Co-treatment of domestic and industrial wastewaters at municipal treatment plants

Training models and materials for increasing capacity and knowledge of stakeholders (Work package 3.2)

Estonian Water Works Association

2020

BEST
Better Efficiency for Industrial Sewage Treatment

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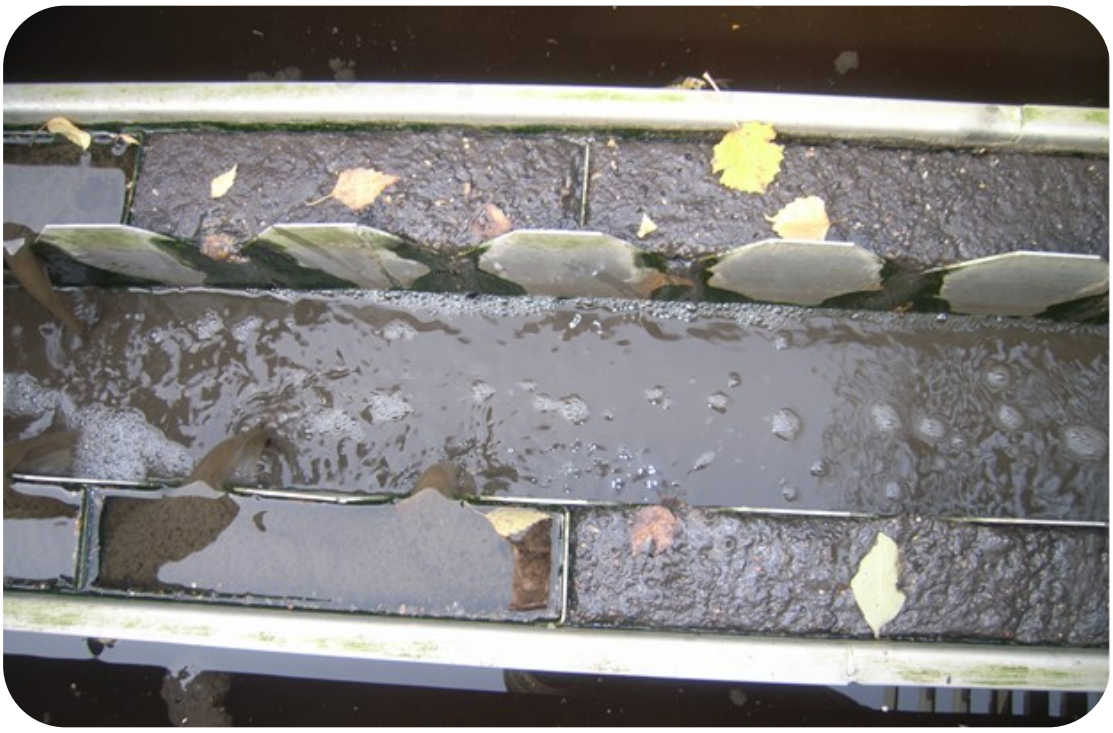

Introduction

Municipal wastewater treatment plants are primarily designed to treat wastewater from households by removing organic material, phosphorus and nitrogen during various process phases. These treatment processes can easily be disrupted by industrial wastewater differing in its quantity and quality compared to domestic wastewater. Otherwise harmless and non-toxic effluents from food processing facilities may disrupt the operation of municipal wastewater treatment plants if large amounts of material, such as dairy products with high organic content, are suddenly released into sewerage systems. On the other hand, even small amounts of wastewater from fabricated metal or chemical industry can cause harm due to residues of hazardous substances.

The consequent risk of releases of inadequately treated industrial wastewater and sewage endangers receiving waters.

Water utilities and wastewater treatment professionals in the Baltic Sea Region have recognized in their daily work several challenges in the treatment of industrial wastewaters at the municipal wastewater treatment plants:

- Water utilities need knowledge about potential treatment solutions as well as improved cooperation between the water utilities, industrial companies and authorities responsible for permits and monitoring, to better plan, further develop and monitor the treatment processes.
- Industrial companies need new knowledge and understanding about impacts of their effluents on municipal wastewater treatment process.
- Authorities on local and regional level need knowledge about wastewater treatment process challenges at the water utilities.

To tackle the challenges and constantly provide new and updated solutions to these issues the training is very important. There are several ways and forms how to train the experts, future experts as well the industry and other stakeholders.

This document presents training models and material that can be used to:

- train the experts' in-depth knowledge and capacity for everyday work;
- target very specific issues in wastewater treatment related to specific industry;
- enhance cooperation and communication between water utilities, industrial companies and authorities.

Project BEST – Better Efficiency for Industrial Sewage Treatment – particularly aims to enhance collaboration between municipalities, industry and waterworks, and to promote best practices in the management of industrial wastewater.

Project BEST runs from October 2017 – September 2020 and involves 15 partner organisations from Latvia, Poland, Finland, Russia and Estonia, with the City of Helsinki as its lead partner.

The project is co-financed by the European Union (European Regional Development Fund ERDF and European Neighbourhood Instrument ENI) with financial support of the Russian Federation. The project's total budget is 3.4 million euros.

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Terms used

Training concept – an idea, theory about the process of learning the skills needed to do a particular job or activity.

Model – good example of something others can base their copy on.

Expert – a person having a high level of knowledge or skill in particular subject.

Capacity building – the process of creating or developing ability to do something particular.

Stakeholder – a person or organisation with an interest or concern in something.

Target group – group of people that a policy or campaign is hoping to influence in some way.

Seminar – a meeting of group of people to learn together by discussing, having workshops and presentations.

Upskill – to learn new skills or teach workers new skills.

BSR – Baltic Sea Region.

WWTP – wastewater treatment plant.

VET – vocational education and training.

Learning as a value

Learning: *the process of getting an understanding of something by studying it or by experience*:

- Knowledge and learning are essential factors for achieving successful outcomes
- Continuous learning and acquiring new skills are pivotal for sustaining achievements

Cambridge Dictionary

There is no doubt among teachers, learners, politicians and officials that education is a value. On the one hand, it is a personal value that guarantees a better quality of life, a higher income and a lower risk of unemployment. On the other hand, it is a national or societal value: a skilled workforce advances the economy, develops the society, and increases the social coherence of the society.

Jaak Aaviksoo, Estonian Minister of Education

1. Training forms

1.1 Seminar or workshop for disseminating and sharing novel developments in the field

Purpose:

- To convey information and promote an active response from attendees
- To contribute to professional sector capacity and competence development
- To establish professional community
- To introduce challenges, developments and technologies
- To have round-table discussions on current issues that the different parties face and to come up with mutual solutions to implement in the field of wastewater treatment

Participants:

Industries, wastewater treatment utilities, municipality representatives, environmental and other authorities.

Program and methods:

The program of the seminar or workshop can focus on one industrial field or specific issue related to the industry or region. It can also be very broad and deal with both

national and international issues and developments.
The methods can include:

- lectures from experts
- study visits
- study cases
- hands-on workshops
- various interactive and participatory methods
- discussions and finding solutions
- webinars

Example of a national seminar based on Estonian best practice is in Annex 1. The aim of the seminar was to draw attention to industrial water which, due the nature of the industry, has a major impact on the activated sludge processes at the wastewater treatment plants.

More examples of the workshop best practices can be found on the project webpage: https://bestbalticproject.eu/events/past-events/

1.2 2-year VET training programme for operators

Purpose:

- To provide professional training and certification for EQF level 5 water treatment operators.
- Water management is a rapidly evolving field where digitalization and IT technologies are playing an increasingly important role.
- Highly developed skills and competencies play an important role in providing the clean water and environment that determines the quality of life for all of us.
- Modern and constantly updated VET curricula provide not only the professional skills but also soft skills that are important for better communication.

Participants:
Already working operators or people whom the water utilities want to hire as operators.

Program:
2-year EQF level 5 water treatment operators training. Training form: work based (*Most of the training takes place in the company where the operators already work. Part of the training takes place in a VET school*).

The two year curriculum includes following modules:

- Occupational and environmental safety
- Basic knowledge of the work of a water treatment operator
- Basics of electrical engineering and automation
- Maintenance and servicing of water treatment plant equipment and systems
- Management of water treatment processes
- Drinking water treatment
- Sewage treatment
- Career planning and entrepreneurship
- Foreign language for professionals
- Customer service
- Environmental protection and sustainable development
- Professional software programs
- Plumbing and welding works

Practice: Internship (780 hours) is integrated into basic study modules

In Estonia the program is provided by the Järva County Vocational Training Centre (https://estonianvoced.com/about-us/).

1.3 Training course for students

Purpose:

- To provide training for students on wastewater management and reduction of environmental pollution caused by industrial wastewaters.
- To provide knowledge on modernization of wastewater technologies.
- To have practical workshops that include a problem solving cases related to the actual cases in water treatment companies.
- Cooperation between the real work life and educational institutions.
- As the universities play the role of both education and research institutes, the students can be involved in coming up with new solutions and innovations related to industrial wastewater treatment. This has to be done in cooperation with WWT experts.

Participants:

Students

Program:

Training contains:

- lectures
- group works

- assignments (to create wastewater management plan)
- discussions (for example on the implementation and needs of modernisation process within the wastewater sector)
- study visits (to visit wastewater treatment plant and to learn about its reconstruction history and future plans)

1.4 Online courses

Purpose:

- E-learning (also called electronic learning) is any type of learning that takes place through or with a computer and is primarily facilitated through the Internet, but can also be accomplished with CD-ROMs and DVDs, streaming audio or video, and other media.
- Online courses provide the flexibility. It can be followed from home or office, and don't take much organizing.
- The purpose of e-learning is to allow people to learn to upskill themselves or to earn a professional degree, without physically attending a traditional university or academic setting.
- E-learning can also be applied for life-long learning and upgrading the professional skills.
- E-learning materials can also include tests for assessment purposes.

Participants:
Professionals and students

1.5 Short-term training for the WWTP workers

Purpose:

- Participants gain expert-level information on industrial wastewater management, current issues and updates, as well as make contacts with experts and gain peer-support in everyday tasks and long-term issues.

Participants:
Operators, monitoring and laboratory personnel at wastewater treatment plants

Program:

- Legislation updates, various challenges
- Wastewater composition and pre-treatment solutions among industrial sectors
- Monitoring and online measurement technics

- Contracts and technical details related to various industrial sectors and WWTPs from different regions
- WSP (Water Safety Plan) and SSP (Sanitation Safety Plan) risk tool and experience of use

2. Interactive and participatory tools for events

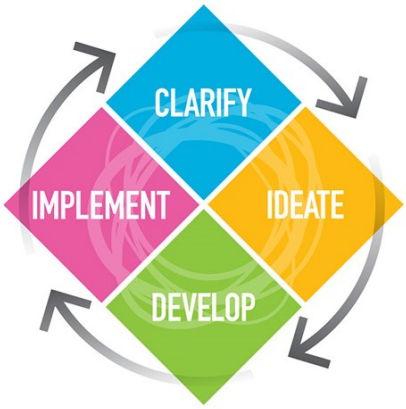
The first chapter discussed various ways to train the experts' in-depth knowledge and capacity for everyday work. The purpose of training is to target very specific issues in wastewater treatment related to specific industry, or even enhance the cooperation and communication between water utilities, industrial companies and authorities.

People's ability to gain knowledge and obtain information can vary. Anyone can be a trainer if they have the knowledge, skills, and good tools to convey the knowledge and skills to group of people, irrespective of the number of people trained. In order to have a successful training or workshop the interactive tools are playing very important role.

The purpose of the following chapter is to give examples and ideas on how to make training (in any form) more attractive and engaging.

2.1. Creative problem solving

In workshop planning, the Creative Problem Solving method can be used: http://www.creativeeducationfoundation.org/creative-problem-solving/the-cps-process/.



Stage	Step	Purpose
CLARIFY	Explore the Vision	Identify the goal, wish, or challenge.
	Gather Data	Describe and generate data to enable a clear understanding of the challenge.
	Formulate Challenges	Sharpen awareness of the challenge and create challenge questions that invite solutions.
IDEATE	Explore Ideas	Generate ideas that answer the challenge questions.
DEVELOP	Formulate Solutions	To move from ideas to solutions. Evaluate, strengthen, and select solutions for best "fit."
IMPLEMENT	Formulate a Plan	Explore acceptance and identify resources and actions that will support implementation of the selected solution(s).

Learner's Model based on work of G.J. Puccio, M. Mance, M.C. Murdock, B. Miller, J. Vehar, R. Firestien, S. Thurber, & D. Nielsen (2011)

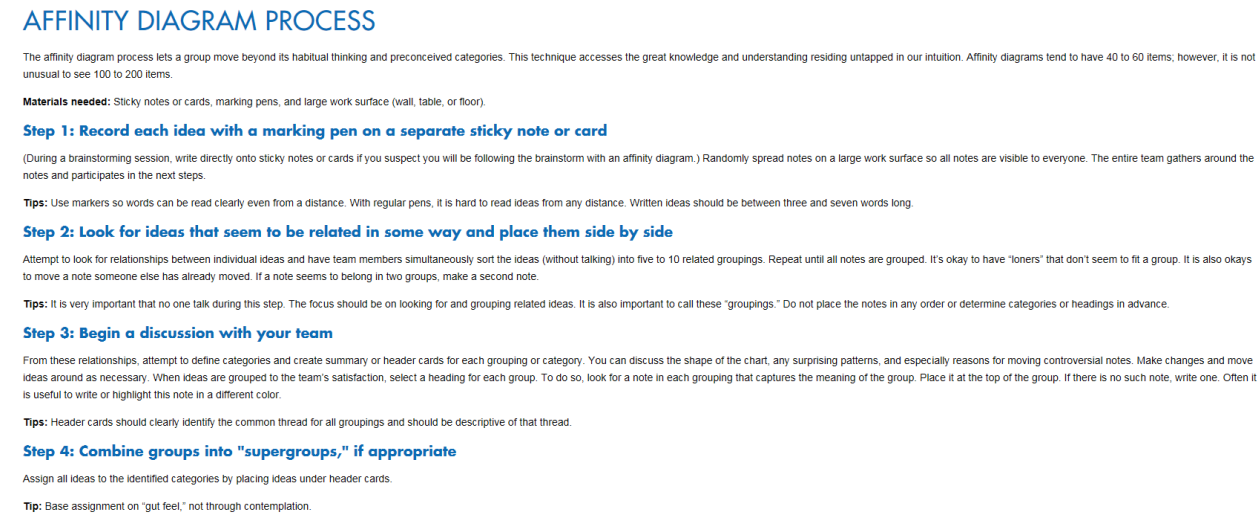
It involves a four-stage process, starting with clarification and ideation and proceeding to the development of solutions and formulation of a plan how to implement the solutions.

Half- or one day workshops shall include first three of the four stages:

- Clarifying the challenge discussed at the workshop. Sometimes also data or facts are gathered at this stage.
- Participants are encouraged to generate ideas around the challenge (divergent thinking).
- Ideas to be worked towards solutions by evaluating and refining them and by selecting the solutions that best fit in the current circumstances (convergent thinking).

2.2 Clarifying and organizing ideas

The affinity diagram by Jiro Kawakita is a method which can help gather large amounts of data, ideas and opinions, and organise them into groups or themes based on their relationships: https://asq.org/quality-resources/affinity.



AFFINITY DIAGRAM PROCESS

The affinity diagram process lets a group move beyond its habitual thinking and preconceived categories. This technique accesses the great knowledge and understanding residing untapped in our intuition. Affinity diagrams tend to have 40 to 60 items; however, it is not unusual to see 100 to 200 items.

Materials needed: Sticky notes or cards, marking pens, and large work surface (wall, table, or floor).

Step 1: Record each idea with a marking pen on a separate sticky note or card

(During a brainstorming session, write directly onto sticky notes or cards if you suspect you will be following the brainstorm with an affinity diagram.) Randomly spread notes on a large work surface so all notes are visible to everyone. The entire team gathers around the notes and participates in the next steps.

Tips: Use markers so words can be read clearly even from a distance. With regular pens, it is hard to read ideas from any distance. Written ideas should be between three and seven words long.

Step 2: Look for ideas that seem to be related in some way and place them side by side

Attempt to look for relationships between individual ideas and have team members simultaneously sort the ideas (without talking) into five to 10 related groupings. Repeat until all notes are grouped. It's okay to have "loners" that don't seem to fit a group. It is also okays to move a note someone else has already moved. If a note seems to belong in two groups, make a second note.

Tips: It is very important that no one talk during this step. The focus should be on looking for and grouping related ideas. It is also important to call these "groupings." Do not place the notes in any order or determine categories or headings in advance.

Step 3: Begin a discussion with your team

From these relationships, attempt to define categories and create summary or header cards for each grouping or category. You can discuss the shape of the chart, any surprising patterns, and especially reasons for moving controversial notes. Make changes and move ideas around as necessary. When ideas are grouped to the team's satisfaction, select a heading for each group. To do so, look for a note in each grouping that captures the meaning of the group. Place it at the top of the group. If there is no such note, write one. Often it is useful to write or highlight this note in a different color.

Tips: Header cards should clearly identify the common thread for all groupings and should be descriptive of that thread.

Step 4: Combine groups into "supergroups," if appropriate

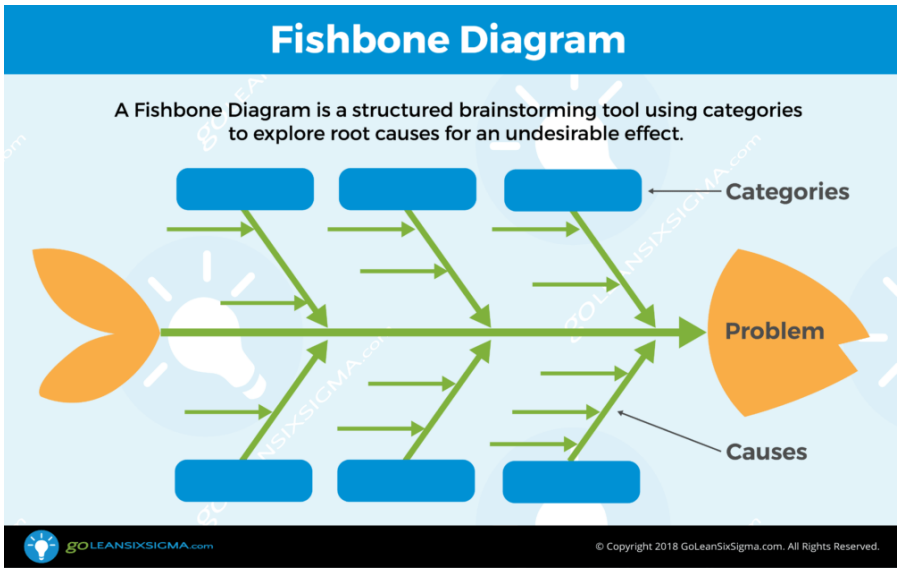
Assign all ideas to the identified categories by placing ideas under header cards.

Tip: Base assignment on "gut feel," not through contemplation.

Steps:
The facilitator asks the participants to:
1. Record each idea on a separate sticky note.
2. Look for ideas that seem to be related and place them side by side.
3. Silently sort cards into groups until all cards have been used. It is ok to have "loners" that don't seem to fit a group. It is also ok to move a note someone else has already moved as all team members sort simultaneously. If a note seems to belong in two groups, make a second note.
4. Create summary or header cards for each grouping.

2.3 Root cause analysis

The fishbone diagram was invented by Dr. Kaoru Ishikawa. It is a tool for systematically looking at an issue and the causes that contribute to it. The design of the diagram looks much like the skeleton of a fish. Fishbone diagrams are processes used to identify the primary source of a problem: https://www.sessionlab. com/methods/fishbone-analysis.



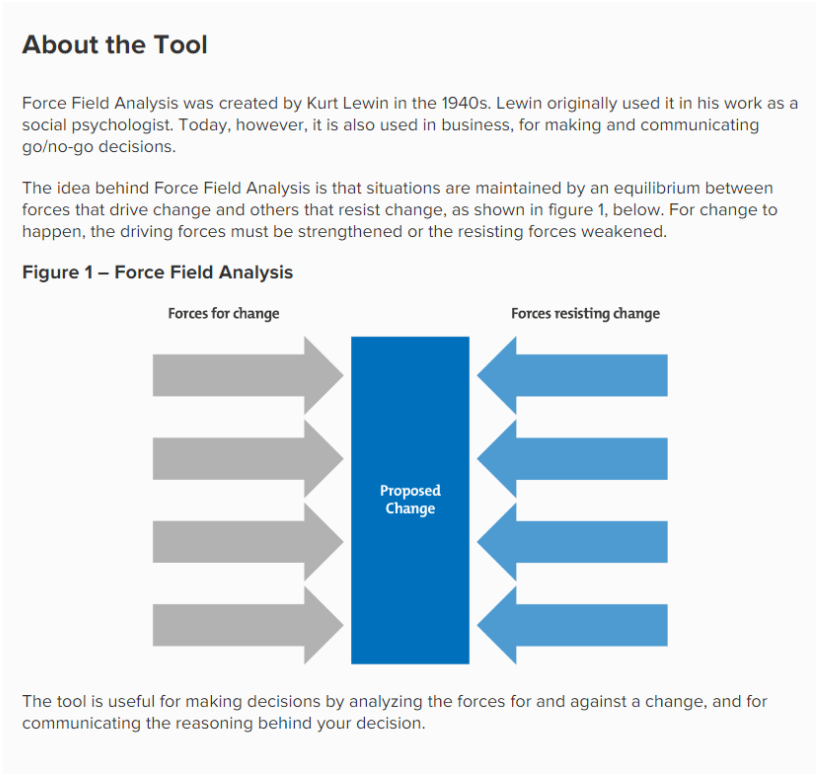
Steps:

1. Draw the fishbone diagram on a large whiteboard of several flipcharts taped together.
2. Agree on the focus question/issue.
3. Write the problem/issue to be worked on in the "head of the fish".
4. Brainstorm issues that "cause" the issue.
5. Organise them into 6 to 12 categories.
6. Label each "bone" of the "fish".
7. For each of the categories create subcategories and put them on the smaller bones of the fish.
8. To generate more and deeper insights into the causes ask, "Why is this happening?".
9. Continue until no more useful information is coming out.
10. When an adequate amount of detail is in each of the major categories, look for items that show up in more than one category. These are "most likely causes".
11. Prioritise them. The first is the most probable cause.
12. Go to the ideation stage to develop solutions.

This method was used in the Project BEST to sort out issues negatively impacting the current situation of industrial wastewater management. In small groups, participants of an expert workshop were asked to write on post-it notes the flaws in the current practises. The facilitator of the workshop then placed one post-it note at a time on a fishbone diagram and asked the participants what has led to this situation. If the answer was found on another post-it note, that one was placed next to the first one. If not, a new post-it note was made. For every new path of reason-cause (category) a new bone on the fish was chosen. Finally, the different bones represented the main big flaw categories with explaining causes for the current situation in industrial wastewater management.

2.4 Force field analysis

Force field analysis developed by Kurt Lewin is an approach to evaluate the factors that will either support or oppose a change for an organisation or community: https://www.mindtools.com/pages/article/newTED_06.htm.



About the Tool

Force Field Analysis was created by Kurt Lewin in the 1940s. Lewin originally used it in his work as a social psychologist. Today, however, it is also used in business, for making and communicating go/no-go decisions.

The idea behind Force Field Analysis is that situations are maintained by an equilibrium between forces that drive change and others that resist change, as shown in figure 1, below. For change to happen, the driving forces must be strengthened or the resisting forces weakened.

Figure 1 – Force Field Analysis

The tool is useful for making decisions by analyzing the forces for and against a change, and for communicating the reasoning behind your decision.

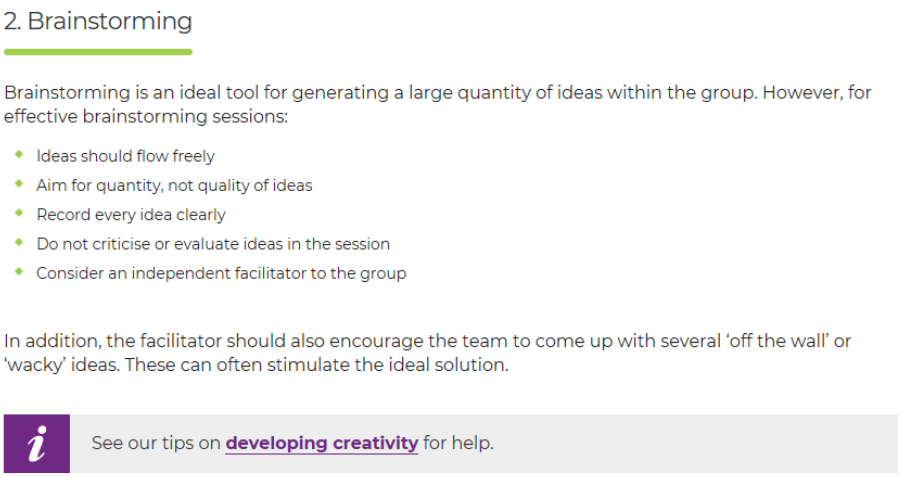
Steps:

1. Define your goal or vision for change and write it down in a box in the middle of the page.
2. Think about the kinds of forces that are driving change. These can be internal and external.
3. Then brainstorm the forces that resist or are unfavourable to change.
4. Next, score each force, from one (weak) to five (strong), according to the degree of influence each one has on the plan, and then add up the scores for each side (for and against).
5. You can utilise the analysis in two ways:

- To decide whether or not to move forward with the decision or change.
- To think about which supportive forces you can strengthen and which opposing or resisting forces you can weaken, and how to make the change more successful.

2.5 Brainstorming

Brainstorming is an ideal tool for generating a large number of ideas within the group: https://www.ksl-training.co.uk/free-resources/facilitation-techniques/group-facilitation-techniques-and-methods/



2. Brainstorming

Brainstorming is an ideal tool for generating a large quantity of ideas within the group. However, for effective brainstorming sessions:

- Ideas should flow freely
- Aim for quantity, not quality of ideas
- Record every idea clearly
- Do not criticise or evaluate ideas in the session
- Consider an independent facilitator to the group

In addition, the facilitator should also encourage the team to come up with several 'off the wall' or 'wacky' ideas. These can often stimulate the ideal solution.

See our tips on **developing creativity** for help.

There are many tips for effective brainstorming sessions. Usually they involve:
- Warm-up of participants so that they know each other, and ideas can flow freely.
- Clear focus and instructions so that everybody can follow the process.
- No criticism or evaluation of ideas while brainstorming. At this stage, the participants are asked to aim for quantity and not quality of ideas.
- Encouragement: Sometimes it is easier to start from improving old ideas and then move on to more creative ideation. Wild ideas are appreciated, too!
- Recording every idea clearly.
- Keeping the participants' energy levels up.

2.6 "Me-we-us"

Me-we-us is the fundamental method to make workgroup interactive: https://grapepeople.fi/en/blogikirjoitus/essential-6-facilitation-tools/.

3. Me-we-us – when you have one topic

The simplest tool every group leader should have in their pocket is Me-we-us. This is the fundamental method to make group-work interactive. With Me-we-us you can manage efficient use of time and the group energy level, you can help them create large amounts of alternatives, and find the focus. And most importantly, you can manage the group dynamics, get everyone to participate, even the silent ones. This method also works for groups of any size. It typically takes 30 minutes.

By Me-we-us you can discuss one topic at a time. The advantages of the method are that you can activate the more silent type of people and also take care that few people will not dominate the whole discussion.

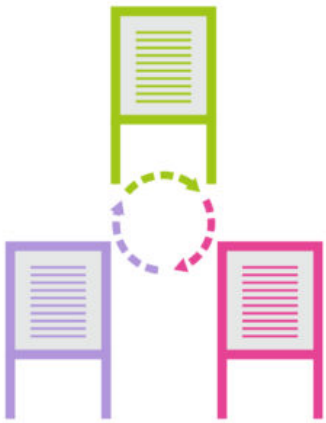
Steps
1. "Me": Write down own opinions. Thinking by your own first makes it easier to talk to others.
2. "We": Share the thoughts in pairs or in small groups. Talking in small groups feels easier than with the whole group.
3. "Us": Share the opinions with the whole group, collecting them on the group memory (flipchart).

This method was used in the Project BEST to compile information about what kind of challenges the different players in industrial sewage management field meet in their work. The participants were divided into three groups according to the organizations they represented: 1) wastewater treatment plants, 2) industrial plants, 2) municipalities and cities. In the groups, everyone thought about the challenges first by themselves, shared their thoughts within the group, and finally together, with the other groups. This way, individual participants and various stakeholders were encouraged to share even contradicting information with each other.

2.7 "World Café"

When you have multiple topics, World Café is a systematic way of running 3-5 simultaneous meetings and rotating groups, so that all participants end up discussing all topics: https://en.wikipedia.org/wiki/World_caf%C3%A9

5. World Café – when you have multiple topics



Sometimes it is more efficient to handle multiple topics simultaneously than one at a time. For example, in Force Field analysis there might be more than one obstacle to be solved. In a traditional meeting everyone is discussing just one topic, with each person speaking in turn. What if there were four topics and four people speaking at the same time? Four times faster you could say! Actually more, as all topics get an energetic start and all participants are engaged in productive work at least most of the time. Compare this to a traditional meeting where the last topics are often hurried through and some people stay silent throughout the whole meeting. World Café is a systematic way of running 3-5 simultaneous meetings and rotating groups in a systematic way so that all participants end up discussing all topics. It takes anywhere from 90 minutes to half a day. For groups of over 30 people you need to adapt the method. When might you need it?

Steps:
1. Groups of about four to six participants sit around tables/stand around flipcharts, together with a facilitator, and discuss questions which have been agreed upon at the beginning of the event or defined by the organisers in advance. Each table has a different set of questions belonging to a comprehensive topic. Discussion results are written down.
2. After approximately 20 minutes, the participants move to the next table where another topic is discussed. The facilitator welcomes new participants, informs them about the results of the previous discussion, and encourages them to develop the ideas further.
3. Finally, the results of all groups will be reflected on in a common plenary session.

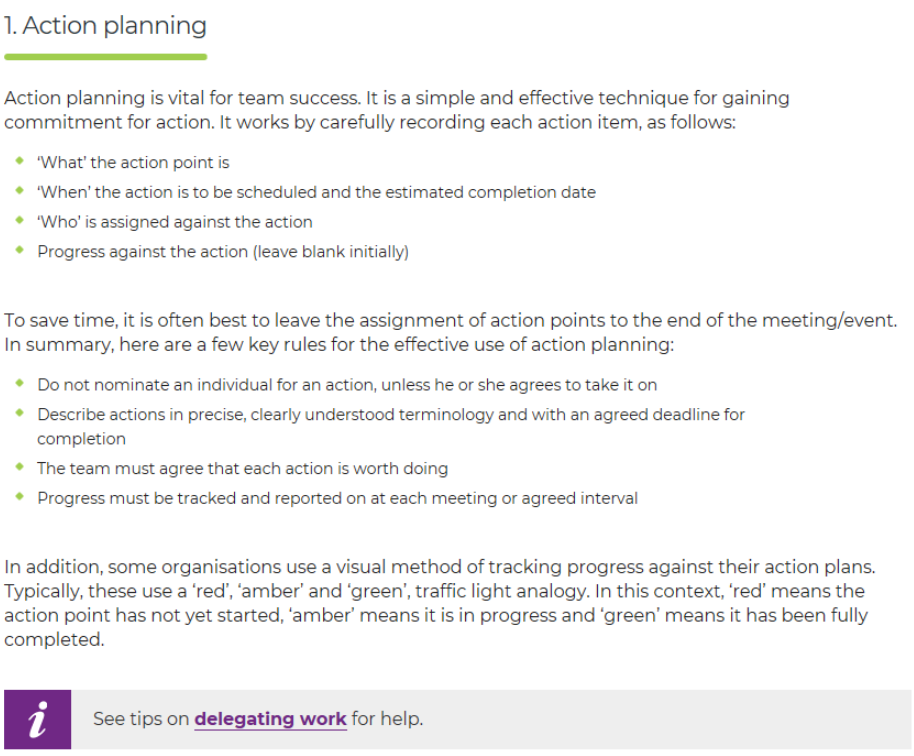
This method was used in the Project BEST to present and share, as well as collect feedback on a draft version of new guidelines for industrial wastewater management. In a workshop, experts representing various stakeholders (wastewater treatment plants, industries, academia, authorities, consultants etc.) were divided in four groups, circulating between the tables with topics included in the draft version of the new guidelines. The topics were: 1) legislation, 2) co-treatment and pre-treatment of industrial sewage, 3) regulation and monitoring, 4) co-operation. When a group arrived at a table, the facilitator presented the topic and the outcome of the discussion of the former group in order to evolve the discussion among the different groups and find consensus if possible. The results of the discussions were then used to further develop the drafted guidelines for industrial

sewage management.

Within the Project BEST, the World Café method has also been used to present and collect feedback on various tools describing the best practices for industrial wastewater management. In this workshop, the tables presented one tool each (i.e. technical solutions or cooperation methods among stakeholders), and the circulating groups had a chance to both familiarize with the tools and give their comments on how these should be developed further.

2.8 Writing of an action plan

The implementation of identified solutions can be supported with the writing of an action plan: https://www.ksl-training.co.uk/free-resources/facilitation-techniques/group-facilitation-techniques-and-methods/.



1. Action planning

Action planning is vital for team success. It is a simple and effective technique for gaining commitment for action. It works by carefully recording each action item, as follows:

- 'What' the action point is
- 'When' the action is to be scheduled and the estimated completion date
- 'Who' is assigned against the action
- Progress against the action (leave blank initially)

To save time, it is often best to leave the assignment of action points to the end of the meeting/event. In summary, here are a few key rules for the effective use of action planning:

- Do not nominate an individual for an action, unless he or she agrees to take it on
- Describe actions in precise, clearly understood terminology and with an agreed deadline for completion
- The team must agree that each action is worth doing
- Progress must be tracked and reported on at each meeting or agreed interval

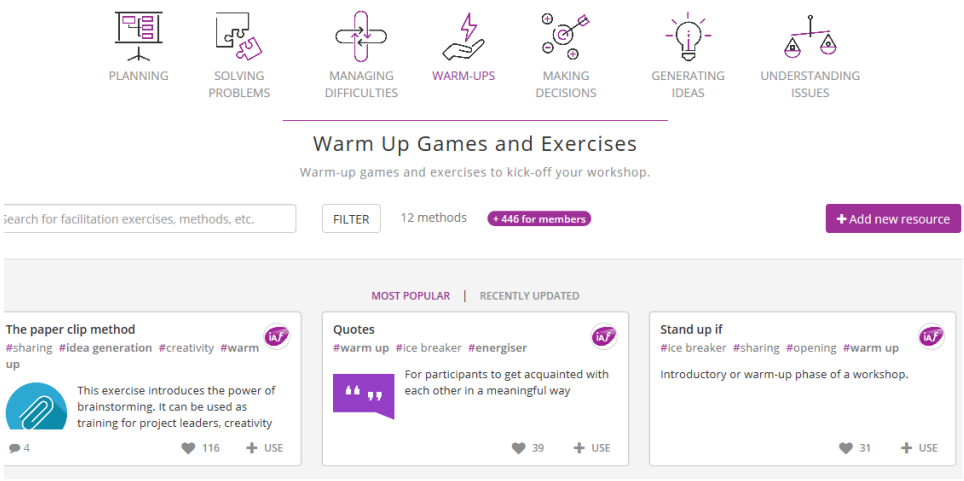
In addition, some organisations use a visual method of tracking progress against their action plans. Typically, these use a 'red', 'amber' and 'green', traffic light analogy. In this context, 'red' means the action point has not yet started, 'amber' means it is in progress and 'green' means it has been fully completed.

Steps:

1. What the action point is?
2. When the action is to be scheduled and the estimated completion date?
3. To whom is the action assigned?
4. What resources and decisions are needed?

2.9 Icebreakers

Icebreakers are short engaging exercises that help people interact early on in the meeting: https://www.sessionlab.com/library/iafmethods/warm-ups.



They are particularly useful for new groups coming together. The icebreaker activity will make each group member feel included and provide a bridge into the meeting itself.

In the Project BEST, various ice breakers have been used throughout the project. In international seminars, for instance, the "cocktail method" has been applied. Following it, the participants have been asked to form groups of 3-4 with participants from different countries (or at least different organisations / people they do not know) and have short chats on e.g. "How do you feel today?", "What do you expect from the seminar?", or something funnier like "If the Project BEST would be an animal, which animal would it be". For the last question, the groups (or some of them) where asked to share their result with all participants. Usually after the warm-up, participants feel more comfortable in the seminar situation.

2.10 Options for ending an effective workshop

In closing of the workshop, it may be a good idea to save a few minutes of time for the participants to reflect and synthesise what they have learned.
http://trainyourboard.com/finish-strong-three-options-for-ending-an-effective-workshop/

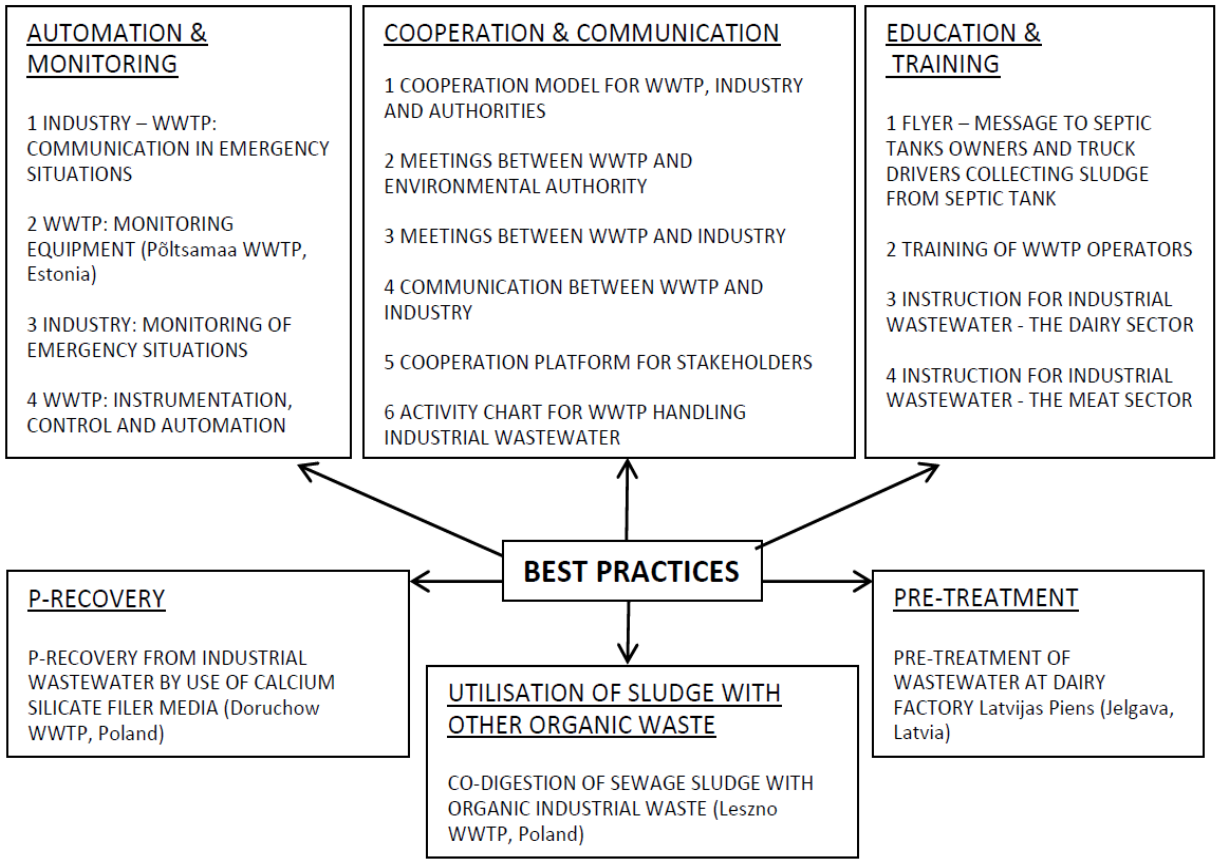
The facilitator may ask e.g. to discuss in pairs:
- What were three take-aways from today's workshop?
- What are you going to do next?

3 Challenge/Solution based tool sheets – Toolbox of best practices

3.1 Introduction to toolbox of best practices

Toolbox of best practices is the output of the work package 3 in the Project BEST. It's a set of tested and evaluated technical solutions and working methods which can be used as "tools" during e.g. the capacity building events of water utilities, WWTPs, industrial companies and local and regional authorities to enhance the knowledge about treatment and management of industrial WWTP in the Baltic Sea Region. The best practices tools represent selected best practices and best technologies presented during the organized international workshops within the Project BEST.

3.2 Toolset of entire toolbox of best practices



As mentioned in previous chapters, continuous training and capacity building are very important. Toolbox of best practices might be helpful in this respect by providing wastewater treatment companies handy and useful (information) tools in case of challenges or some emergences.

In this chapter, you can find examples of some of the information tool sheets. These tool sheets can be used according to the specific needs of wastewater treatment company. Creating tool sheets to fulfil the specific challenge in your company can also be a part of training process or used as a content of the workshop during the seminars.

As graph above shows, the tools responding to the certain challenges can be found on the Project BEST webpage: https://bestbalticproject.eu/

3.3 Goal of the Learning Package

In this project, many challenges faced in the industrial wastewater management were identified. Toolbox of best practices focuses on the following problems:

- Lack of automation and monitoring

Industries very often have to deal with fluctuations in production and processes, resulting in changing amounts and characteristics of released wastes or wastewater. Many industries are still lacking the **automation**. The development and installation of on-line analysis tools can provide real-time information, which can result in improving efficiency and reliability. The real-time adjustment of the processes makes it possible to optimize costs and increase efficiency of the industry. Innovations also focus on developing wastewater characterization tools. Automation at the industrial plant can significantly help not only to improve production efficiency but also to **monitor** the production of wastewater and to **warn in case of any environmental risk**. Monitoring tools dynamically assessing wastewater variability and providing operators with real-time information on the changing quality of the wastewater to be treated can play important role in pro-environmental approach of industry which nowadays is so important. Automation and monitoring tools significantly improve communication between industry and municipal WWTP operators in case when industrial wastewater is released to municipal sewage network. Toolbox of best practices includes tools showing examples of positive influence of installed automation and monitoring instruments both at industry and municipal WWTPs sides.

- Lack of skilled labour and education

Industry from its nature mainly focuses on delivery of the product or service. Environmental protection is of secondary importance. The industrial sector often is lacking **skilled labour** in this context and is thereby unable to respond effectively to the needs of environmentally sustainable development strategies. There is very rarely interest in exploring information about innovative teaching and learning methods or innovative approaches to integrating learning in sustainable development and environmental protection at the industrial plants. Over time, the situation has changed and it is increasingly acknowledged that sustainable solutions for water challenges strongly depend on the availability of adequately trained human resources also in the

industry. A new vision of industry that contributes to social cohesion and promotes environmentally sound sustainable development should be promoted. Moreover, it is important to reach specific groups of industry and increase their knowledge on how their behaviour and habits influence the environment.

- Lack of cooperation WWTP-Industry-Authority

Analysis of problems and challenges in the industrial wastewater management indicated that cooperation between the stakeholders – WWTPs' operators, industry owners and authorities – is a serious problem. Lack of communication, co-operation and understanding of responsibilities and needs of these groups can be one of the problems leading to the low quality of wastewater discharged to the Baltic Sea. Promotion through bridging linkages and ensuring cooperation between the authorities, municipalities and industries seems to be the right way to deal with the wastewater management challenges. Therefore, the project attempted to improve the situation by proposing certain learning package tools that might be helpful when facilitating meetings between involved shareholders.

- Material recovery

Another main challenge and objective of industrial wastewater treatment should be **material recovery**. The way to isolate the compounds that can be recovered should always be analysed. Wastewater often contains materials that could be reused or recovered from production process, in order to limit the amount of waste and to spare the natural resources – in particular, costly rare metals. Best practices related to **P-recovery** are presented in the Toolbox of best practices.

- Pre-treatment methods

The other issues included in the Toolbox of best practices include novel **pre-treatment** methods of industrial wastewater and co-digestion of sewage sludge with industrial wastes as method of **industrial waste utilisation**.

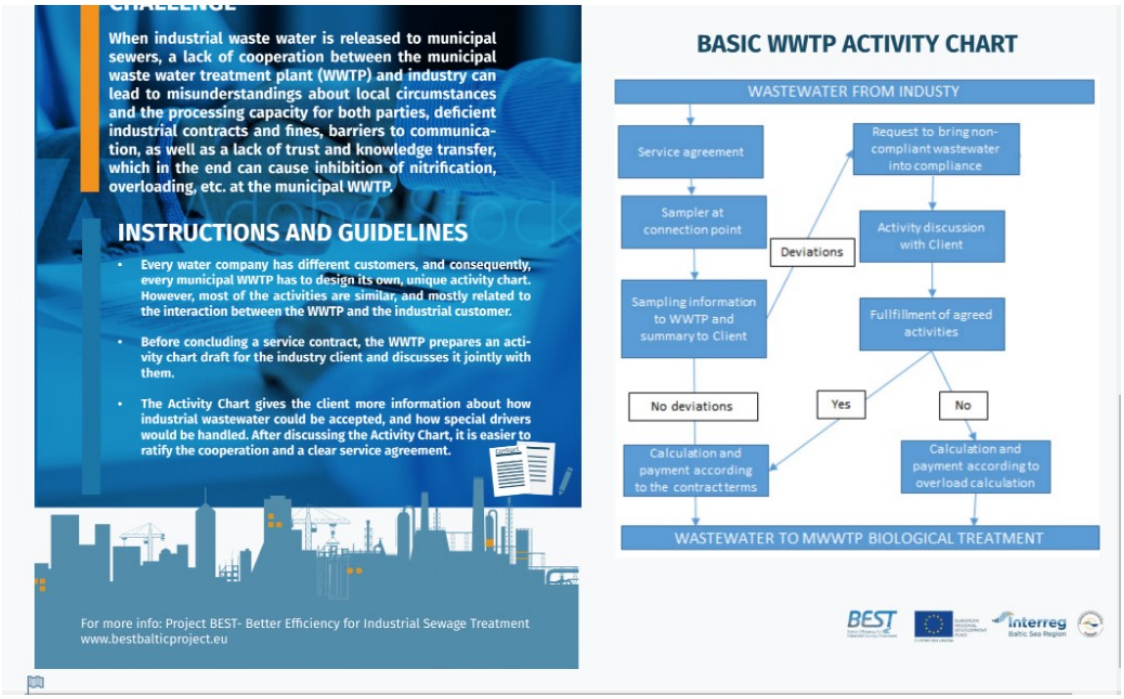
To sum up, the main goal of the Toolbox of best practices is to provide guidance, give examples and ideas on how to improve wastewater management and, in a long term, how to reduce the negative environmental impact of industrial wastewater.

3.4 Examples of the toolsets

Example of Communication TOOL – use of Activity Chart

3 CO-OPERATION THROUGH ACTIVITY CHART .pdf

3 CO-OPERATION THROUGH ACTIVITY CHART .pdf



Example of Automation TOOL:

12 INSTRUMENTATION, CONTROL AND AUTOMATION.pdf

CHALLENGE

Industrial companies often release high loads of wastewater to the municipal sewage network. When releases are unannounced or unexpected, they may seriously harm treatment processes and even lead to their breakdown at municipal wastewater treatment plants (WWTP). Process repair involves high costs. Therefore, control, quick evaluation of treatment processes, and information flow between industry and the municipal treatment plant is a big challenge.

SOLUTION: INSTRUMENTATION, CONTROL AND AUTOMATION

Nowadays, automatic instrumentation plays an important rule both at municipal and industrial WWTPs. Measurement should be carried out on-site (avoiding long lasting analytical analysis), thereby providing quick response and enabling the process to be controlled as quickly as possible.

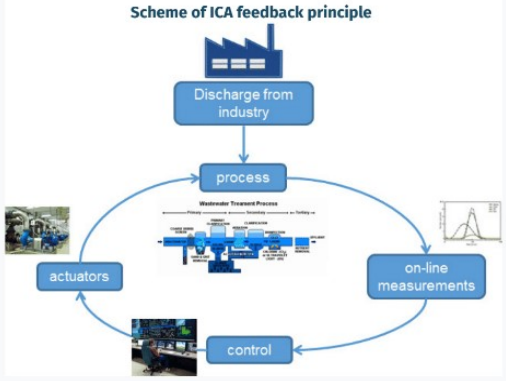
Instrumentation, Control and Automation (ICA) is a key technology to keep the WWTP working as efficiently as possible despite disturbances. The task of ICA is to provide information on the current state of the wastewater treatment process. ICA also helps to monitor the status of the equipment and helps to make decisions based on the collected information.

For more info Project BEST- Better Efficiency for Industrial

PRINCIPLE OF OPERATION

An automation systems consist of sensors gathering information, actuators managing the system, and controllers. At a basic level, ICA is applied to keep the plant running by automatically manipulating the actuators, i.e. the pumps, valves and compressors, in order to keep physical variables, such as flow rates, levels and pressures, around the desired values. Once this is guaranteed, at the second level, the effluent or "product" quality requirements must be satisfied. Computers are used to remotely monitor and control WWTPs and to archive the data. The complexity of the automation system depends on the size of the WWTP. In small WWTPs, systems are usually less complex, however, in some cases, even a small WWTP may need a more sophisticated automation system. ICA has a major positive impact on the performance of the wastewater treatment plant by regulating the wastewater treatment process.

Scheme of ICA feedback principle

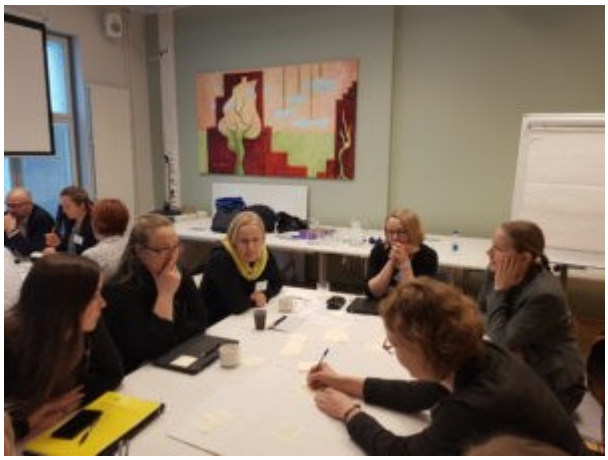


BEST Interreg

4. Project BEST events and materials for training

In this chapter, you can find a list of international events that took place during the Project BEST. Presentations made on the events can be used as training materials.

Helsinki Kick-Off 6–8 February, 2018



Programme: https://bestbalticproject.eu/wp-content/uploads/2018/08/BEST-Kick-off_PROGRAM_Version-2.pdf

Presentations: https://bestbalticproject.eu/materials/event-materials/best-kick-off/
Topics:
EU strategy for Baltic Sea Region

1. Efficient structures and practical experiences of industrial wastewater treatment
2. Management of industrial WWT by Riga Technical University
3. Guidelines for better management of industrial effluents in Baltic Sea Region by John Nurminen Foundation
4. Pilot cases (introduction of investments) for new solutions for better management and treatment of industrial wastewaters
5. Cooperation models among authorities, WWTPs and industrial companies by John Nurminen Foundation
6. Study visit to Viikinmäki Waste Water Treatment Plant, Riihimäki Waste Water Treatment Plant and Dairy company Valio.

Read more about the event: https://bestbalticproject.eu/event/best-kick-off-in-helsinki/

Workshop in Gdańsk, 11–13 June, 2018

Programme: https://bestbalticproject.eu/wp-content/uploads/2018/08/BEST_Gdansk-workshop_PROGRAM_Version2-2.pdf

Presentations: https://bestbalticproject.eu/materials/event-materials/gdansk-workshop/
Topics:

1. Phosphorus recovery from wastewater: strategies and technologies
2. Circular economy assumptions in phosphorus management in the Baltic Sea Region
3. Estonian sludge management strategy and possibilities for phosphorus recovery
4. Phosphorus recovery in Finland – Case RAVITA
5. Phosphorus filtering system in Doruchów
6. Handling of wastewater from food industries to WWTPs in Vimmerby and Linköping, Sweden
7. Examples on cooperation practices and tools in industrial wastewater management in Germany
8. Study visit to municipal WWTP "Wschód" in Gdańsk, sewage sludge biogas and incineration plant.

Read more about the event: https://bestbalticproject.eu/event/best-workshop-in-gdansk/

Workshop in Toila, 20–22 November, 2018

Programme: https://bestbalticproject.eu/wp-content/uploads/2018/11/BEST_Toila-workshop_PROGRAM_Version2.pdf

Presentations: https://bestbalticproject.eu/materials/event-materials/best-workshop-toila-estonia-20-22-november/

Topics:

1. Impact of industrial wastewaters on municipal WWTP
2. HELCOM work to prevent contamination of the Baltic Sea environment from wastewater sector
3. Implementation of the Urban Wastewater Treatment Directive and permitting practices in Finland
4. Estonian legislation on management of industrial wastewaters
5. Removal of hazardous substances from industrial wastewaters, examples from the Netherlands
6. Experiences on good methods and tools from Finland
7. Study visit to Viru Keemia Grupp (VKG) and Eastman company. VKG produces shale oil and shale oil chemicals and Eastman benzoic acid, sodium benzoate and plasticizers
8. Another study visit to municipal WWTP Järve Biopuhastus OÜ.

Read more about the event: https://bestbalticproject.eu/event/best-workshop-in-toila-estonia/

Workshop in Riga, 2–4 April 2019

Programme: https://bestbalticproject.eu/wp-content/uploads/2019/04/BEST_Riga-workshop_PROGRAM_Final.pdf

Presentations: https://bestbalticproject.eu/materials/event-materials/best-project-workshop-in-riga-latvia/

Topics:

1. Assessment of the current situation in the BSR – comparisons, bottlenecks and success stories
2. Contaminants in wastewater from households in Latvia – comparison to industrial wastewater
3. Industrial wastewater pre-treatment at dairy: Case study of A/S Smiltenes piens, Latvia
4. Dairy wastewater treatment in Poland
5. Co-treatment at cheese factory E-Piim and WWTP in Põltsamaa, Estonia
6. Flocculation process at cheese factory Latvijas Piens, Latvia
7. Variations in industrial wastewater composition at inflow of Riga wastewater treatment plant, Latvia
8. Case: combined wastewater treatment plant in Municipality of Eura, Finland
9. Case: Warsaw Waterworks and Czajka plant, Poland
10. The Baltic Sea Challenge – sparking local action and international cooperation
11. Study visit to Ādažu Čipsi potato processing factory and pre-treatment facilities and to wastewater treatment plant at municipal City of Ādaži.

Read more about the event: https://bestbalticproject.eu/event/best-project-workshop-on-management-of-effluents-from-food-and-dairy-production/

Workshop in Kaliningrad, 26–28 November 2019

Programme: https://bestbalticproject.eu/wp-content/uploads/2019/12/BEST_Kaliningrad_wokshop_PROGRAM_final.pdf

Presentations: https://bestbalticproject.eu/materials/event-materials/best-project-workshop-in-kaliningrad-russia/

Topics:

1. Legislative framework and its implementation in Russia
2. Requirements for wastewater treatment in Russian Federation. Integrated environmental permits for WWTP
3. Sewage treatment system of «Producty pitaniia Kombinat» Ltd, Kaliningrad
4. Best available technologies for industrial sewage treatment
5. Industrial wastewater at MWTTP Vitebsk Vodokanal (in Russian)
6. Energetic autarky wastewater treatment in Germany
7. Pre-treatment at dairy company Latvijas Piens, Latvia
8. Pre-treatment at dairy company E-Piim and cooperation with Põltsamaa WWTP, Estonia
9. Impact of inhibitors used in varying industries on municipal treatment processes
10. Different tertiary treatment materials for suspended solids, phosphorous and heavy metals removal
11. Pilot-scale fermentation installation in Leszno Water Utility in Poland
12. Phosphorus recovery from wastewater using calcium silicate material in Doruchów WWTP. Video of the Doruchów investment
13. Site visit at fish can industrial complex LCC “RosKon” and municipal WWTP “OKOS”.

Read more about the event: https://bestbalticproject.eu/event/best-project-workshop-on-pre-treatment-for-industrial-effluents/

Annex. Example of the national seminar based on the Estonian best practice

Program for the seminar:

Welcome

Presentation:
Daily struggle that the wastewater treatment plans have with filamentous bacteria from the dairy industry. The presentation can be found:
https://drive.google.com/open?id=1GpYPtW56zFOJ4yIha8UDFBQPTMFqqm4H

Presentation:
Focusing on the characterization of the activated sewage sludge.
The presentation can be found:
https://drive.google.com/open?id=1aZug5yXT6vpp2iy63HKnWBA2F8w_cAFx

Lunch

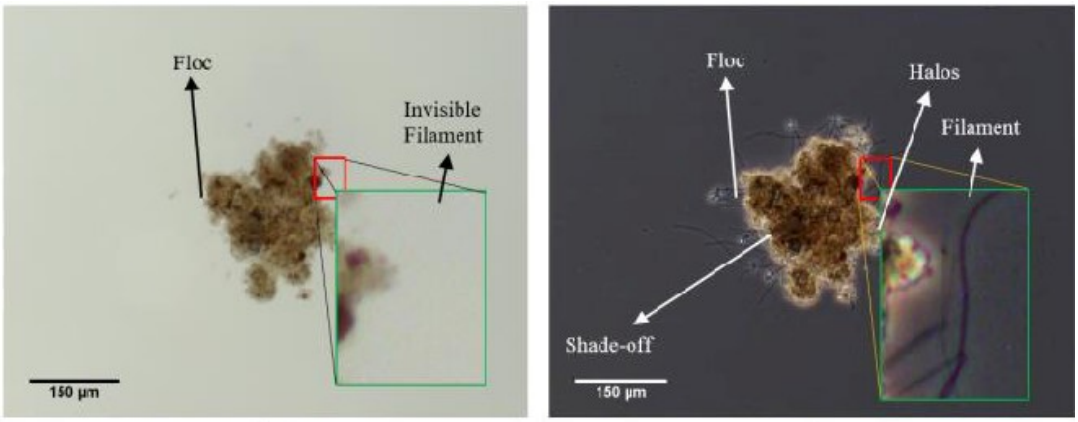
Presentation: Outlined the activities that an industrial customer could follow in order to reduce the pollution load on a domestic wastewater treatment plant. The presentation can be found:
https://drive.google.com/open?id=1IntfGoenWeusuqClBcN5AJb3FWg5aNlc

Coffee break

Presentation: How the biological treatment of industrial wastewater differs from the treatment of domestic wastewater? The presentation can be found:
https://drive.google.com/open?id=1g9YSerA5xeZ_DD_yC9kvpzWWqW05U67r

Workshop: Examination of activated sludge.
The water companies that are interested in the activated sludge can send the sludge samples for a research. The bacteriological composition of the samples can be examined by using a microscope, picture displayed on the whiteboard. The lecturer can outline in samples under examination the factors that characterized the biological treatment of a specific wastewater treatment plant. All different phenomena found in samples can be taken into consideration. In the last phase of the workshop, solutions were suggested for more efficient operation of the wastewater treatment plant in the future.

To provide more accurate results of analyse, a phase-contrast microscope is needed instead of Brightfield microscope. See the picture below to see the difference between the microscopes:



(a) Brightfield microscopy (b) Phase-contrast microscopy

Expected results: Practical guidelines for both industries and wastewater treatment plants. Increased knowledge of activated sludge in the wastewater treatment process. Practical knowledge what can industry itself change in its production process to make the wastewater produced safer.