealing with CI; transferability of knowledge and solutions to and from the project via interaction with other projects/networks), see also D2.1.

The **L-CoPs** are organized around the four FR utilities – Oslo VAV (Norway), Mekorot (Israel), Berliner Wasserbetriebe (Germany), and Aigües de Barcelona (Spain). Up to **M12** of STOP-IT the guideline for the set-up and management of the CoPs was elaborated (finalised in M6), and two rounds of CoP workshops already took place for Oslo and Barcelona, and one round for Berlin and Mekorot. **Between M12 and M25** two L-CoPs took place: Mekorot (Israel), and Berliner Wasserbetriebe (Germany). For Aigües de Barcelona (Spain) and Oslo VAV (Norway) several dedicated technical meetings were held instead. The workshops are geared towards communication, data collection for project activities, and experience sharing with internal and external stakeholders of the FRs. **Between M25 and M37** 11 L-CoPs were held. **Between M38 and M49** 6 L-CoPs were held in which the second preparatory phase for demonstration and testing started. Their distribution across FR utilities is summarized is summarized (Table 1).

Table 1: Local CoP meetings between in STOP-IT

Organizer	No. of L-CoP M1-M12	No. of L-CoP M12-M24	No. of L-CoP meetings M 25-M37	No. of L-CoP meetings M38-M49
Oslo VAV	2	3	2	0
Mekorot	1	1	4	0
Berliner Wasserbetriebe	1	1	2	2
Aigües de Barcelona	2	1	3	4

From March 2020 onward, the CoPs were held virtually due to the COVID-19 pandemic. Monitoring how the CoPs are working towards the objectives is important in order to understand what works and what can be improved in organizing and carrying out the workshops, as well as understanding what potential follow-up activities should be encouraged. During year three of the project, a new evaluation form was developed (Annex A) to measure the three fundamental dimensions of CoPs (community, practice, and domain) in relation to social learning outcomes based on the approach of Fulgenzi et al. (2020). The monitoring activity is the object of the current brief, and is based on anonymous surveys taken at the end of the workshops by the participants. In addition, during the first year of the project, the facilitators were asked to share their experiences in facilitating the workshops, feedback

on the application of CoP guidelines, as well as recommendations to the WP 2 team and the WPs that put forward the workshop requirements and materials. During the fourth year of the project, several of the recommendations that were formulated in the third year were used and recommendations for future CoPs and input for D2.3 - Best Practice Guidelines for Communities of Practice in Water Infrastructure - were formulated.

As for the **P-CoPs**, we aimed to identify productive interactions [1]between the participants. We learned in the first year that the P-CoPs are evolving rather organically over a longer period of time. Between M25 and M37, one P-CoP was held: an online P-CoP during the online Project Steering Board (PSB) meeting in June 2020. Between M38 and M49, four P-CoPs were organized: one online PSB meeting, one webinar or the resilience of water infrastructure and two CoPs with the TORC game, one for the FRs and one for the FLs. The increase in the number of P-CoP towards the end of the STOP-IT project (see Table 2) shows that at the end of the project there was more need to discuss between the different cases. Monitoring of these activities is again based on an online survey conducted at the end of the P-CoP and has led to recommendations for future CoPs.

Table 2 Overview P-CoPs in the STOP-IT project

Year 1	2
Year 2	2
Year 3	1
Year 4	4

As for the **T-CoP,** we aimed for cross-pollination potential with other related projects. The T-CoP activities are led by the project coordinator Rita Ugarelli. The activities started in the first three years of the project and were further developed into year four. Some new initiatives in year four have also been undertaken. Specifically:

(1) Hosting a session during the ICT4Water Cluster annual event on the importance of Cybersecurity in the water sector, potential solutions and how STOP-IT can contribute to the EU cybersecurity strategy.
(2) Presentations at the ECSI workshop
(3) Participation in the 1st International Workshop on Cyber-Physical Security for Critical Infrastructures Protection
(4) Participation in Joint Research Center Workshop on Cybersecurity
(5) In the process of establishing a Water ISAC grounded on STOP-IT
(6) Presentation to the research program BTO of Dutch and Flemish water utilities.
(7) STOP-IT_N initiative, with SINTEF, Bergen, Powel (now: Volue), Devoteam and Norwegian Water including training activities, workshop and a paper under review.

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[1] Definition of productive interactions: "exchanges between researchers and stakeholders in which knowledge is produced and valued that is both scientifically robust and socially relevant." (Spaapen &van Drooge, 2011 P.212)

Table 3 Overview communities which STOP-IT collaborates with

Community	Collaboration likely to continue after STOP-IT ends
ICT4WATER (EASME, now REA)	Yes, various STOP-IT members are active in other ICT4water projects. STOP-IT leads the cybersecurity action group.
Community of Users on Secure, Safe and Resilient Societies	Yes, Rita Ugarelli joined
ERNCIP- Chemical and Biological Risks to drinking water group	Yes, Rita Ugarelli is now formally engaged with this group
SCOUT project	No, activities were only webinars
NATO science for peace and security program	No, STOP-IT was only involved in Kick-off meeting
CoU - INFRA Scoping Group (now CERIS)	Yes, resulted in contribution to workshops organized by DG-HOME.
Cyberwatching.eu	Yes, we periodically update the cyberwatch radar (https://radar.cyberwatching.eu/radar/)
European Cluster for Securing Critical Infrastructures (ECSI)	Yes, synergies established in organizing conferences and publications.
ENISA	Yes, in dialogue to establish a Water ISAC building on STOP-IT from October 2021.
Empowering EU ISACs project	Yes, in dialogue to establish a Water ISAC building on STOP-IT from October 2021.

2 CoP effectiveness through social learning and KPI 8

WP 2 is responsible for measuring KPI 8 (community involvement: STOP-IT aims at awareness creation and communication between stakeholders within CoPs, target is to achieve at least 25% of identified stakeholders with effective and active participation in CoPs).

Looking more closely at KPI 8, three elements need to be measured:

- Awareness creation;
- Communication between stakeholders;
- Effective and active participation of 25% of the stakeholders.

In addition to measuring KPI 8, at the end of the project, WP 2 has to provide a deliverable on best practices for CoPs (D2.3). By adopting a model developed in the H2020 project NextGen by Fulgenzi et al. (2020), which measures CoP effectiveness in the three fundamental domains in terms of social learning outcomes (relational outcome, shared understanding and substantive outcome), these three elements of KPI 8 can be measured. Moreover, we can understand which factors stimulate and support an effective and efficient CoP (best practices). By looking at success factors from the literature on CoPs, we can also provide the current CoPs with suggestions for improvement. Therefore KPI 8 is measured through the critical success factors devised by (Fulgenzi et al., 2020) as it measures both KPI 8 and the performance of the CoPs.

2.1 Brief explanation of the adopted evaluation framework

According to Fulgenzi et al. (2020) a CoP's effectiveness is operationalized as the achievement of three social learning outcomes (SLO); relational outcome, shared understanding and substantive outcome, and, in parallel the development of three CoP dimensions: community, domain and practice. In the literature, a large set of preconditions and key elements can be found that indicate the effectiveness or success of a CoP. These elements have to be taken into consideration when evaluating a CoP in order to define strengths and weaknesses and potential for improvement.

Fulgenzi's et al. (2020) approach defines the development of CoPs as their increased effectiveness in stimulating and supporting the creation of knowledge (social learning), see Figure 1. Based on a literature review, Fulgenzi et al. (2020) created a list of indicators based on the preconditions for success. These indicators were clustered into six critical success factors (CSF). Each CSF is measured as the average of its indicators. The CSFs are related back to the dimensions of CoPs and social learning outcomes. This model therefore measures the overall functioning of the CoP, which is needed for identifying best practices. KPI 8 can be measured through a selected set of indicators in Fulgenzi's et al. (2020) model.
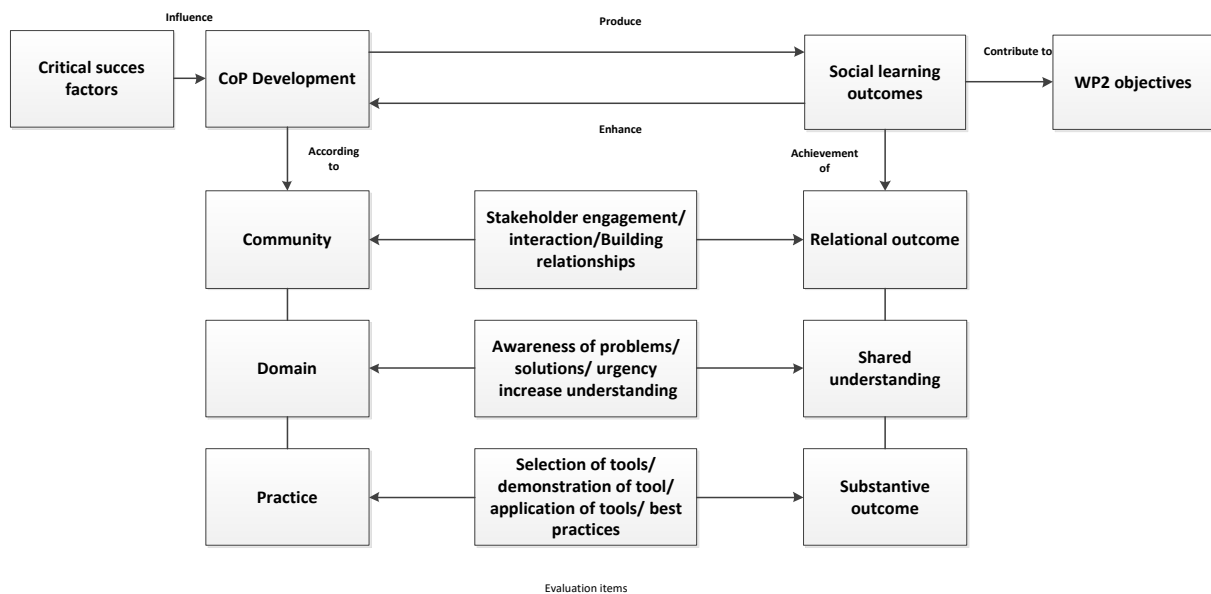
Figure 1 Framework of Fulgenzi et al. (2020)

Each evaluation item, based on KPI 8 and the CoP objectives, is thus measured by two CSFs: one is related to structural and organizational aspects, the second to epistemic and content-related ones. The indicators making up the CSFs are translated into statements that participants can rate from 1 to 5 on a Likert scale.

By adopting this framework, it is possible to identify the aspects of the CoP that stimulate and support social learning outcomes, where a score above 3 is satisfactory.

2.1.1 KPI 8

KPI 8 is measured by the following evaluation items (indicators):

Communication:

- Improvement in working relationships (indicator 2.1)
- Trust in others; openness in communicating own opinions, concerns, interests, and goals (indicator 2.5).

Active and effective participation of relevant stakeholders:

- Opportunity for individual participation and input (indicator 3.1)
- Representation of all relevant stakeholders (indicator 3.4 & indicator 3.5)
- Increased knowledge on the issue(s) at hand (indicator 6.1)

Awareness creation:

- Awareness of interdependencies of actions and desired outcomes (indicator 4.2)
- Awareness of presence/lack of resources in the community (indicator 4.3)
- Changes in own perspective (indicator 4.4)
- Awareness of own role and role of others (indicator 6.4)

2.2 Results of KPI 8

In this section scores of the KPI 8 indicators are presented. The effectiveness of the CoPs in general is discussed in the next chapter. The scores on the vertical axis for all figures are the average score on the Likert scale from 1-5.

Communication between stakeholders
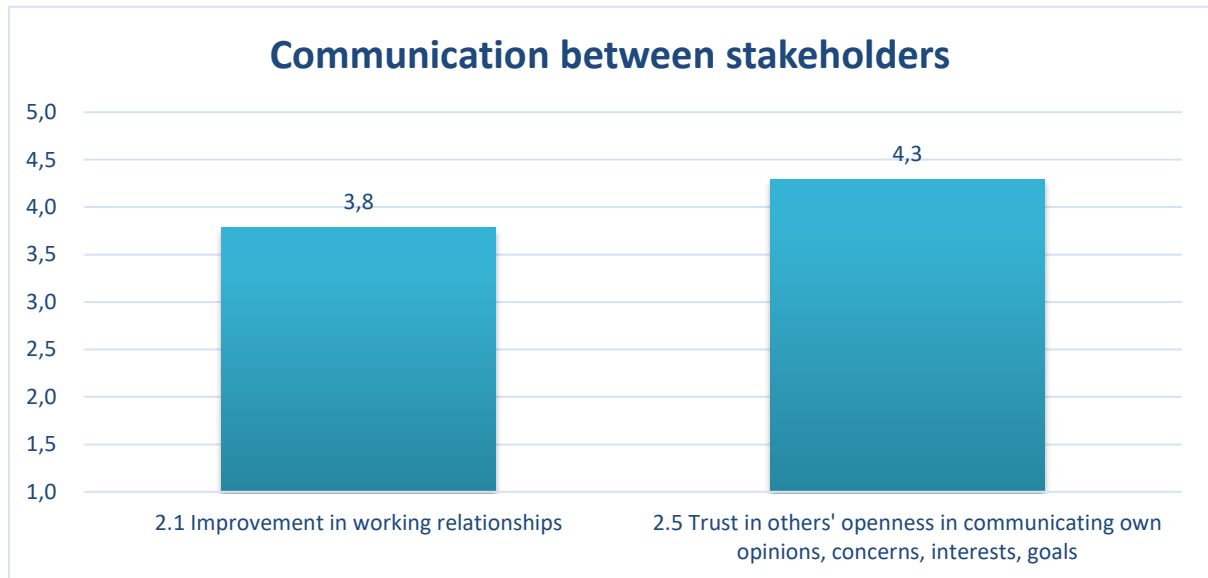
Figure 2 Communication between stakeholders in CoPs (N=82)

Part of KPI 8 is to achieve communication between the stakeholders. As it can be deduced from Figure 2, there is open communication between the stakeholders. The participants believe that other participants are communicating in an open way and working relationships are continuously improved in the CoPs. Therefore, it can be said that the CoPs foster communication between the stakeholders in the project. The score on improved working relationships (score = 3,8) remained the same for the fourth project year as for the previous year. This was as expected, as the working relationships already are established and considered satisfactory. In comparison, the score on trust in each other's openness went down, from 4,7 in year three to 4,3 in year four. This may possibly be explained by the shift to online CoPs this year due to the COVID-19 pandemic. Participants seem to miss the personal interactions. Despite the lower score, it is still satisfactory, and it can be concluded that the communication between stakeholders was sufficient.

Active and effective stakeholder participation
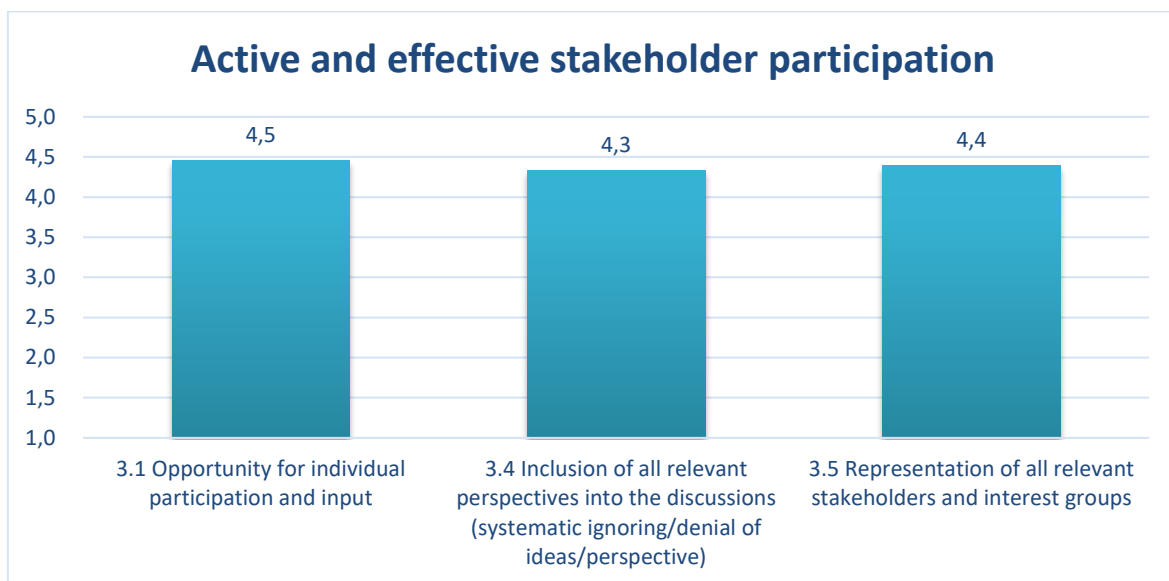
Figure 3 Active and effective participation in CoPs (N=82)

KPI 8 aims for active and effective participation of 25% of the stakeholders. As shown in Figure 3, the indicator on representation of all relevant stakeholders and interests groups scores 4,3 out of 5. This indicates that 86% of the CoP participants believed that all relevant stakeholders were represented. Accordingly, it can be concluded that the threshold of 25% is reached. The stakeholders also seem to have participated in an active manner during the meetings. The participants state that there is sufficient opportunity for their individual participation and input (score 4,5 out of 5), and that the CoPs allow for the inclusion of all relevant perspectives into the discussion (score 4,4 out of 5). As shown in Figure 4, participating in the CoPs led to an increase in knowledge on the issues at hand, indicating that the participation of the stakeholders was indeed effective. Also for these indicators, the scores are lower than for the previous year, which can again be explained by the lack of personal interactions and solely online CoPs which make it for some people harder to participate.
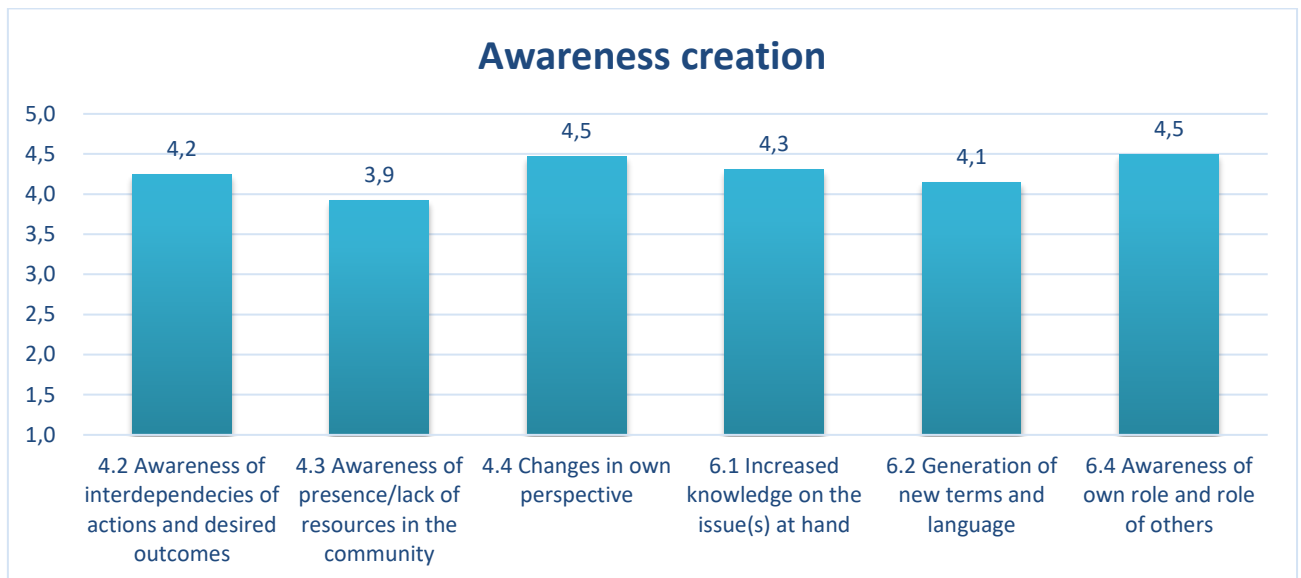
Figure 4 Awareness creation in CoPs (N=82)

Lastly, KPI 8 aims at the creation of awareness. Awareness creation is measured through six indicators which can be seen in Figure 4. All indicators received a score from 3,9 or above, indicating that there is sufficient awareness creation. The CoPs not only enhance the awareness of the stakeholders' own role in the project and the roles of others, but also bring to light the interconnectedness of stakeholder roles and the interdependency of stakeholders to achieve the desired outcomes of the project. Furthermore, there is increased understanding of the other stakeholders' perspectives, and in relation to that, the participants learned more about the language and jargon used by participants from other organizations or WPs. Finally, the participants also became more aware of the availability or lack of resources to handle specific cyber-physical threads. Also for these indicators, the scores were 0,1 point lower compared to the previous years. The lower score, in combination with the written feedback of the participants indicating that they miss the face-to-face interactions and connections, suggests that solely online CoPs might not be the best format for knowledge exchange. Participants feel the need to personally connect. If circumstances allow it, online CoPs should be combined with physical CoPs.

Overall, the scores of all indicators, except the indicator on the improvement of working relationships, were 4 or above out of 5. The lowest scoring indicator has a score above 3, namely 3,8. These scores indicate that KPI 8 is sufficiently reached.

The CoP guidelines developed in WP 2 (D2.1 Guidelines for CoP set-up and animation) have been revised by WP 2 and are approved by the review (M18). The updated guidelines make clear the need to measure the success of the CoP activities, especially related to the local activities carried out, Local activities are connected to the first line of users of results stemming from STOP-IT: the FR and FL utilities, as well as other connected local stakeholders. As part of the template provided to CoP managers and facilitators for reporting on each of the workshops, a specific section was designed to capture indicators related to outputs and outcomes of the workshops. These include direct indicators, such as number of participants and resulting follow-up actions, as well as indicators to gauge the participants' satisfaction in relation to the activities of the CoP. During the third year of the project, the evaluation form was updated according to the evaluation method of Fulgenzi et al (2020) and made available online in response to the shift towards online CoPs. In the following sections, a summary of the workshop goals, participants and their feedback, as well as feedback from the facilitator is provided. During the second, third and fourth year no feedback from the facilitators was gathered separately as they were also asked to fill in the evaluation form.

3.1 Workshop goals

A set of objectives is established before every workshop is set up. These objectives have the role of guiding the general motivation and workflow within the CoP meeting. They are established by the leader of the project activity for which the workshop is developed. For the first 2-3 workshops, it was envisaged that the objectives are set up in such way that participants become comfortable with the idea of the CoPs, the STOP-IT project and its ambitions, as well as the format of the workshops and the roles of the facilitator and community manager. Also, for the first workshops it was agreed that these are carried out with internal stakeholders of the FR's organizations, primarily to pilot the concept of CoPs in STOP-IT and to become aware of the level of sensitive information that is shared within the activities. However, each workshop organizer was given the freedom to choose how open the workshop would unfold, and invite members from external organizations to the CoP as they see fit.

3.1.1 Round one – year one
For the *first workshop round* (Nov 2017), the objectives were set to familiarize all the STOP-IT participants with the project, to define the scope and goals of the CoPs, and to collect and discuss the stakeholders' ideas and needs regarding the STOP-IT project.

3.1.2 Round two – year one
For the *second workshop round* (Feb-Mar 2018), the objectives set were slightly different for each local-CoP. Apart from introducing CoP members to the STOP-IT project, or bringing them up to date with the developments after the first workshop, the second workshop, in February-March 2018, had the explicit goal to provide input to the risk identification database (RIDB) for work carried out as part of WP3, task 3.2 – Risk Identification.

3.1.3 Round three – year two

For the *third workshop round* (July 2018-June 2019) the objectives and set-up for each L-CoP were different. While some FRs chose a clear L-CoP (BWB, Mekorot), others opted for several separate sessions, which could be clustered as a L-CoP (Oslo VAV, AdB). Being in the second year of the project, it can be assumed that at this stage the participants were now familiar with the concept of CoPs and STOP-IT itself. Therefore, the objectives of the workshops were more content orientated than in the first year. In general, the workshops were oriented towards the preparation of demonstration activities, exchanging user requirements with the tool developers, and showing the overall process of the tool development. The FRs differed in their progress within the project. While some were already focusing on getting ready for demonstration, some were still at the risk identification part.

3.1.4 Round four – year three

The L-CoPs during the *fourth workshop round* (July 2019-June 2020) were centered on the preparation for demonstration phase 2. All FRs had completed the risk identification and were preparing for demonstration. The local-CoPs were focused on updates on the status of the STOP-IT tools, gathering ideas for testing of the tools, and identifying test cases. Moreover, the L-CoPs during the first half of 2020 were used to discuss and institutionalize these next steps with the FRs and make a timeline and planning for the actions to be taken during the remaining time of the project. The fourth round of workshops took place in the middle of the COVID-19 pandemic. Naturally, travel restrictions and social distancing influenced the nature of the CoPs. Since March 2020, the L-CoPs have taken place in an online format with an online evaluation provided by WP 2.

3.1.5 Round five - year four

During the *fifth workshop round* (July 2020-May 2021) the number of L-CoPs decreased to 6. The CoPs that were held focused on preparation for testing, and exploitation. Only two FRs chose or organize a CoP; AdB and BWB. It seemed that these water utilities needed to work out technical details in their specific context before testing the tools and their exploitation. Mekorot organized a P-CoP and Oslo VAV chose not or organize a CoP. Similar to the previous year, the CoPs were held online due to the pandemic.

The feedback from participants, CoP leaders, managers and facilitators, as well as from the beneficiaries of the information shared in the workshops (WP3, 4, 5) shows that the objectives were realistic and achieved successfully, either during the workshops, or during the follow up activities.

3.1 Participants' workshop evaluation and feedback

3.1.1 Round one and two - year one

The workshops set up as part of the CoP activities during the first two rounds were mostly focused on engaging internal stakeholders (from FRs and research institutes), in order to

collect information required by WP3, which lead to the development of CoP core groups. For the CoP workshops during these first two rounds, eighty participants attended in total – some of these are counted twice as they attended both sessions[2]. Feedback was generally positive with regards to the atmosphere, structure, openness, and collaborative opportunities. The participants appreciated the opportunity to interact with other project partners and exchange ideas. They were a little less positive with regards to the timing with which prior information about the workshop was provided, duration of the meeting (too short), and some less interactive parts of the workshops. *Participants' suggestions were to avoid long lectures, make the sessions more interactive, provide the objectives of the CoP well in advance, include more external stakeholders, and to organize more thematically oriented CoPs.*

3.1.2 Round three – year two

The third round of workshops focused mainly on the preparation for demonstration activities, exchanging user requirements and expectations. At the L-CoPs in Berlin, Israel and Oslo a total of 41 participants was present. Since no formal CoP in Barcelona was held, there is no information on the number of participants. Only at the L-CoP in Berlin an evaluation was conducted including a reflection round during the session. Overall, the workshop was valued as positive in terms of atmosphere, exchanging ideas and discussion, getting more connected with other participants in the project, bridging the gap between tool developers and FRs, having an update on the development of the tools and for the FRs to provide input to the development. The less positive comments focused on the logistics of the meeting such as the location. It was also mentioned that there should be more time for discussion. *Participants suggestions were to have a more realistic planning, central location, more time for discussion on the end users' needs, and more time for the demonstration of the tools.*

3.1.3 Round four – year three

The fourth round of workshops was centred on the preparation for the second phase of demonstration and on identifying the next steps. In total 66 attendees participated in the L-CoPs during this period. Some are double counted as they participated in multiple sessions. The CoPs during the third year of the project were evaluated systematically, based on the social learning outcomes and CoP domains which are at the centre of a successful CoP, namely community involvement, domain and shared understanding and practice, and substantive outcomes.

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[2] Aigües de Barcelona and Oslo VAV had both two workshops each, while BWB and Mekorot held one each, combining the first and second set of objectives.
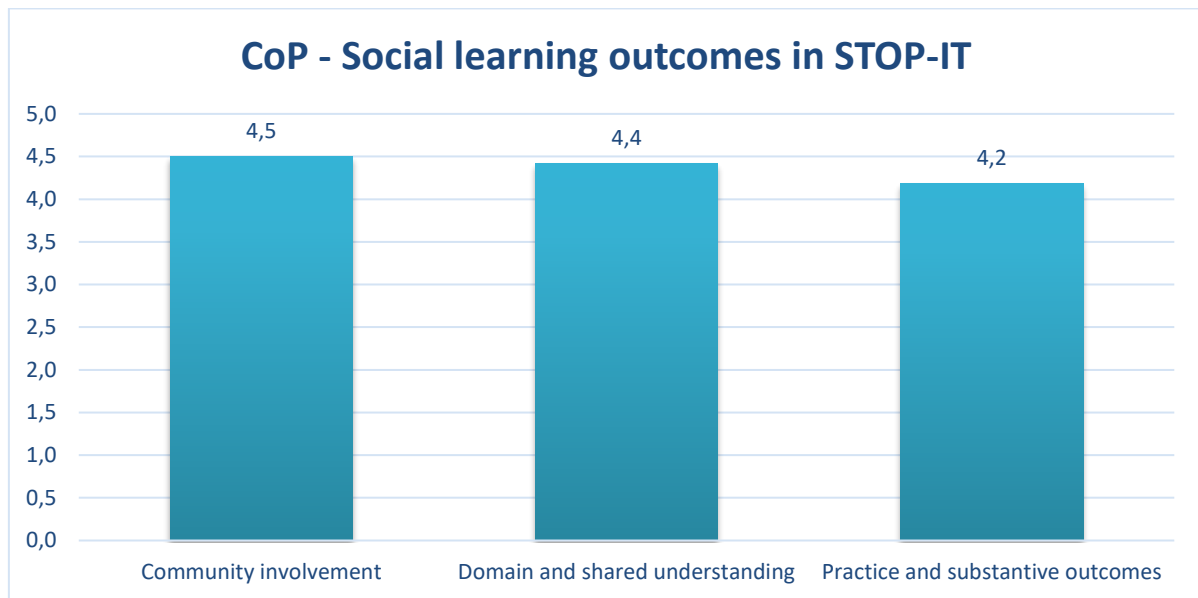
Figure 5 Social learning outcomes CoPs year 3 (N=34).

As shown in figure 5, all three domains received a score higher than 4 on a scale from 1-5. Therefore, it can be concluded that the CoPs were functioning well.

The open-ended questions confirmed this result. The open-ended questions showed that the participants valued the CoPs for the opportunity to interact, exchange ideas and learn from each other (community involvement and shared understanding), but also for their practical contribution to the project such as identifying the follow-up steps, bottlenecks, and information needed for the implementation of the tools (practice and substantial outcomes). Moreover, their efficiency and discussions were highly appreciated. The least positive points mentioned were related to the progress of the tools and that some were developed without specific knowledge on the water service industry. While this has little to do with the CoP approach, the last point shows the importance of organising CoPs in the early phases of the project.

The shift to online CoPs gave the opportunity to experiment and learn from online engagement. The online CoPs were appreciated for their focus, efficiency and not needing to travel. However, the participants missed the elements which they usually value most: the personal contact, small talks for news, creative ideas; furthermore, the online meetings are more prone to misunderstandings. Therefore, it would be good to combine online CoPs with physical CoPs if the situation allows it.

While the participants understand that online CoPs are currently the only feasible option, they recommended to hold future CoPs face-to-face as much as possible. Moreover, they prefer more live demonstration of tools, more tool developers participating in the workshops, and to work together with the technology providers to test the tools. Other suggestions were more

organisational: having a more focused agenda and making the objectives of the meeting clearer beforehand.

3.1.4 Round five – year four

The CoPs during the fourth year of the project focused on working out technical issues, understanding the tools better, allowing the FRs to select the tools for testing, and preparing the FRs to test and exploit the tools in their own specific context. In total 41 people participated in the L-CoPs, some are double counted as they participated in multiple CoPs. The FRs were asked to distribute the evaluation form after the CoP, unfortunately not all FRs did. The figure below represents the social learning outcomes based on the evaluation form of both L-CoPs and P-CoPs.

CoP - Social learning outcomes in STOPIT

	Community involvement	Domain and shared understanding	Practice and substantive outcomes
	4,3	4,4	4,2
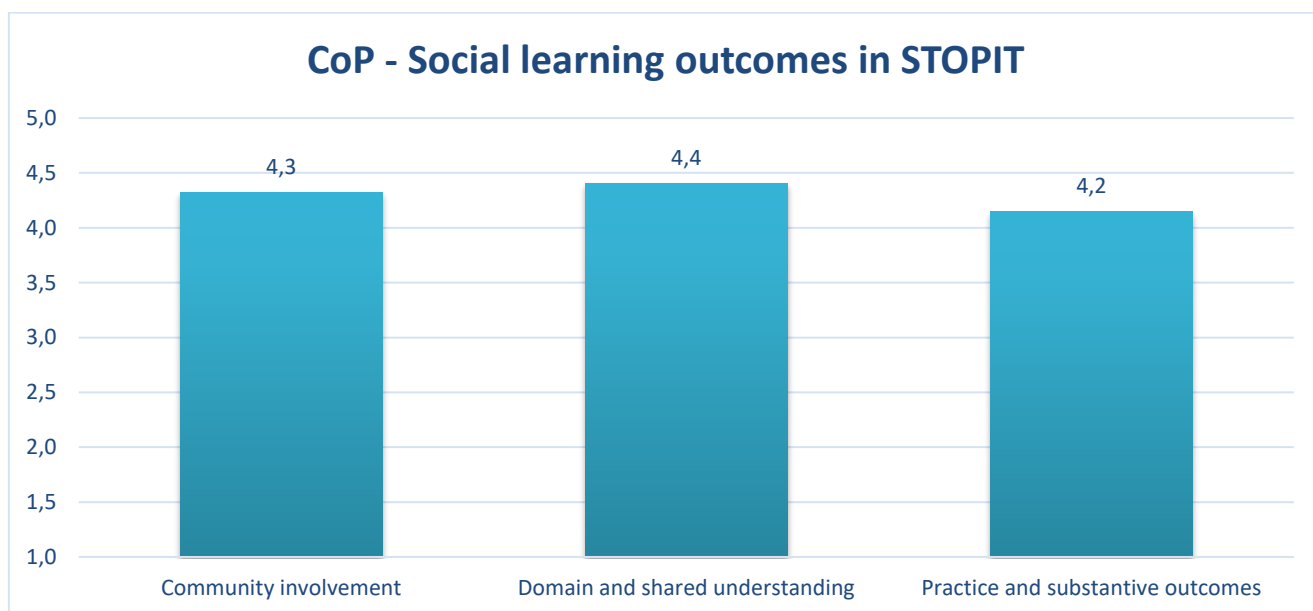
Figure 6 cumulative social learning outcomes CoPs year 5 (N=82)

Figure 6 shows that the CoPs score well on all dimensions; community involvement, domain and shared understanding and practice and substantive outcomes all have a score above 4 on a scale from 1-5. The scores on domain and shared understanding and practice and substantive outcomes remain the same compared to the previous year, while the score on community involvement drops with 0.2 points. The open-ended questions confirm these scores. The L-CoPs are appreciated for the knowledge exchange between the tool developers and end users. The FRs gained more understanding of the needed follow-up activities to progress with testing the tools, and the online platform made the meetings very concise and to the point, contributing to reach consensus among the participants. However, the negative effect of having only online meetings becomes visible on the lower score on community involvement. The participants understand that online meetings are not only prone

to technical issues, but they also make informal exchanges between the participants more difficult. Luckily, the overall score is still sufficient, and the CoPs are functioning well.

All four years of CoPs evaluation show that the meetings are valued for being a platform where the different participants of the project can come together, share their knowledge and experiences, and better understand each other. The CoPs thus help to **bridge the gap between the end users of the tools and the tool developers**. They do **form a community**, **have a shared domain** and the meetings are **focussed on the implementation and testing of the tools** (practice). The shift to online meetings illustrated the sense of community that the face-to-face CoPs bring and which was missed in the last year of the project. Despite the overall positive score of the CoPs, recommendations can be made for future CoPs. *The participants suggested clearer communication on technical aspects and expertise required to use the tools. CoPs should preferably be held on site and allow plenty of room for discussion and interaction to create community feeling. Time management remains an issue, it is necessary to strike a good balance.*

3.2 Local CoP Facilitators feedback

As the L-CoP development is performed in coordination with the research institutes active in the project and in collaboration with the FRs, it was important to gauge the perception that the facilitators have on the workshops performed so far. As such, the L-CoP facilitators were asked in year one to respond to the following questions, related to the set-up, management of the L-CoPs, as well as the support offered from WP 2:

1. How would you describe the facilitator experience overall? What have you gained/learned from this activity?
2. Are there/have there been follow up actions decided with CoP members so far?
3. Have the guidelines elaborated by WP 2 through D2.1 provided you with the tools and knowledge you felt were required to facilitate the workshops?
4. What are your recommendations for:
    a. The WP 2 team – elaborators of the CoP methodology in STOP-IT?
    b. The other WPs representatives that develop the workshop subjects, materials and ideas?
5. What are your suggestions for improvement overall?

All facilitators noted that the CoP approach has been a positive experience so far with direct learning outcomes for them, as well as for the participants. The first two workshops were mainly designed (aside for setting up the CoP) for FRs to provide inputs for the work carried out in WP3, specifically in tasks 3.1 and 3.2., and as such, there has been less room for developing social learning and characteristics associated with the CoP approach. However, there is an overall beneficial sentiment that the facilitators are building their own role within the STOP-IT CoPs through their approach to the application of the concept, their role as the project tasks "translator" to actions, and through ensuring that attention is given to the goals,

values and social learning between stakeholders. Follow up actions, including additional meetings and telephone-conferences, are being organized by the communities.

Facilitators reported that the guidelines prepared in WP 2 for the design, set-up and management of the CoPs were beneficial in providing a theoretical basis before the CoPs became operational. In practice, the CoP meetings took their own direction and started taking their own identity. This is a consequence of a deliberate choice made in the development of the guidelines, namely the CoPs were given flexibility in choosing the methods to use in the meetings, such as the order in which they approach the subjects, flexibility to adapt to local culture and work conditions, to the FRs primary interests, etc. Not all questionnaires, templates and recommendations were used as prescribed, which indicates that the facilitators were relying on their own experience and best practices to lead the workshops. Principally, this is a positive development for CoPs. In a project context, it is also important to ensure alignment with the overarching goals and procedures initially defined.

One particular point of attention raised by the facilitators, also seen in the participants' feedback, is that guidelines, suggestions, materials, and requests from WP leaders should be made available to both the facilitators and the CoP members more in advance compared to how this has been done so far. As noted by the facilitators, after the establishment of the L-CoPs there needs to be a good flow of information between the CoPs and the WPs. *The facilitators suggest to clearly mark the future workshops on a 6-12 months basis, so that a calendar of events can be established. This will enhance the capabilities for the CoPs to collaborate (between locations, as well as between local-project-trans-project). Another suggestion is to have CoP members provide information in advance of the workshops, and then summarize, compare and discuss during the workshops, rather than asking for the information to be shared as part of the discussions. This feedback around proper communication and information sharing relates to the "what's in it for us?" question to which the CoP members should have a clear answer formulated for themselves.*

P-CoPs are designed for project partners to exchange experiences on the applicable outcomes of STOP-IT by promoting a multi-stakeholder approach to water system protection (see also D2.1). Up to M49, P-CoPs have been launched on different levels:

i.   on Task- and WP level, within the Scientific Technical Committee (STC), the Project Advisory Board (PAB) and
ii.   as a P-CoP of STOP-IT operators in order to connect FRs, FLs and other WPs and
iii. as a P-CoP specifically targeting FLs as part of the training sessions by WP 8

CoPs on project level are not considered in this report as these CoPs consist mainly of project working groups and meetings and interactions.

This chapter summarizes and reflects on the different kinds of P-CoPs.

4.1 Project CoP connecting Frontrunners, Followers and WPs

In order to connect FRs and FLs beyond project activities and tasks and to enhance exchange of knowledge and experiences, it was decided to provide a CoP for FRs and FLs water utilities. Six P-CoPs of this kind were organized. A first meeting took place within the expanded L-CoP workshop at Berliner Wasserbetriebe (Workshop on IT-Security on 12.-13.03.2018). At the meeting three (out of four) FR utilities and three (out of four) FL utilities were attending.

The objective of this first water utility meeting was to bring together FRs, FLs, research institutions and technology providers in order to:

• Provide a framework for knowledge exchange between utilities
• Achieve a common understanding of upcoming tasks and tools developed
• Exchange experiences and ideas
• Discuss and define needs and expectations

A second workshop connecting FRs, FLs and tool developers was held at the first PSB meeting in Barcelona (19.06.2018). At this meeting all water utilities participating in STOP-IT were present as well as representatives from the research institutes and other parties involved in the STOP-It project. The CoP had the following objectives:

• To enable communication between FRs, FLs, research organisations and further project partners about existing risk management procedures.
• To provide feedback to FRs and FLs on their existing risk management concepts.
• To agree on do's and don'ts in risk management processes.
• To provide opportunity to state expectations and give input to future L-CoP designs.

The third P-CoP connecting FRs, FLs and tool developers was held at the second PSB meeting in Athens (19.06.2019). The focus shifted from risk management towards technical understanding of the tools, preparation for demonstration activities and created opportunity to exchange expectations and feedback between water utilities and tool developers. Objectives were:

- To ensure all FRs and FLs have a profound understanding of the tools developed in STOP-IT (WP4, WP5 and WP6).
- Planning of the tool demonstrations with focus on open questions, technical requirements, participants, timeframes, demonstrated scenarios, key performance indicators and evaluation methods.
- For FRs to provide feedback and recommendations to the tool developers.
- To enhance the involvement of water utilities into the tool development process for a higher degree of customization of the technologies.

The fourth P-CoP was meant to be held at the PSB meeting in Berlin. Unfortunately, due to the COVID-19 pandemic, the PSB shifted to an online meeting and so did the P-CoP. The P-CoP had the following goals:

- To update all the project participants of the progress, limitations and action plans of the FRs
- To create shared understanding on the progress and next steps for testing of the tools.

The fifth P-CoP was again an online meeting due to the COVID-19 pandemic (3.11.2020). The P-CoP acted as a progress check-point for the WP7 demonstration activities at two levels, overall and on a FR basis. The P-CoP had the following goals:

- Gain a clear understanding of the demonstration-related progress made so far.
- Each FR will provide a summary of the results achieved by the meeting, and a clear plan for the future with check-points at December 2020 (just before Christmas holidays) and May 2021 (original end of the project). Also, briefly report any related problems identified (e.g., installation related issues).
- Identify, and agree on a plausible (COVID-19-adapted) action plan for the future in order to successfully finalize the demonstration activities (incl. resolving any demonstration related problems).
- Host specialized talks for ATOS and RISA's solutions, aiming at gaining a clear understanding of the proposed COVID-19-adapted plans for theirs solutions (acting also as lessons learnt for all FRs).

The sixth P-CoP was organized by Mekorot (28.01.21). This was in a webinar setting with the opportunity to explore new connections (business opportunities, exchange of experience, and collaboration of tool developers) and new project ideas for after the end of the STOP-IT

project. The webinar was open to all STOP-IT project members, but was primarily attended by the FRs and FLs. The P-CoP had the following goals:

- The primary goal of the P-CoP (webinar) was to present Mekorot cyber department activity and awareness to cyber threats and to present Mekorots' activities with tech start-ups

Mekorot provided four presentations on the topic of cyber-threats (infrastructure and sensors), water quality events, and new operational system.

As can be seen, the P-CoPs have developed over the four years of the project. While the first one was mainly set to up a framework for knowledge exchange, create common ground and shared expectations between all the parties involved, gradually the aim shifted towards knowledge exchange on the content of the project. First on risk management, but as the project tools and modules developed, the emphasis of the CoPs shifted towards preparation for demonstration, preparing the FRs and technology providers to test the tools, updates on the progress and experiences of the demonstration and even looking ahead to the continuation after the project has ended. The exchange of knowledge between the various participants remains an objective. Based on the feedback by the participants the goals set are realistic and have been met.

4.1.1 Participants'workshop evaluation and feedback

Similar to the L-CoPs, the P-CoPs were evaluated by the participants through the evaluation form and the updated evaluation form, measuring the main components of CoPs from the third year on.

The overall feedback on the first P-CoP meeting connecting FRs, FLs and WPs was very positive and the participating (and also other) partners from water utilities indicated interest in future meetings. This led to the provision of such a session within the annual project meetings in Barcelona (2018) and Athens (2019). The third one that was planned for Berlin turned online (2020) as did the following during the online PSB in 2020.

The P-CoP in Barcelona was viewed overall positive. The participants mentioned their intention to keep the communication with the other partners, and keep the momentum and understanding that was generated during the session going. In Athens, the participants were also positive about the P-CoP.

The participants of the P-CoPs specifically mentioned their appreciation of the opportunity to have face-to-face discussions, getting to know each other, having a collaborative and productive atmosphere and gain better understanding of the tools. The participants also expressed the need to bridge the gap between the worlds of water utilities and the research institutes/technology providers.

Less positive aspects were that the duration of the workshop day was too long, but the sessions were too short, there were too few technology providers present, overview of how

the tools interact was missing, and overall some questions were left unanswered in regard to the tools. Overall, the FLs should be more included. There were also some logistic issues as the lack of climate control and difficulty in finding one's way to the locations.

Some concrete suggestions for future P-CoPs were more precise announcements of the discussion topics, using the world café method for future P-CoPs, and organizing specific sessions around the tools for both FLs and FRs.

The P-CoPs in year three and four were held in an online format. Therefore, the results are presented separately. Similarly, to the online L-CoPs, the format was appreciated for being fast, productive, focused and the only option during the current situation. The meeting itself was valued for catching up on the project developments, providing a COVID-19 safe alternative, and for providing a clear plan. However, the lack of face-to-face interaction and having no possibility to have informal small talk led to less of a community feeling. During year four, WP 2 experimented with online engagement tools to make the meetings more interactive. WP 2 was not in charge of organizing these CoPs and only provided the options and guidance for using the online engagement tools. While initially the organizers seemed excited about using the tools, unfamiliarity and inexperience with the tools made them decide to not use the tools.

In one P-CoP a game-like approach was adopted for interacting with the FRs. (TORC game). The TORC game was played online and the debriefing was done through GroupMap, both interactive tools which fostered the online discussion. This CoP was co-organized by WP 2 and WP 8, which both had experience with these tools. The participants really appreciated the interactive set-up and indicated that they prefer to have more interactive online CoPs.

Suggestions for future CoPs would therefore be to hold the meetings as much as possible face-to-face. If there is a need to have virtual CoPs, interactive tools to keep the participants engaged such as Mentimeter, serious games, GroupMaps can be used, but the hosts need to be trained, willing to take the time to experiment with it, and supported.

4.2 Project CoP for Followers

In order to transfer the applicable outcomes of STOP-IT to the FL water utilities, the first P-CoP meeting targeting the FLs was held on day two and three of the PSB meeting in Athens (19.-20.06.2019). All FL water utilities were represented. This P-CoP had the following objectives:

- To train the FLs –according to the classification of Deliverable 8.1
- To check MS13 for the first round of training activities delivered
- Use the feedback to improve the training materials for profile 1

During the session, the presentation, training material and a video explaining the added value for the decision makers was presented. This gave the FLs the opportunity to provide

feedback on the materials and also to express their challenges and need for training material.

Based on the feedback the goals of the session seem to have been realistic and met.

During the fourth project year, a P-CoP to train the FLs using the TORC game was organized. The aim of the CoP was to:

- Train the FLs to use the TORC game.
- To reflect on CoPs using gamification elements.

The session allowed the participants to get familiar with the various STOP-IT tools, cyber physical threats and gave the FLs the opportunity to ask questions directly to the tool developers. During the workshop the participants reflected on the use of these gamification elements in CoPs.

4.2.1 Participants'workshop evaluation and feedback

Overall the participants evaluated the first P-CoP focusing on the FLs as positive.

Only the most interesting parts of the training session were mentioned:

- To get an overview and general information.
- To see the progress of the work that has been done by SINTEF and ICCS.
- To have a face to face meeting.
- The opportunity to talk to each other.

The only suggestion for improvement was to:

- Make an overview of the status of where the different FLs are in the process also in cooperation with the FRs.

The second P-CoP dedicated to the FLs was also perceived positively. The FLs appreciated the interactive form of getting to know the TORC game. They found it a fun and engaging method and felt that the participants were more actively involved than in "conventional" online CoPs with presentations with a question-and-answer part. Overall, they found it a very useful way to explore the STOP-IT tools and all indicated to prefer the future online CoPs to use engagement tools.

The less positive aspects mentioned were that the participants would have preferred to play the game on a day which was not filled with other project meetings before and they would have preferred to get clear instructions on how to play the game before the session. Similarly, to other online meetings, the participants prefer face-to-face meetings and social interactions.

5 Trans-project CoP activities and feedback

T-CoPs make the outer layer of CoPs in STOP-IT, and are associated with the lowest confidentiality level. They are designed to establish interaction with other international networks, initiatives/projects or research communities dealing with critical infrastructure, enabling knowledge exchange and methodological exchange. Additionally, they encourage dialogue for the pre-establishment of certification mechanisms by facilitating debate, expert elicitation and consultation across borders between different critical infrastructures (D2.1). The activity of the T-CoP has been led by STOP-IT coordinator Rita Ugarelli.

5.1 Trans-Project CoP activity, first year (May 2017-May2018)

During the first year, collaborations were established with relevant communities: the ICT4Water cluster (www.ict4water.eu/), the "Community of Users on Secure, Safe and Resilient Societies" (CoU, now CERIS) (www.securityresearch-cou.eu/about), the FP7 project SCOUT (www.scout-project.eu/) and the Net4Society (www.net4society.eu).

During the second year of the project, STOP-IT partners contributed to the physical and cyber-safety in critical water infrastructure workshop by the NATO science for peace and security program, and STOP-IT partners participated in the joint kick-off of the Digital Water projects (12-06-2019) by EASME. Furthermore, Rita Ugarelli became now formally engaged to collaborate with the European Reference Network for Critical Infrastructure Protection (ERNCIP) - Chemical and Biological Risks to drinking water group.

The ICT4water cluster aims at safe, sufficient, valued and "smart" water for EU citizens by stimulating the development of innovative water management products and services, based on Information and Communication technologies and enabling greater cooperation among researchers, industry, water regulators, operators and users across the EU. The cluster comprises 20 ongoing H2020 projects, including STOP-IT, and 13 concluded projects.

The collaborative activities established were:

- Contribution to the ICT4water newsletter by STOP-IT (WP9).
- Participation to the ICT4Water cluster events (e.g. the EIP Water conference in Porto in September 2017 and the combined events of ICT4Water cluster and the Water Europe working group on ICT and Water).
- STOP-IT was presented by Rita Ugarelli (SINTEF) within an ICT4Water dedicated session at the coming 13th International Conference on Hydro informatics (HIC 2018). (www.hic2018.org/) in June 2018. STOP-IT is member of the ICT4Water Cluster and actively involved in the implementation of their ACTION PLAN.
- Rafael Giménez (CET), Gustavo Gonzalez (ATOS), Rita Ugarelli (SINTEF), are the leaders of the action "Cybersecurity".
- Christos Makropoulos (KWR) is the leader of the action "Actor Awareness - Water & Digital".

- Andreas Hein, Fabian Vollmer and Achim Mälzer (IWW) presented STOP-IT at [BSI](#), Germany to connect the expert group for the water sector to the project. BSI is the German Federal Office for Information Security.
- Strong presence of STOP-IT partners at the ICT4Water annual event – June 2019 (SINTEF, KWR, CET, and EUT). At this event it was confirmed that STOP-IT is still the only project dealing with cybersecurity in the water sector. Ways to collaborate have been discussed.

The "Community of Users on Secure, Safe and Resilient Societies" (CoU) was launched in January 2014 and has since developed to become an efficient platform of exchanges among different actors of different branches of security and crisis management. The CoU thematic programme for 2018 had a dedicated theme on water safety and security (Theme 2).

Collaborative activities established are:

- On the 8th of March 2018, Rita Ugarelli (SINTEF) participated to the "Science to Science" round-table on Theme 2, to present the project on behalf of the STOP-IT consortium
- The CoU created an expert team on cybersecurity and Rita Ugarelli expressed the availability to join on behalf of the consortium. The expert team will also interact with NATO on selected topics.
- At the 7th of June 2018 Rita Ugarelli (SINTEF) attended the 11th CoU Theme 12 "Urban CIP", led by DG HOME with [ERNCIP](#). The event focused on urban critical infrastructures:
  - FP7 and H2020 Projects (see list below) for the "science to science" panel.
  - Involvement of policy DGs and MS in the "policy to policy" panel.
  - Bringing scientists, policy-makers and industry/SMEs together around crisis management at city level and CIP in the "policy to research & innovation" panel with involvement of stakeholders.
  - Involvement of practitioners in the "Interactions with practitioners" panel.
  - Projects of relevance to the theme: SMR, RESOLUTE, IMPACT, CARISMAND, CUIDAR, SMART-RESILIENCE, DARWIN, ATENA, DEFEND, STOP-IT, SAURON, GAMMA, SUCCESS

The SCOUT project was based on the use of multiple innovative and low impact technologies for the protection of space control ground stations and the satellite links against physical and cyber-attacks. STOP-IT was presented at the final workshop of SCOUT by Juan Caubet (EURECAT) the 15th of March 2018 within the AFCEA conference "Protection of critical infrastructures: the SCOUT workshop" devoted to the thematic topic of protection of critical infrastructure.

STOP-IT has also been invited to events organized by [ERNCIP](#) and to contribute to their activities. ERNCIP is an EC platform, which is formed by different Thematic Groups (TG). Aigües de Barcelona (AdB), FR of STOP-IT, is involved in one of those TG (Chemical and

Biological Risks to drinking water). Since M12, Rita Ugarelli is formally engaged to collaborate with the same TG.

5.2 Trans-project CoP activity, second year (May 2018- May 2019)

In October 2018, STOP-IT partners (ICCS, Bergen, Oslo, and SINTEF) contributed to the CYBERWATER 2018 Physical and Cyber Safety in Critical Water Infrastructure workshop organized by the NATO science for peace and security program. The workshop brought together experts from 12 NATO countries and 6 partner countries, envisaging to formulate "Best practices" based on recommendations and conclusions for policy and practices. An important result from the event was a call for papers for ASCE J. Environ. Eng. Special Collection "Physical and cyber safety in critical water infrastructure". Christos Makropoulos and Rita Ugarelli were involved as co-authors. At the PSB meeting in Athens the attendees were asked to also submit papers for the next issue.

Lastly, STOP-IT partners SINTEF, KWR, Eurecat participated in the joint kick-off of the digital water projects on 12.06.2019, which was organized by EASME. This resulted in establishing valuable connections with the newest H2020 projects in digital water.

5.3 Trans project CoP activity, third year (May 2019 – May 2020)

During the third year of STOP-IT, the trans-project activities built upon the connections established in the previous years:

ICT4Water Cluster: the ICT4Water Action Plan 2018-2030 (https://www.ict4water.eu/wp-content/uploads/2019/04/ict4wateractionplan2018.pdf), focuses on implementation of actions related to interoperability and standardization, data sharing, smart water, cybersecurity, actors' awareness, policy and business models. For each of these actions an expert team has been created. STOP-IT partners (CET, ATOS and SINTEF) are co-leading the action group on cybersecurity. As such, STOP-IT is actively involved in the ICT4Water initiatives, with monthly meetings, contributing to the Connected Digital Single Market and the Resilient Energy Union objectives by promoting energy efficient and safe smart ICT technologies in the water sector. The action group includes only two H2020 projects: STOP-IT and aqua3S. The actions under development are to strengthen the collaboration with the European Cybersecurity Organisation (ECSO) to examine the possibility of some joint dissemination actions, and the preparation of a whitepaper on cybersecurity in the water industry.

CoU - INFRA Scoping Group: participation to the DG HOME Unit B4 'Innovation and Industry for Security' annual event including thematic panels of the CoU - for Secure, Safe and resilient Societies (17th September 2019). Rita Ugarelli presented the STOP-IT project. This format was a key source of exchange and discussion with the Commission to define future security research priorities and to facilitate contacts between H2020 projects and policy makers. More information on the CoU can be found here: https://www.securityresearch-cou.eu/.

An immediate outcome of this experience was to include STOP-IT in the https://www.cyberwatching.eu/. The Cyberwatching.eu project uses a number of underpinning information sources to visualize the state of the art of projects as a means to maintain oversight of the larger European Cybersecurity research landscape. The radar maps projects by research themes. Improved color-coding makes it possible to understand the project lifecycle status and Market and Technology Readiness Levels, as well as evaluate performance compared to other projects in the same sector. Further details such as start/end date, the budget, funding call, funding scheme are also included.

CoU - INFRA Scoping Group: The participation at the CoU eventfurther resulted in the establishment of the European Cluster for Securing Critical Infrastructures (ECSCI - https://www.finsec-project.eu/#comp-k38hag4h), including the following projects:

- FINSEC (https://www.finsec-project.eu)
- ANASTACIA (http://www.anastacia-h2020.eu/)
- DEFENDER (https://defender-project.eu/)
- InfraStress (https://www.infrastress.eu/)
- RESISTO (http://www.resistoproject.eu/)
- SAFECARE (https://www.safecare-project.eu/)
- SATIE (http://satie-h2020.eu)
- SecureGas (https://www.securegas-project.eu/)
- SPHINX (https://sphinx-project.eu/)
- STOP-IT (https://stop-it-project.eu/)

The cluster organized an international workshop on Cyber-Physical Security for Critical Infrastructures Protection (CPS4CIP) 2020 in conjunction with ESORICS (https://www.surrey.ac.uk/esorics-2020). Rita Ugarelli (SINTEF) and Christos Makropoulos (KWR) contributed as Project Committee Chairs, and proceedings are available at https://www.springer.com/gp/book/9783030697808 -

Collaboration with the cluster of projects funded under the H2020 digital water call 2018: through the dialogue established with the five projects aqua3S, Digital Water Cities, Fiware4Water, SCORE and NAIADES, Rita Ugarelli has proposed to make available results of STOP-IT, which are public and which could help the "younger" projects to build from our results. This resulted in the decision to connect STOP-IT colleagues (of EURECAT) to contribute to the working group about risk management ontology within the task force "FIWARE and ontology". A possible evolution of the dialogue will be to create a new working group related to FIWARE in the ICT4Water cluster, as platform to exchange between projects on a bigger scale.

Additionally, during the third year of project, Rita Ugarelli co-organized an International Water Association (IWA) webinar (https://iwa-network.org/learn/managing-risks-from-digitalisation-in-the-water-sector/ on "Managing Risks From Digitalisation In The Water Sector", on 1 April 2020, where Rita and Christos Makropoulos (KWR) also contributed as panellists.

Lastly, STOP-IT is connected to the IMG-S. The IMG-S is an informal and European-wide network of experts in the security domain, connecting academia (UNIV and RTO), industry (SMEs and large) and end-users.

At M37 of the project, the trans-project activities continue making STOP-IT visible in the most relevant networks/communities at EU level related to safety, security and CIP. The T-CoP activities in the first two years have laid the groundwork for the T-CoP activities in the third year. STOP-IT is presented at various events on cybersecurity which made it possible to establish the European Cluster for Securing Critical Infrastructures (ECSCI) through which several EU project on cybersecurity for critical infrastructures are connected and several workshops are planned. Therefore, it can be concluded that during the course of the project, STOP-IT has become more visible and has increasingly contributed to relevant network/communities at the EU-level.

5.4 Trans- project CoP activity, fourth year (May 2020 – June 2021)

During the fourth year of STOP-IT, the trans-project activities built upon the connections established in the previous years:

Cluster Annual Event (16-18 June 2020): During the ICT4Water Cluster annual event a dedicated session was organized by STOP-IT with the following contributions:

- Cybersecurity importance in the water sector and the contribution of the STOP-IT project (Rita Ugarelli, SINTEF)
- Physical and Cybersecurity integration and modelling at strategic and tactical level (Christos Makropoulos, NTUA, KWR)
- Cyber-physical solutions for real-time detection at operational level (Gustavo Gonzalez-Granadillo, ATOS)
- How can STOP-IT contribute to the EU cybersecurity strategy? (Discussion chaired by Rita Ugarelli)

The Cybersecurity action group, led by STOP-IT, announced a white paper on "Improving cybersecurity in the water sector", which is under preparation in collaboration with the Aqua3S and NAIADES projects. Authors from STOP-IT will be Rafael Gimenez Esteban (CETAQUA) and Rita Ugarelli (SINTEF).

STOP-IT has contributed to the ICT4Water paper "The need for digital water in a green Europe – EU H2020 projects' contribution to the implementation and strengthening of EU environmental policy".

ECSI workshop 2020 (24-25 June 2020): The event was co-organized by Rita Ugarelli, and had the objective to create synergies and foster emerging disruptive solutions to security issues. Besides presentations of the projects results also including discussion sessions aiming at identifying cross collaborations on how to protect critical infrastructures and services, highlighting different approaches and establishing tight and productive connections

with closely related and complementary H2020 projects. Attendants included policy makers, industry and academic, practitioners, and representatives from the EC.

STOP-IT contributed with the following three presentations:

- STOP-IT: Protection of critical water infrastructures by Rita Ugarelli (SINTEF)
- Applied to WATER critical infrastructure by Christos Makropoulos (ICCS/NTUA, Greece)
- Applying Machine Learning algorithms to build anomaly-based cyber and physical detection systems - Juan Caubet (EURECAT)

The presentations can be found at: https://www.finsec-project.eu/ecsci-presentations

As follow up of the workshop, an Open Access Book focusing on cross-sectoral and multi-risk approaches in different critical infrastructure sectors was initiated, where STOP-IT contributed with four chapters:

- Chapter 6. Cybersecurity importance in the water sector and the contribution of the STOP-IT project - Authors: Rita Ugarelli
- Chapter 7. Cyber-Physical security for critical water infrastructures at strategic and tactical level - Authors: Dionysios Nikolopoulos, Georgios Moraitis and Christos Makropoulos
- Chapter 8. Cyber-physical solutions for real-time detection at operational level - Authors: Gustavo Gonzalez-Granadillo, Rodrigo Diaz, Theodora Karali, Juan Caubet and Ignasi Garcia-Milà
- Chapter 9. Applying Machine Learning and Deep Learning algorithms for Anomaly Detection in Critical Water Infrastructures- Authors: Víctor Jimenez, Juan Caubet, Mario Reyes, Nikolaos Bakalos, Nikolaos Doulamis, Anastasios Doulamis and Matthaios Bimpas

The Open Access Book should be published in July 2021.

The 1st International Workshop on Cyber-Physical Security for Critical Infrastructures Protection (organized by ECSI, 18 September 2020): Participation and follow-up with a special issue of the Journal of Cybersecurity and Privacy entitled "*Cyber-Physical Security for Critical Infrastructures*". Rita Ugarelli (SINTEF) has acted as Programme Committee Chair, while Christos Makropoulos (KWR) and Gustavo Gonzalez-Granadillo (ATOS) contributed as members of the Programme Committee.

Four papers from STOP-IT have been submitted, but only one was accepted: Fusing RGB and Thermal Imagery with Channel State Information for Abnormal Activity Detection using Multimodal Bidirectional LSTM. Authors: Nikolaos Bakalos, Athanasios Voulodimos, Nikolaos Doulamis, Anastasios Doulamis, Kassiani Papasotiriou and Matthaios Bimpas. Abstract video link: https://youtu.be/iSN3Y92ZTh0

BTO webinar 'What threatens your water infrastructure? A BTO Webinar on the EU STOP-IT project' (7 October 2020): A webinar to present the STOP-IT project to the Dutch and

Flemish drinking water utilities hosted by KWR. The presenters of this webinar discussed the results of the project, and how these could be applicable in the Dutch water sector, learning about specific physical and cyber threats and how to prevent them by using the tools and technology outputs from the project. Further, the webinar had the objective to receive input from the Dutch water utilities on how they might use or collaborate on this topic or project. Presenters: Christos Makropoulos (KWR) and Harald Rishovd. Moderators and organisers: Lisa Andrews (KWR), Rita Ugarelli (SINTEF) and Dimitrios Bouziotas (KWR). The target audience was the BTO programme of Dutch and Flemish water utilities. 33 participants attended. For more information and a recording of the event please refer to: https://www.kwrwater.nl/en/actueel/focus-on-eu-projects-in-webinar-series-for-dutch-water-utilities/

Joint Research Center Workshop on Cybersecurity (9 December 2020): STOP-IT partners collaborated with the JRC ERNCIP Chemical and Biological Risks to drinking water group by taking part in the webinar series on 'water security'. STOP-IT was represented by Rita Ugarelli (SINTEF, chair of webinar), Christos Makropoulos (NTUA/KWR), Gustavo Gonzales-Granadillo (ATOS), Juan Caubet (EURECAT), and Dora Karali (RISA) with following presentations:

- Rita Ugarelli (Chair): Cybersecurity importance in the water sector and the contribution of STOP-IT project
- Christos Makropoulous (NTUA/KWR): Physical and Cybersecurity integration and modelling at strategic and tactical level
- Gustavo Gonzalez-Granadillo (ATOS): Cyber-physical solutions for real-time detection at operational level
- Juan Caubet (EURECAT): Applying machine learning algorithms to build anomaly-based cyber physical detection systems
- Dora Karali (RISA): Empowering informed decision making with an overarching solution for the security of water critical infrastructures.

The webinar aimed to identify the water infrastructure cybersecurity gaps and needs. It was designed for utility managers, researchers, policy experts and operational level and attended by about 150 participants. As a follow-up, the following paper has been prepared: Batlle Ribas M., Bernard T., Brill E., Coelho M. R., Coimbra M. F., Deuerlein J. W., Gattinesi P., Hohenblum P., Pieronne P., Raich J., Simas L., Teixeira R., Ugarelli R., Weingartner A., Cardarilli M., Giannopoulos G., (2021). Water Security Plan - Towards a more resilient drinking water infrastructure. In press (*soon accessible at https://erncip-project.jrc.ec.europa.eu/*).

CERIS - DRS – Multi-hazards disaster risk management, including cascading effect (05 May 2021): CERIS (Community of European Research and Innovation for Security) is the new name for the Community of Users (CoU), and Rita Ugarelli presented on STOP-IT, alongside presentations from selected other H2020 projects. The key findings, recommendations, and perspectives discussed during the event will be reported and combined with those resulting from other CERIS-DRS events organized in the first semester 2021, into background materials for the DRS Synthesis & Info Day planned on the 14th of June 2021 and the "Annual

State-of-the-Art and Emerging Trends" report that will be released by CERIS at the end of year 2021.

Establishing a Water ISAC grounded on STOP-IT (11 May 2021): Rita Ugarelli (SINTEF) received an invitation from the [Empowering EU ISACs](#) project, [ENISA](#), EU Commission, to create a water ISAC from STOP-IT. A water ISAC is a community of practice around the topic of cyber protection with focus on the European water sector, supported by an external dedicated team (the Empowering EU ISACs project, represented by the colleagues of CAPGEMINI), and involving more, project-external water utilities. The meeting was to scope the interest for an ISAC initiative to be organized. The target group was interested organizations in the European Water sector, and with respect to STOP-IT, STOP-IT water utilities and colleagues within water utilities.

The attending water operators expressed high interest in the establishment of an EU Water ISAC. According to ENISA much of the work performed in STOP-IT, which was presented by Rita Ugarelli, is highly valuable for the ISAC. STOP-IT could contribute with the expertise of its partners in awareness creation in the sector towards cybersecurity, and competence creation thanks to the extensive training material already created. From the STOP-IT point of view, the Water ISAC is also an opportunity to further make visible the results produced (technological and not) through the information-sharing platform made available by the Empowering EU ISACs project. Ongoing interactions between STOP-IT and the organizers of the event aims at clarifying the governance structure of a potential Water ISAC, as well as the alternative options to formalize the cooperation within an ISAC and to ensure long-lasting collaboration.

[CERIS Scenario-based innovation workshop](#) June 29th: Enhancing Infrastructure Resilience against Hybrid Threats 29 June 2021. The Infra-Scoping group, under the Coordination of DG-HOME, has organized a scenario-based innovation workshop with focus on hybrid threats. Rita Ugarelli is the representative of STOP-IT in the Scoping group. The workshop included scenario-based discussions in three breakout groups: Breakout Group 1: Water, Breakout Group 2: Finance, Breakout Group 3: Communication. STOP-IT, besides being responsible for organizing the breakout group 1 session, made a new version of the digital TORC developed ad hoc for the event available for all the three sessions. During the session, the Players have been engaged in exploring and deciding on strategies and resources to be adopted under unexpected situations related to a complex scenario of attack developed by the [EU-HYBNET project](#). Major contribution in developing the new version of TORC and in organizing the event has been provided by SINTEF. The original STOP-IT version of TORC is described in D4.4.

STOP-IT_N initiative, with SINTEF, Bergen, Powel (now: Volue), Devoteam and Norwegian Water: The STOP-IT_N imitative is a project funded by the Norwegian Research Council with the goal of extending the impact of STOP-IT in Norway, The following activities were performed:

- training activities on the use of RAET for PhD students and water operators

- 1 paper under review (submitted to the Norwegian Journal VANN)
- 1 workshop organized by Norwegian Water last fall
- 1 workshop, including the use of TORC; will take place in October 2021

IWW- Kolloquium on the new drinking water directive (webinar) on June second and June 15 2021: These webinars centered on the new drinking water Directive and was attended by a diverse group of stakeholders. The webinar was used as a platform to inform the German water sector about the STOP-IT project and its results.

Summarizing the feedback and indicators provided by both CoP participants and facilitators creates a basis for improvement of the future operation and knowledge gathering/sharing within the CoPs. The following subchapters are primarily directed towards local and P-CoPs. For T-CoPs there are currently no particular recommendations for improvement, as most activities are developing on longer time frames and in connection to other projects and initiatives.

6.1 Lessons learned in year one

The CoP guidelines were designed to support facilitators and managers in the setting up, starting and managing the activities carried out in the workshops. These guidelines were not set up as prescriptive, and each CoP had flexibility in how to carry out the initial activities. In the guidelines, it was suggested that the first CoP workshop should start with an introduction to the CoP concept, leading the participants through the different aspects that the activities will cover. For some of the CoPs it was found that introducing and discussing the different CoP aspects gradually, in relation to the specific tasks required, was more efficient.

In the guidelines the importance of the roles of facilitators of the CoPs were clearly recognized: "The CoP facilitator is designated from the related research institute and supports the CoP manager. The facilitator should be an 'independent expert', who is given the authority to lead, to impose clear rules and roles, and who can generate an environment of trust." In practice, this aspect was proven, as the facilitator has the important role to keep FR utilities engaged, to collect their needs for corresponding tasks and project activities and vice versa.

Sets of questionnaires, materials, and templates, as well references to the CoP guidelines, were provided to the CoP facilitators prior to the workshops being organized. To this point, the facilitators reported that it would have been excessive to use all questionnaires, templates and recommendations exactly as provided. In practice, the facilitators have tailored the approach to their respective contexts and only used the materials perceived as needed in the workshops.

The CoP activities in the first project year were focused on (1) setting up the CoPs and (2) providing information required for WP3 of STOP-IT – namely, the identification of risks for the FR utility systems. FRs were mostly asked to provide information, but it was envisaged that as the CoPs advanced and coalesced by attracting more members, STOP-IT would also have need to focus on showing the benefits in terms of "what is in it for us" to the members.

The distinction between local and P-CoPs is blurry in practice; however, this is not perceived as a problem. Instead, while allowing for flexibility for the organic development of project CoPs, efforts are made to be inclusive in the approach, especially for the STOP-IT utilities.

During the first year the lessons learned led to the formulation of the list of recommendations below. The recommendations provide actionable information, mostly dedicated to the WP 2

team, while facilitators and managers should be informed about the actions taken by the WP 2 team on the basis of the following recommendations.

1. Efforts should be made to balance the gender representation in the workshops;
2. The CoP guidelines may be more appropriate for formal meeting formats. They should be considered and applied for the annual meeting, when a dedicated session for utilities is programmed as a P-CoP;
3. Material and information should be provided earlier by WPs or task leaders responsible for the workshop (i.e., info material, graphics, suggested moderation techniques etc.), graphics are already prepared to clarify the STOP-IT project and approach to participants;
4. Dates for CoP events/meetings should ideally be set 6-12 months in advance in a calendar of activities;
5. Ensure that attention is given to the goals, values and social learning between stakeholders;
6. Ensure and enhance experience sharing between the L-CoPs, as well as with project and T-CoPs;
7. Involving more/external stakeholders is relevant for experience sharing, user requirements, technology development, testing experiences, and the building of contact networks;
8. Focus on experience sharing in the coming project year and, to the extent possible, expand beyond the local situation and connect FRs;
9. Try keep the meetings lively by avoiding long lectures and the filling of Excel files/questionnaires during meetings. These activities should be carried out before or after the actual meeting, while the meeting should be reserved for discussing results and summaries of these activities;
10. Try placing more emphasis on what the input/feedback will be used for to show what the next steps will be (envisaged characteristics of RIDB, capabilities of the solutions, etc.), provide some visions, knowledge that will be inspiring and show the participants 'what's in this for me';
11. Explore the provision of a toolbox of moderation techniques (in case there is no suggestion from the WPs or task leaders who are responsible for workshops content). This could be for instance a short presentation showing 3-5 useful moderation techniques, such as world café, visioning etc., which could support discussions and engagement;
12. Implement a more illustrative overview of outcomes and storylines, identifying the stage of the project in relation to project activities, what results are envisaged to be obtained through the information requested, what are the future steps to be taken.

6.2 Lessons adopted in year two

Of the twelve recommendations mentioned above, four points were implemented in the second year. The first recommendation, organising a P-CoP at the annual meeting, was followed. Moreover, the preferred working method mentioned in the participants evaluation,

the world café method, has been used. The second implemented recommendation is the provision of materials and information earlier. The agenda and instructions for CoP preparations have since been sent to the participants a few weeks in advance. The third implementation refers to more information sharing between L-CoPs. Based on this recommendation a "living document" was created where the main results of the L-CoPs have been published continuously. This living document can only be accessed by project partners and has the goal to make knowledge exchange between the FRs easier. The fourth recommendation implemented was the toolbox of moderation techniques, which was developed by WP 2 during the second project year and contains eight moderation techniques. The techniques are clustered, based on the situation in which they are suitable, and explained to the extent that hosts should be able to adopt these techniques by reading the toolbox. The toolbox has been shared on the Innovation Platform (the internal platform of the STOP-IT project), and is thus accessible by all project partners.

Other recommendations refer to more ongoing processes which should be paid attention to during the entire duration of the project. This holds true for the suggestion to make efforts to balance the gender representation in workshops. For the formal L-CoPs in year two (Berlin and Israel) it is possible to provide a percentage for the amount of women present. For the L-CoP in Mekorot (Israel), this was 22.2% and for BWB (Germany) it was 31.6%. For the P-CoPs the overall percentage of women present was 33.3%. Ideally this percentage would be close to 50% and to achieve this remains an ongoing process, which should communicated to the water utilities as WP 2 has only limited influence in this.

The suggestions to ensure that attention is given to the goals, values and social learning between stakeholders and trying to keep meetings lively by avoiding long lectures and filling in Excel files are also points that should be kept in mind continuously. While the CoPs during the second year allowed for a sufficient amount of discussion, some participants still found the presentations too long. Therefore, this remains an ongoing process.

The same can be said for the next two suggestions: involving more external stakeholders for experience sharing and building contact networks. This remains an open issue, but requires a good balance with the confidentiality requirements of the L-CoPs, which have the highest level of confidentiality. This makes it a challenge to involve more external stakeholders. While the second year of the project brought more P-CoPs and T-CoPs activities, and BSI expressed their wish to participate in a L-CoP, there was still the need to focus needs on building networks and sharing experiences with a broader range of stakeholders.

Finally, some recommendations were not solely meant for WP 2 and collaboration with other WP's are necessary. As seen below, some of these were implemented during the following years.

6.3 Lessons learned in year two

The work of WP 2 in the second year of the project mainly consisted of implementing the recommendations made in the previous year and supporting new local and P-CoP

workshops. Based on the observation and evaluation of these workshops, lessons can be learned.

One of the positive aspects of the P-CoP session in Barcelona was that participants were very positive about the concept and motivated to continue with the CoPs in the following year. In practice however, little initiative was taken. Two formal L-CoPs were held and the other companies organized several separate workshops. It is the responsibility of the FRs to organize L-CoPs as is written in D2.1: "The meeting topics will be decided by the CoP managers in collaboration with WP or task leaders and *support from WP 2* as part of the preparatory work for the meetings." WP 2 could also more proactively offer their support, however WP 2 is dependent on FRs to communicate this with WP 2. One example of this more proactive support could be to make an annual schedule to indicate periods where FRs should organise CoPs. This would require closer contact with the FRs as they decide on meeting topics.

During the first year several forms such as the evaluation form and templates for minutes and workshop were designed by WP 2 and made available on the Innovation Platform. D2.1 states that at each CoP a person should be appointed to take the minutes and write workshop reports as these minutes and reports are crucial for other work packages within the STOP-IT project. However, an evaluation and a written report was only delivered for those CoPs with the presence of a WP 2 member. Therefore, it can be concluded that it is not enough just to make these forms available, but WP 2 should actively promote these forms and stress their importance to the CoP manager. Again, this requires input and information of the FRs in regard to organizing L-CoPs.

Most of the feedback received from the workshop during the second year related to practical issues, such as the location of the venue, the directions to the venue, dietary needs, and working climate control systems. The CoPs seemed to function well in bringing various stakeholders together and as a platform to exchange explicit and tacit knowledge.

The recommendations list from year one, combined with the lessons learned in year two, results in the following list of recommendations for future workshops:

1. Keep making efforts to balance the gender representation in the workshops;
2. Set up CoP events/meetings schedule 6-12 months in advance in a calendar of activities;
3. Keep ensuring that attention is given to the goals, values and social learning between stakeholders;
4. Keep involving more/external stakeholders for experience sharing, user requirements, technology development, testing experiences, and the building of contact networks;
5. Keep trying to maintain the meetings lively by avoiding long lectures;
6. Try to create a better connection with the other WPs that develop tools to implement the suggestions made in the previous year, such as presenting a graphic overview of their progress and next steps during the CoPs;

7. Actively offer the evaluation, minutes and workshop report template and stress the importance for the monitoring of CoPs to the workshop hosts, alternatively be present at the workshops;
8. Provide a checklist with practicalities for organizing a CoP to the FRs;
9. Design KPI's for CoPs;
10. Design a new evaluation form based on the new KPI's.

6.4 Lessons adopted in year three

Most of the recommendations from year two were addressed in the third year of the project. Starting with the effort to balance the gender representation in the workshops, the workshop report now monitors the gender balance per CoP. There have been two CoPs with a gender balance with both 50% men and women. Unfortunately, the gender balance of the L-CoPs in general is 67% male and 33% female. Gender balance remains a point of attention for the final year of the project, it should also be recognized that the water sector in general is gender imbalanced (World Bank, 2019).

During the third year, WP 2 offered support more actively and kept reminding the FRs to organise L-CoPs. This resulted in an increase of L-CoPs and better documentation of their activities in the third year. In this phase, WP 2 also got more closely connected to other work packages such as WP 8 for organising P-CoPs for the FLs.

The update of the evaluation form for the CoPs addressed several recommendations. First, it was designed to measure KPI 8. Second, updating the evaluation form itself was a recommendation from last year. Lastly, the new evaluation approach focusses on social learning in CoPs, a topic for which more attention was recommended.

During the third year, the CoPs also became livelier, with less long lectures. The received feedback does not mention the lack of interaction or long presentations.

What was not adopted from the recommendation of year two is a yearly planning of the CoPs. This was recommended because of the small number of L-CoP workshops in the previous year. However, in the third year, the number of L-CoPs increased. Therefore the approach to organise CoPs on need base, seemed sufficient. In relation to that, during the online L-CoPs the FRs and technology providers already planned for the remaining activities for the last phase of the project.

Lastly, the involvement of external stakeholders remained an issue. While some CoPs have included parties such as Water Europe, Kraft Cern, Norsk Vann, and the Norwegian University of Science and technology (NTNU), this involvement remained limited.

6.5 Lessons learned in year three

During year three of the project, WP 2 focused on the continuous improvement of the CoPs in STOP-IT.

Most issues from year two were addressed, however the gender balance and involvement of external stakeholders in the CoP remains an issue. The feedback during year three suggests that some progress was been made. As WP 2 role is to simply supporting the organisation of CoPs, its influence is limited. However, when reminding partners to organize CoPs, WP 2 could also stress the importance of striving for gender balance, and concerning the inclusion of external stakeholders, WP 2 could offer the FRs to jointly design a plan to involve more external stakeholders.

Based on the evaluation of the P-CoPs and L-CoPs on their dimensions and social learning outcomes, the CoPs seemed to be functioning quite well.

Still, while the CoPs scored quite well on the three dimensions of a) community and relational outcomes, b) domain and shared understanding, and c) practice and substantive outcomes, there is room for improvement. Therefore, it may be worthwhile to look into detail at the specific indicators, combined with the received written feedback, to see what can be improved. The scores of the indicators presented on the vertical axis is the average score on the Likert scale from 1-5.
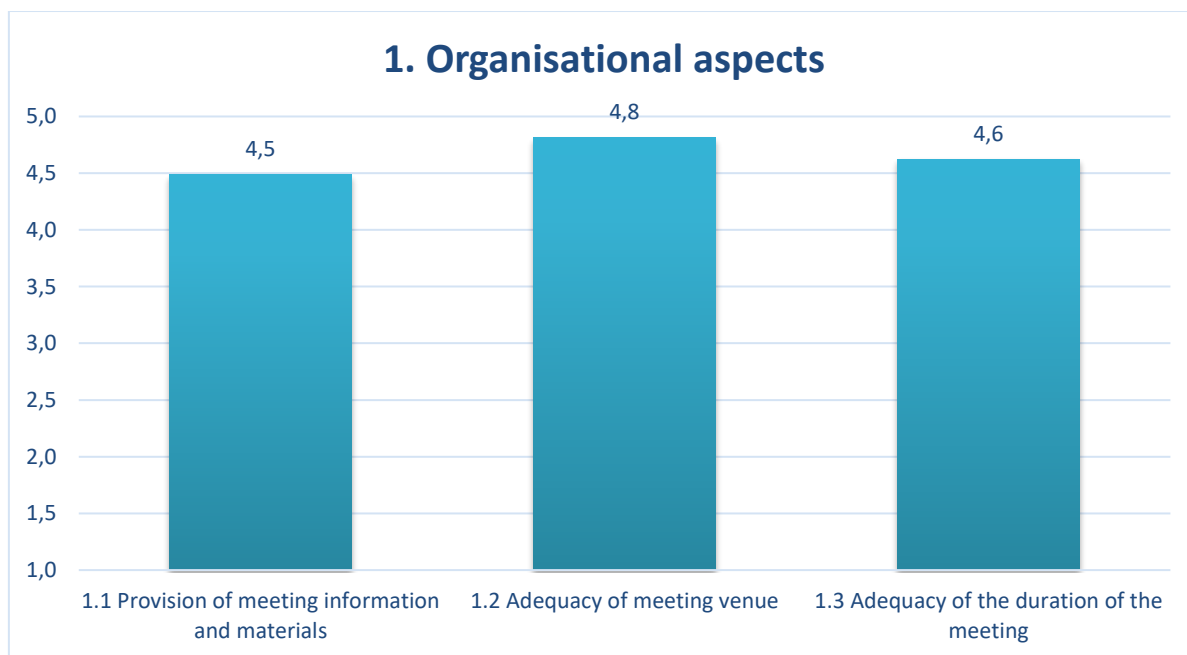

1. Organisational aspects

Figure 7 Organizational aspects of CoPs (N=34)

Figure 7 shows that the participants were content with the venues of the meetings (all scores above 4,5), but found an improvement potential when it comes to the provision of meeting information and materials. This is in line with the written feedback. The duration of the meeting also scored well. However, from the written feedback it seems that some workshops still were too long or too short, and therefore should remain a point of attention.
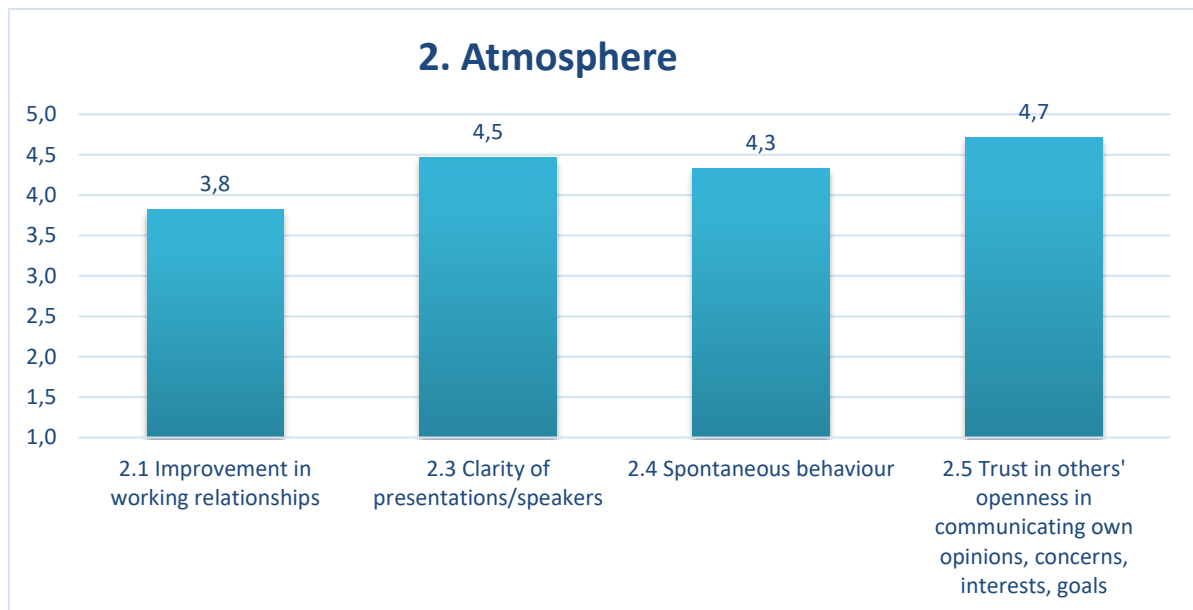
2. Atmosphere

Figure 8 Atmosphere during the CoPs (N=34)

In general, the participants were satisfied with the atmosphere during the CoPs (lowest category score 3,8; highest category score 4,7). The participants were communicating openly and the presentations and speakers were clear. The working relationships could be further improved. This could be done, as suggested, by including more technology providers in the CoPs and have the technology providers work closely together with the FRs to prepare the testing of the tools. The "lower" score on spontaneous behaviour could be caused by the switch to online CoPs. The written feedback showed that the online meetings did not allow for small talk and informal discussions which usually lead to new creative ideas and better connection between the participants. Therefore, it is advised to have as much of the CoP activity as possible face-to-face.

3. Stakeholder inclusion and representation
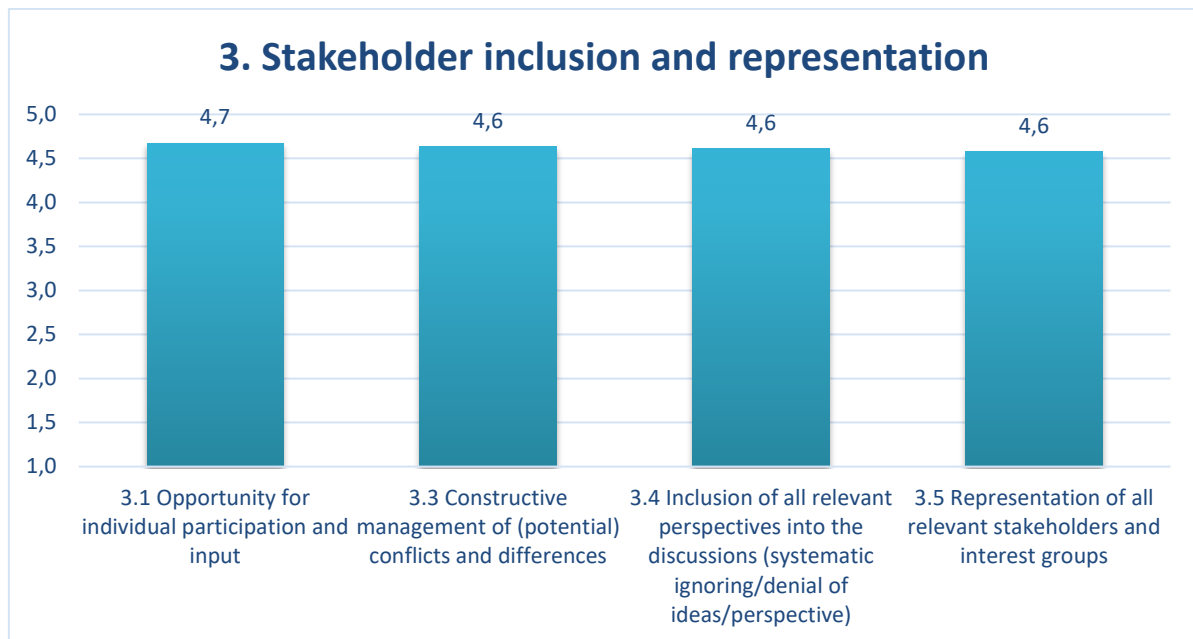
Figure 9 Stakeholder inclusion and representation (N=34)

Figure 9 shows that the participants were confident that the relevant stakeholders were included in the CoPs (all scores 4,6 or higher). The score could be improved by inviting more tool developers to the CoPs, and perhaps also external stakeholders. The figure also shows that there is enough opportunity for everyone to participate, differences are solved in a constructive manner, and all ideas are welcome. This shows that the CoPs are inclusive in terms of perspectives and participants, and constructive.
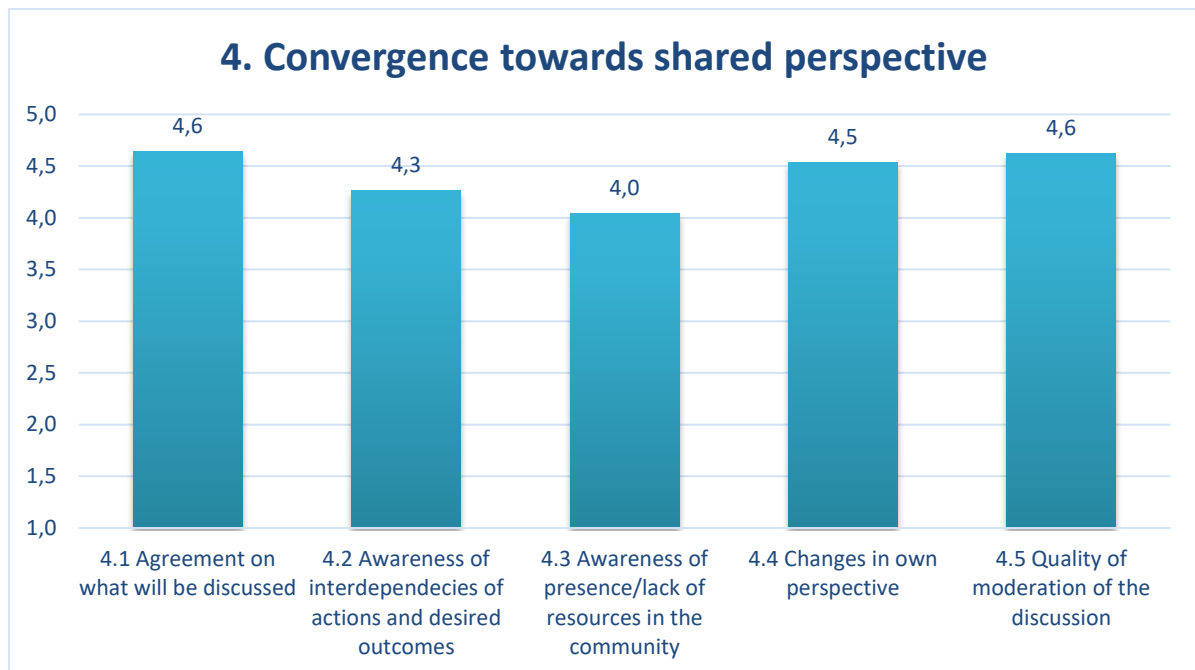
Figure 10 Stakeholder inclusion and representation (N=34)

Figure 10 shows that the CoPs were working quite well in the convergence towards a shared perspective (all scores above 4,0). Awareness of the presence and lack of resources to tackle cyber-physical security issues could be improved as well as the awareness of interdependencies. For future CoPs it could be a good idea that while preparing for testing the tools that a small stakeholder analysis could be made (e.g. who do you need for this?). The same could be done for the actual resources. Starting at the desired outcome and back-casting until present time could be a forward. A first attempt of this has already been made in the online CoP sessions.

5. Identification opportunities and challenges

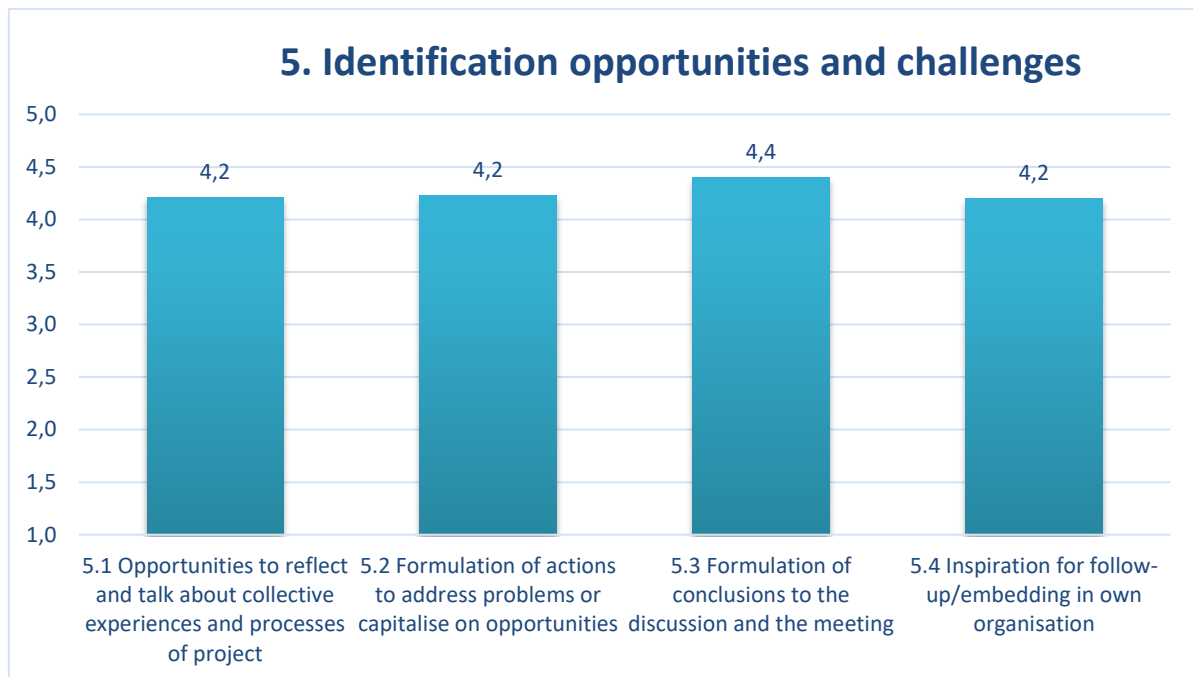Figure 11 identification of opportunities and challenges (N=34)

Figure 11 shows that the identification of opportunities and challenges went quite well (score of 4,2 or higher). Yet, there could be more focus in the CoPs on concrete actions and follow-ups. This goes well together with the back-casting approach. At the end of the CoPs, there should be time reserved for formulating conclusions and follow-up steps.
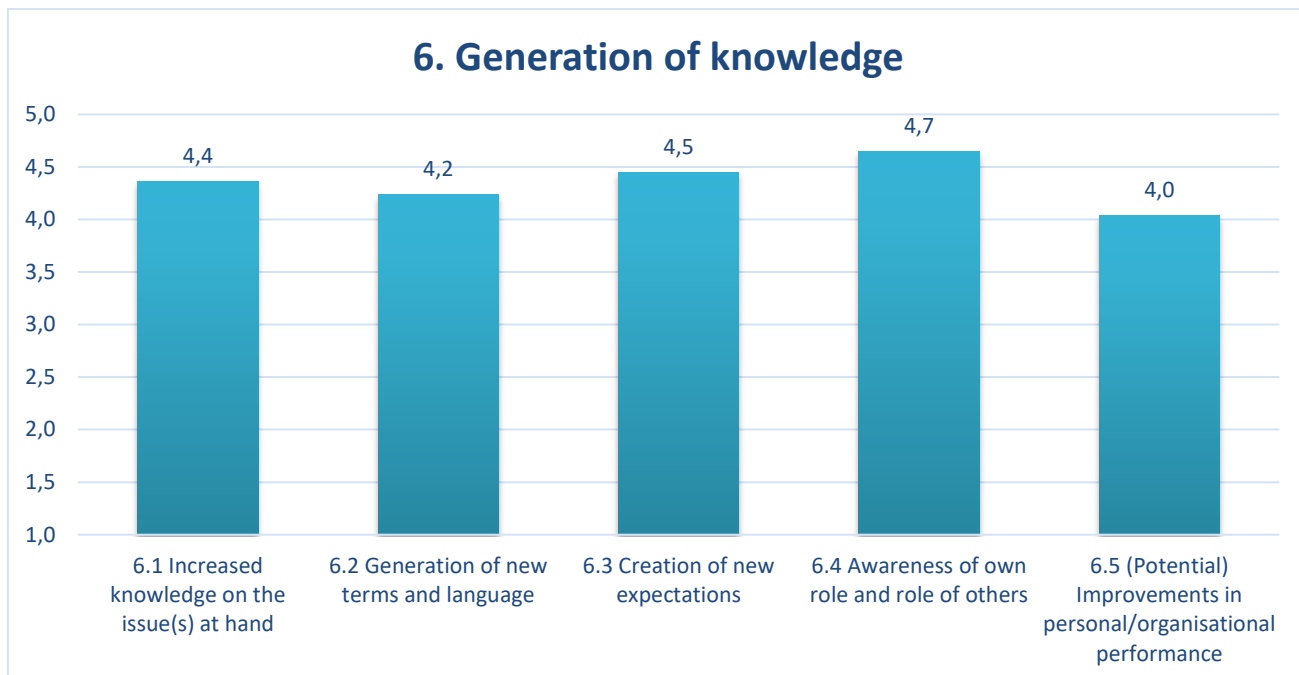
6. Generation of knowledge

Figure 12 Generation of knowledge (N=34)

The generation of knowledge through the CoPs was rated as sufficient (scores of 4,0 and above, figure 12). The identification of potential improvements for the participants' organisation could be improved. This coincides with the formulation of conclusions and follow-up steps. As a form of moderation, the participants could be asked to formulate take-home messages for their organisations. Better understanding of new terms and language used by others outside the participants' own organisation and WPs could be improved through more interaction with different stakeholders. However, being in year three of the project this "lower" score could also be explained by the fact that the participants already knew each other and their terminology quite well.

The recommendations for the last year of the project focused on maximizing the impact of the CoPs and included the following points:

- Remind FRs actively to keep the gender balance of CoPs in mind;
- Offer FRs the opportunity to design a plan to involve more external stakeholders;
- Include more tool developers in the CoPs;
- Organize the CoPs face-to-face as much as possible;
- If the CoPs have to be online, experiment with interactive tools such as Mentimeter, Mural, etc.;
- WP 2 could provide a tips and tricks sheet for the FRs including:
  - When to send out preparatory documentation;
  - Topics that the participators of previous CoPs mentioned for future CoPs;

- o Suggestions for interactive tools;
- o Asking the participants to formulate take home messages;
- o Reminding the front runners to schedule time to formulate conclusions and follow-up steps.
- Making a detailed plan from now on until the end of the program through a back-casting method in combination with a small stakeholder analysis;
- Having live demonstrations of the tools (suggestion for WP7).

6.6 Lessons adopted year four

The last year of the project has been different than the previous years, mainly due to the COVID-19 pandemic. This has also influenced WP 2 work as delays in the project resulted in delayed CoPs. Moreover, the CoPs remained in an online format. WP 2's work mainly focused on supporting these online CoPs and implementing the recommendations from the previous years. Most recommendations have had follow-up, but not all were implemented.

Due to the circumstances, not all recommendation could be implemented such as the face-to-face meetings. However, WP 2 has taken this opportunity to experiment with online tools in CoPs such as Mentimeter and Mural. In collaboration with other H2020 projects, Ultimate, B-WaterSmart, and Water mining, WP 2 members have built on the experience from CoPs in STOP-IT and other projects to design a guidance to set-up and run CoPs, which will be included in D2.3, tailored to the STOP-IT project. This guidance includes a check-list for CoP facilitators, and an overview of online engagement tools. While the checklist as such was developed slightly too late to be used in the L-CoPs and P-CoPs, the list of engagement tools has been used in STOP-IT by WP 2 to select suitable tools to use in the STOP-IT CoPs.

Gender balance has remained an issue in the fourth year of the project. The balance for the L-CoPs is 29.3 % women and 70.7% men and for the P-CoPs it is 23.3% women and 76.7% men. During the course of the project, this gender imbalance seemed difficult to change as people have already taken up their roles in the project. It is recommended for future CoPs that gender balance is a point of attention during the selection of the CoP members.

The FRs have been reminded by email of the need to organize CoPs, to include external stakeholders, and to inform WP 2 about planned CoPs, so that WP 2 could provide support. Unfortunately, WP 2 has not always been updated before the CoPs took place. When WPs were informed beforehand, the organizers were reminded to use the proper documentation and online engagement tools. WP 2 offered their support to CoP organizers.

The back-casting exercise including a small stakeholder analysis has been suggested by WP 2 to WP leader as potential topic for a P-CoP. However, WP leaders organizing the P-CoP decided to go another direction during the CoP meetings as FRs were asked to do the back-casting exercise before the meeting itself. As WP 2 has a supporting role, it has limited influence on setting the agenda. However, the inclusion of tool developers during L-CoPs improved. Most L-CoPs entailed discussions between the FRs and tool developers.

6.7 Lessons learned year four and overall project

Approaching the end of the project in year four, some lessons can be drawn over the overall functioning of the CoPs in STOP-IT. The following figures show the level of functionality of the different components of the CoPs. The results are based on all available data (year 1 to year 4). The scores of the indicators presented on the vertical axis is the average score on the Likert scale from 1-5.
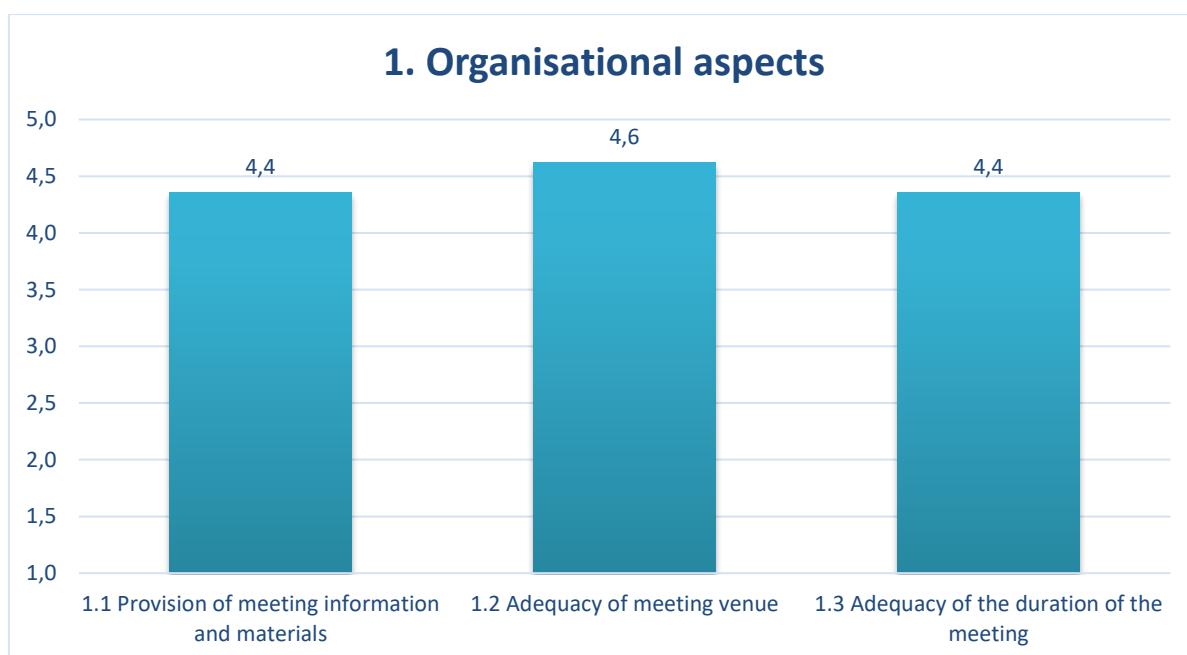

Figure 13 Cumulative score of organizational aspects (N=82)

The CoPs have a good cumulative score on the organizational aspects, showing that the participants are satisfied with the duration of the meetings, adequacy of the venue and the provision of meeting information and materials. Over the years, the CoPs meetings have become well established and the CoP organizers know how to prepare a CoP meeting. By the end of the fourth year, most CoP organizers were familiar with the CoP process and understood the evaluation is important for the yearly monitoring, sending out the online evaluation form afterwards, sending out an agenda beforehand and time management during the COP remain points of attention. For future CoPs it is recommended to instruct the CoP organizers at the beginning of the project about organizational aspects of the CoPs, as was also done in STOP-IT, and send them reminders including a check list for running a successful CoP (D2.3).
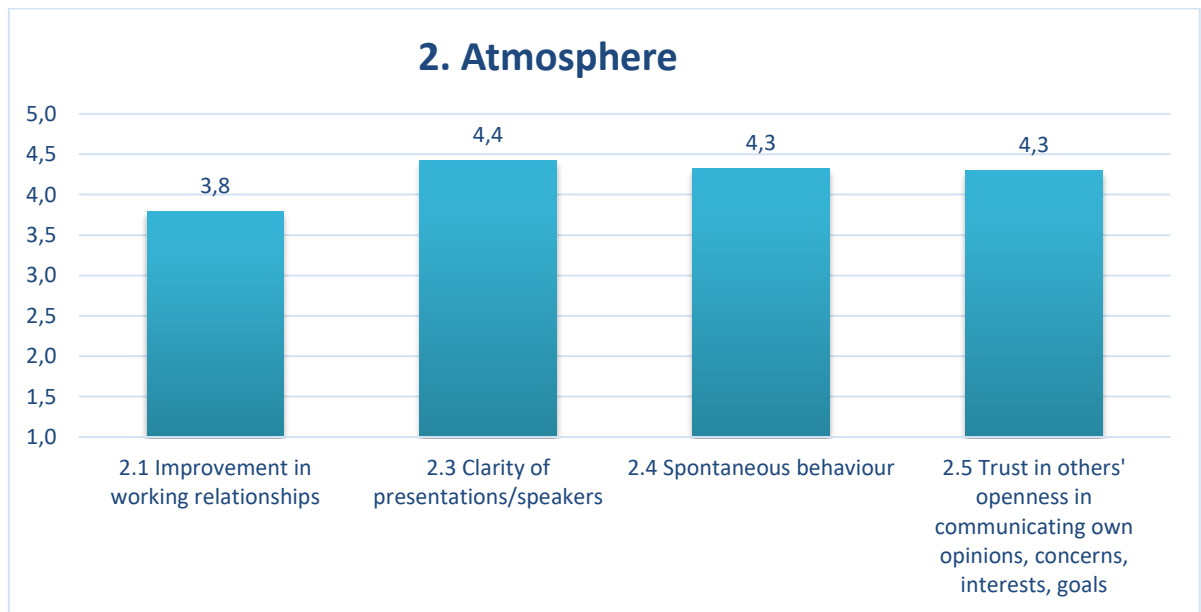
Figure 14 Cumulative score atmosphere (N=82)

The atmosphere in the CoPs is good, all indicators have a score above 3,8 (Figure 14). While the participants miss face-to-face interactions and networking, they still feel free to behave in a spontaneous way. The lower score on improvement in working relationships and trust each other's openness is likely to be influenced by the online format. The participants mention that they miss the informal talks and ideas that come from these informal talks.

3. Stakeholder inclusion and representation

Figure 15 Cumulative score stakeholder inclusion and representation (N=82)

The CoPs score well on stakeholder inclusion and representation with no score lower than 4,3. The participants feel that they are free to participate and provide input in the meetings and are open to other perspectives.

4. Convergence towards shared perspective
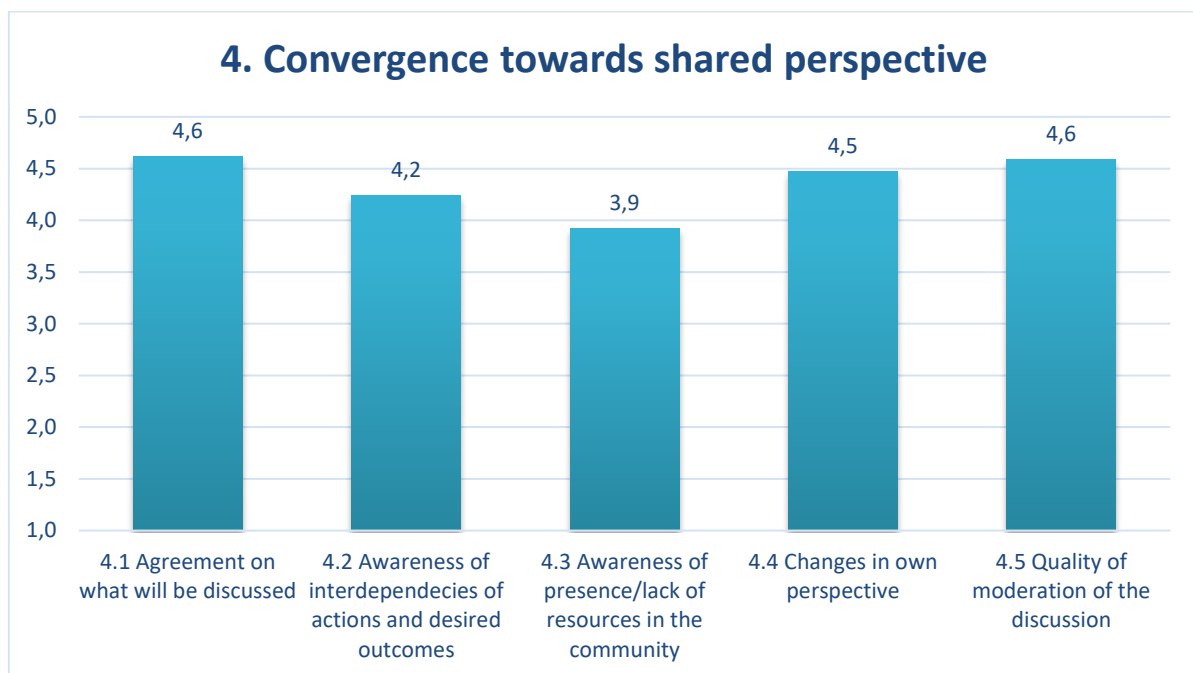
Figure 16 Cumulative score convergence towards shared perspective (N=82)

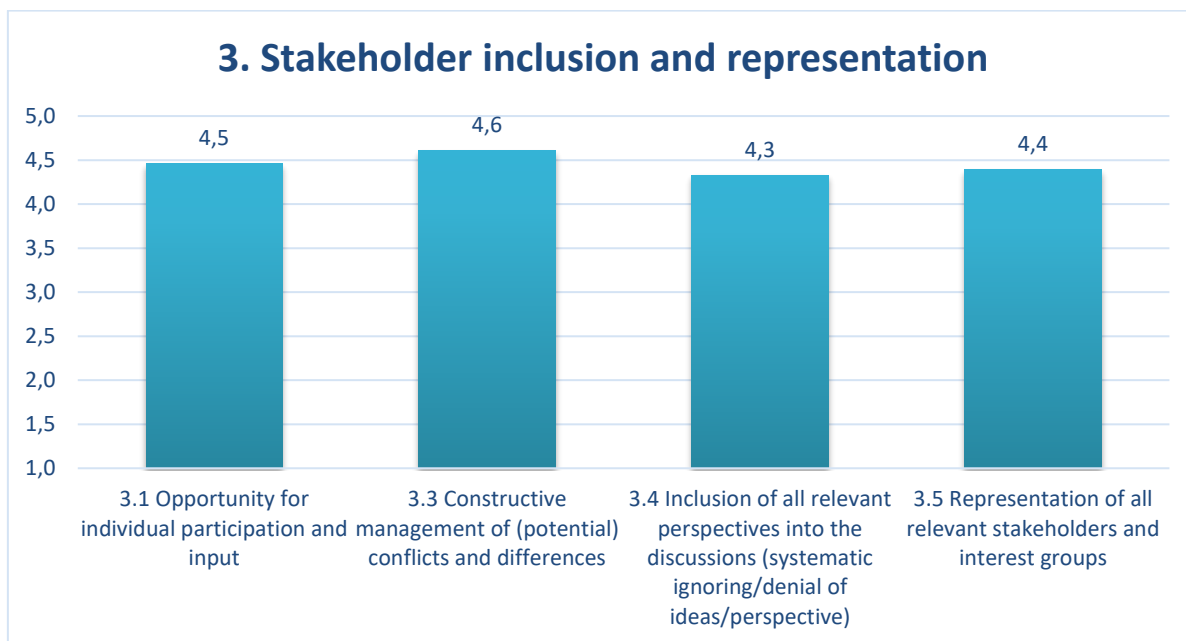The CoPs help the participants to move towards a shared perspective (Figure 16). The participants agree on the topics of the CoPs, have good discussions, and are open to change their own perspectives through learning from each other. While a score of 3,9 is still sufficient, the score on the awareness of presence and lack of resources is somewhat lower than the other scores of this theme. This is confirmed in the written feedback in which some participants expressed that it was not clear to them what personal expertise the STOP-IT tools required, which could have been explained earlier on in the project. However, in the beginning of the project, the tools were only in form of general descriptions, and still needed to be developed, making it difficult to specify what specific expertise is needed for them.

5. Identification opportunities and challenges
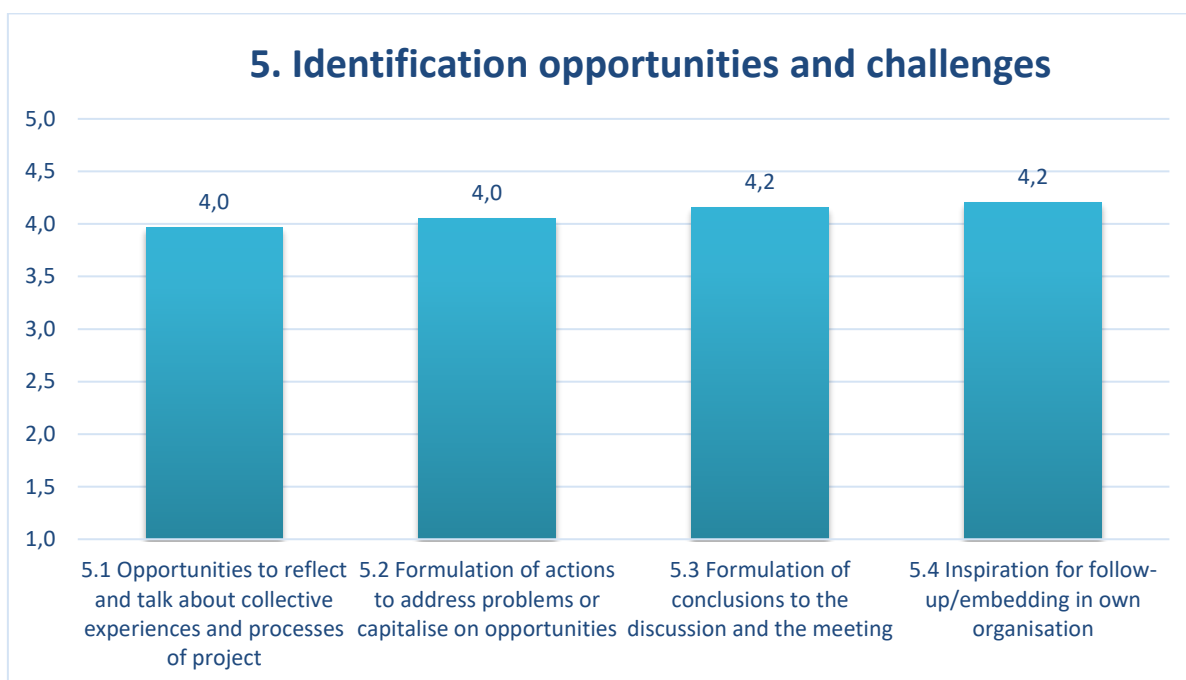
Figure 17 Cumulative score identification opportunities and challenges (N=82)

The CoPs were successful in identifying opportunities and challenges in the project with all indicators having a score of 4,0 and higher (Figure 17). The CoPs helped the participants to formulate actions, conclusions and also inspired them for follow-up actions in their organization.
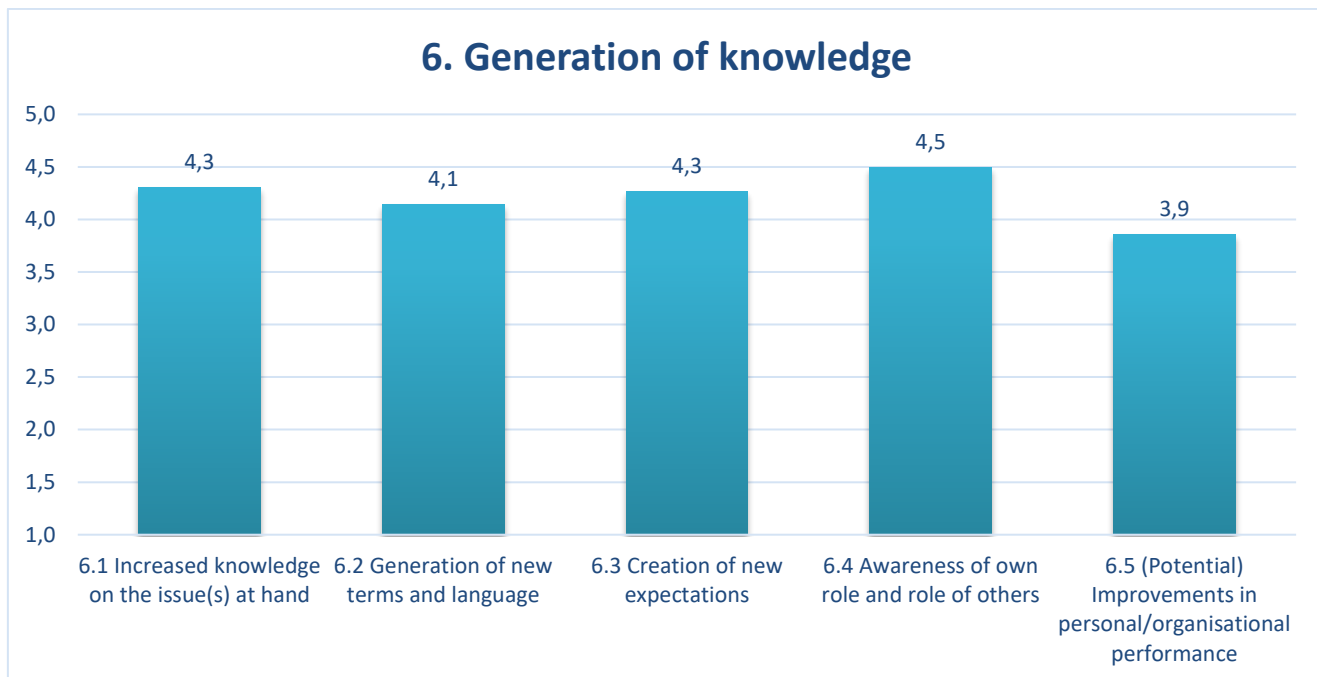
6. Generation of knowledge

4,3	4,1	4,3	4,5	3,9
6.1 Increased knowledge on the issue(s) at hand	6.2 Generation of new terms and language	6.3 Creation of new expectations	6.4 Awareness of own role and role of others	6.5 (Potential) Improvements in personal/organisational performance

Figure 18 cumulative score generation of knowledge (N=82)

Lastly, the CoPs score well on knowledge generation (scores of 3,9 or above, figure 18). Through the CoPs, the participants learned more about cyber-physical security issues in the water sector and the STOP-IT tools. The FR and FL specifically enhanced their understanding about the STOP-IT tools, while the tool developers learned more about the specific needs of the FR utilities and the P-CoPs allowed for knowledge exchange between different locations and water utilities.

Based on the figures above, it can be concluded that the CoPs function well and the participants seem happy with the CoP workshops. Nevertheless, a critical reflection on the frequency, gender balance, inclusion of external stakeholders, set-up and use of online CoPs resulted in lessons learned for future CoPs.

6.7.1 Lessons on the frequency of CoPs

The frequency of the L-CoPs has decreased in the last year, while the number of P-CoPs has increased. The L-CoPs were mostly used to learn about the tools and work out technical issues with the tool developers. During the last year of the project, the focus of the FR has been on the demonstration of tools at the FR site. The combination of FR trying to fulfill their tasks under the COVID-19 pandemic conditions led to the decrease in L-CoPs. The participants of those CoP workshops that were organized appreciated the inclusion of the tool developers to solve open technical issues together.

The increase in P-CoPs in the fourth year indicates the need to share the progress of the STOP-IT tools, which by then entered the demonstration phase with the FRs. Also the P-CoPs with tool developers and FRs were an opportunity to learn from each other's experiences. A similar effect could be noticed with the P-CoPs dedicated to the FL. Once the tools were more developed and concrete, a training session on the tools through a game could be organized.

Aside from the fourth year, the number of L-CoPs was also lower in the second year. The CoPs mainly focused on technical issues based on the pace of the tool development, which influenced the need for CoPs. It could have been beneficial to emphasize the added value and long term benefits of the CoPs to the water utilities to get them more motivated to organize CoPs. However, this was difficult to do in the STOP-IT project as in the beginning of the project, the tools, were not yet developed and were only general descriptions. There may have been a lack of perception on the benefits to organize a technical CoP on a product that at that time only existed as a general description. Nevertheless, this can be a lesson for future projects to create motivation for hosting CoPs and designing a roadmap including agreements on the frequency of the CoPs, which was not included in D2.1. This could stimulate the CoP organizers to organize more CoPs.

6.7.2 Lessons on the inclusion of external stakeholders

The CoPs aimed to involve external stakeholders in the L-CoPs, but this remained challenging until the end of the project. At the beginning of STOP-IT, there were many possible tools to be developed in the project, which were not all relevant for all FRs. The FRs had to select tools they wanted to test based on a still general description. The actual developed tools sometimes differed from the initial description and required many technical discussions between the FRs and tool providers to be developed. The sensitivity of the topic and security issues made it difficult to have open discussions on vulnerable systems. Due to the technical issues that needed to be solved and sensitivity of the topic, the CoPs were simply not ready to engage with external stakeholders. Despite this, some lessons can be drawn to ensure that external involvement is higher in future projects.

Alternatively, the set-up of the P-CoPs and L-CoPs could have been organized differently. It would have been good to wait with the L-CoPs until the tools were more concrete and make use of the P-CoPs to elicit and map the preferences and needs of both the FR and FL utilities concerning the STOP-IT tools. By combining the L-CoPs with a technical meeting beforehand, a focus on knowledge exchange, technical discussions during the L-CoP could be avoided, thus making it a suitable meeting to involve policy makers. In addition, it could be an idea to define a process distinguishing between events for the core participants (project partners) and events involving more peripheral participants/stakeholders (policy makers) and defining a flow between them. It is also advisable to provide the FRs with more guidance to identify external stakeholders at the beginning of the project.

6.7.3 Lessons on online CoPs and online engagement tools and gamification

The fourth year of the project was characterized by online CoPs. These were appreciated for their productivity, being to the point, and simplicity to join from various countries. However, participants missed the social connections. The online meetings felt more impersonal. Online meetings provide little networking opportunities, informal discussions are less likely to happen and the consequential follow-up collaboration. Moreover, the loss of in-depth conversations is perceived as barrier to identify the bottle necks in the next steps of the project. Technical issues such as internet connectivity, make discussions more difficult.

Online engagement tools such as GroupMap and Mentimeter were used to make the online CoPs more engaging and interactive. Conventional online CoPs, consisting of presentations and a Q&A session have the benefit the participants are familiar with the concept and know what to expect, but conventional online CoPs can be tiring and boring, making it difficult for the participants to stay concentrated. When asked, the participants indicated to prefer more interactive CoPs. While the participants are enthusiastic about the use of online engagement tools, the CoP organizers are hesitant to use them and ended up not using them. Being unfamiliar with the tools, and wanting to minimize technical difficulties during the meetings led to a hesitant attitude towards the engagement tools. For future projects, it is advisable to host a training session on online engagement tools with the CoP organizers to familiarize them with the tools, and invest more in online networking platforms.

A specific interactive element in CoPs occurred with the TORC game during two P-CoPs, which added a gamification element. The TORC game was appreciated by participants; it supported lively discussions, helped engagement and was perceived as an easy and fun way to learn about the different tools in the STOP-IT project. Gamification elements are very effective for knowledge exchange, but do require preparation. The organizers need to prepare the session well in advance and the participants need to learn how the interface works prior to the meeting.

Overall, the CoPs in the STOP-IT project can be considered successful. Participants appreciated the CoPs for providing a platform for knowledge exchange, for meeting the project participants and bringing them closer together. The CoPs in STOP-IT also provided lessons that can be used in other projects. The STOP-IT team already brought these experiences into practice in other projects such as Ultimate, B-WaterSmart and WaterMining. These lessons are briefly mentioned in this deliverable and will be described in more detail in D2.3 - Best Practice Guidelines for Community of Practices in Water Infrastructure.

Fulgenzi, A., Brouwer, S., Baker, K., & Frijns, J. (2020). Communities of practice at the center of circular water solutions. *Wiley Interdisciplinary Reviews: Water*, e21450.

Spaapen, J., & Van Drooge, L. (2011). Introducing 'productive interactions' in social impact assessment. Research evaluation, 20(3), 211-218.

Worldbank (2019) Women in Water Utilities: Breaking boundaries, retrieved on 01-06-2021, https://www.worldbank.org/en/news/feature/2019/08/27/breaking-barriers

CoP Evaluation Form

Place: _____ **Date:** _____

It was a pleasure to have you in this meeting. We would like to know your opinion, so that we can improve future events and meet your expectations. Thank you for your collaboration!

Name *(optional)*:_____

Organization *(optional)*: _____

Please rate the extent to which you agree with each of the following statements:
(1=strongly disagree; 2=disagree 3=neutral; 4=agree; 5=strongly agree; N.A=not applicable)

1. Meeting logistics and stakeholder engagement	
1.1 I received the information about the meeting and materials well in advance	
1.2 The venue was adequate for the purpose of the meeting	
1.3 The meeting had the right duration in time	
1.4 The presentations and speakers were clear and understandable	
1.5 During the meeting I improved or made new connections for my professional network	
1.6 During the meeting, my behavior was spontaneous and unfiltered	
1.7 I believe others were communicating openly with me	
Comments: *(optional)*	

2. Awareness and increased understanding	
2.1 I believe that all relevant stakeholders were present at the meeting	
2.2 I agreed with the items listed on the agenda	
2.3 I had sufficient opportunities to provide input to the discussion	
2.4 Most ideas/perspectives were included and respected during the discussion	
2.5 Differences and (potential) conflicts among us were addressed in a constructive manner	
2.6 The way the discussion was facilitated and moderated supported the meeting objectives	

2.7 I have a better understanding of the perspective of the stakeholders (i.e. end users, tool developers)	
2.8 I believe that actions and objectives of the stakeholders are interconnected (i.e. end users, tool developers)	
2.9 I know which resources are available and which are still lacking to handle specific cyber and or physical threats	
Comments: (*optional*)	

3. Outcomes and conclusions

3.1 There was enough time to reflect on our collective experience and functioning as a group	
3.2 I have a better understanding of the language/ terminology used by the participants outside my organization/ work package	
3.3 Participating in the meeting increased my knowledge on the solutions/ needs of the end users	
3.4 I am aware of my own role in the project and how each of us can contribute to the projects goals	
3.5 I believe that clear conclusions were formulated at the end of the meeting	
3.6 I believe that clear actions were formulated to improve solutions. For example solutions for cyber physical threats	
3.7 After participating to the meeting I identified (potential) improvements for my organization/ work package	
3.8 The meeting inspired me to take follow-up actions in my own organization/ work package	
3.9 My expectations on the outcomes of the meeting were met	
Comments: *(optional)*	

Pros and cons of the local CoP

In your opinion, what were the <u>most positive</u> and <u>less positive</u> aspects of the meeting?
<u>Most positive:</u>

<u>Less positive:</u>

Suggestions for improvement

What suggestions for improvement do you have for future meetings?

Thank you!
Please give this questionnaire back to the workshop organizer before leaving.

Annex B overview CoP activities in STOP-IT

This annex provides an overview of both the local and P-CoPs that have taken place within the STOP-IT project

P-CoPs

Table 4 Overview P-CoP activities in the STOP-IT project

Type of CoP	Date	Location	Organizer
P-CoP	12/13-03-2018	Berlin	BWB
P-CoP	19-06-2018	Barcelona	CET/AB
P-CoP	19-06-2019	Athens	ICCS/KWR/IWW/ SINTEF
P-CoP	20-06-2019	Athens	WP 8/WP 2
P-CoP	10-06-2020	Online	SINTEF/KWR
P-CoP	03-11-2020	Online	ICCS
P-CoP	12-01-2021	Online	SINTEF/KWR
P-CoP	13-01-2021	Online	SINTEF/KWR
P-CoP	28-01-2021	Online	MEKOROT

L-CoP

Table 5 Overview of L-CoP activities in STOP-IT

Type of CoP	Date	Location	Organizer
L-CoP	November 2017	Oslo	Oslo VAV
L-CoP	November 2017	Barcelona	AdB
L-CoP	November 2017	Berlin	BWB
L-CoP	November 2017	Israel	Mekorot
L-CoP	27-02-2018	Barcelona	AdB
L-CoP	07-03-2018	Oslo	Oslo VAV
L-CoP	July 2018- June 2019	Barcelona	AdB
L-CoP	11-02-2019	Oslo	Oslo VAV
L-CoP	11-03-2019	Israel	Mekorot
L-CoP	01-04-2019	Oslo	Oslo VAV

L-CoP	03-05-2019	Oslo	Oslo VAV
L-CoP	15-05-2019	Berlin	BWB
L-CoP	12-09-2019	Oslo	Oslo VAV
L-CoP	10-11-2019	Israel	Mekorot
L-CoP	13-11-2019	Israel	Mekorot
L-CoP	27-01-2020	Oslo	Oslo VAV
L-CoP	27-01-2020	Barcelona	AdB
L-CoP	12-02-2020	Berlin	BWB
L-CoP	27-04-2020	Online	Mekorot
L-CoP	05-05-2020	Online	BWB
L-CoP	06-05-2020	Online	Mekorot
L-CoP	10-05-2020	Online	AdB
L-CoP	02-06-2020	Online	AdB
L-CoP	19-02-2021	Online	BWB
L-CoP	22-02-2021	Online	BWB
L-CoP	25-02-2021	Online	AdB
L-CoP	15-03-2021	Online	AdB
L-CoP	15-04-2021	Online	AdB
L-CoP	15-05-2021	Online	AdB