

## Midterm report for WG1 – Intersectoral bridging

Lead: Judit Knisz

Vice Lead: Jan Stouilil

Our working group has 115 members, 53 female and 61 male, 1 prefers not to tell. In the first 2 years, we had 10 working group meetings, 7 online and 3 face-to-face. The general attendance is around 25-30 people per meeting with good activity.

The main goal of WG1 is to **provide a platform for knowledge sharing and critically reviewing the status quo in MIC**, which can form the basis of a road map for the next decade of MIC research.

Below, tasks and deliverables of WG1 as well as the effort to achieve them and/or their success is listed:

### **Task 1.1. To develop a MIC-roster with member's expertise, capabilities and suggested list of challenges with a specific focus on environmental and societal aspects (CB7)**

**Deliverable:** D7: MIC-roster (T1.1) of specialists in the field "Who is Who in MIC" published on the Euro-MIC Webpage (deadline: M36) (CB1, CB2)

#### **Objectives:**

CB1 - Create a forum for European MIC community to foster interdisciplinary and intersectoral collaboration and sharing of knowledge, best practices and most impactful developments in MIC in the focus areas of "Diagnosis, Monitoring and Mitigation".

CB2 - Stimulate knowledge and experience sharing between different stakeholders from academia, industry and consultancy by generating a common language, a forum, and most importantly, by building trust between different sectors and between countries

CB7: Establish a permanent community and contact network of experts from scientific, academic, industrial, governmental organisations and national/regional initiatives/platforms.

In the 1<sup>st</sup> grant period (GP1), we have started to collect **MIC specialists and a list of experts has been published on the website**, by contacting further stakeholders through round-table meetings, we continue the collection of MIC experts and update the list in the Euro-MIC website periodically. This allows stakeholder to search for expert in the field of MIC. There are 2 versions of MIC Roster. The internal part covers personal data and contacts of 188 MIC Experts. The public part is currently available on the EuroMIC website ([www.euro-mic.org/participants/](http://www.euro-mic.org/participants/); [www.euro-mic.org/wg1-intersectoral-bridging/](http://www.euro-mic.org/wg1-intersectoral-bridging/); [www.euro-mic.org/wg2-diagnostic-technology-development/](http://www.euro-mic.org/wg2-diagnostic-technology-development/); [www.euro-mic.org/wg3-development-of-innovative-monitoring-technologies/](http://www.euro-mic.org/wg3-development-of-innovative-monitoring-technologies/); [www.euro-mic.org/wg4-strategize-green-mitigation-methods/](http://www.euro-mic.org/wg4-strategize-green-mitigation-methods/); [www.euro-mic.org/wg5-achieving-standardization/](http://www.euro-mic.org/wg5-achieving-standardization/)). It contains approx. 80 experts, who provided the consent with public sharing of their data, and the number is rising.

**Suggested list of challenges with a specific focus on environmental and societal aspects** is achieved by reviewing the *status quo* of MIC. To **review the status quo**, we have published an **open access, peer-reviewed review article** in the prestigious *FEMS Microbiology Reviews* **addressing a list of challenges** and highlighted the need of interdisciplinarity and intersectoral

communication among academia and industry. There is very positive feedback from the MIC community and although the publication become available in its final version only at the beginning of September, there is already 2 independent citations as of the end of October. The publication was a true collaboration between working groups of our COST Action and between scientists from all over the world (Europe, Canada, USA, Australia). The article can be downloaded from: <https://doi.org/10.1093/femsre/fuad041>

We have also started **writing sectoral articles** focusing on specific industrial sectors where *MIC cases affect the environment and/or the society*. A review about *green energy* is almost ready to submit, it will be published in GP3 Q1 or Q2. The *utilities sector* review work has been started and will be submitted in GP3. The *nuclear industry/cooling water systems* review work has been launched in Q4 of GP2 and a manuscript is expected ready to be submitted in Q4 of GP3 or Q1 of GP4.

Furthermore, we have performed **bibliometric analysis** to demonstrate the siloed nature of MIC research, at first only in the oil and gas sector. This study was performed under the framework of a VM grant and presented at the ISMOS9 conference. During our study, however, we have realized that many articles fail to address the right questions and bibliometric studies are often superficial. Thus, we have started to write an article about how to properly perform bibliometric studies using the example we did on MIC cases in the oil and gas sector. We aim to add bibliometric analysis into some of our sectoral reviews as well to further help pinpointing silos and gaps in collaboration in the given sector.

**In summary:** Goal T1.1 has been achieved as a list of MIC experts are available on the website, and by publishing the FEMS review, we outlined the *status quo* of MIC research. However, we plan to dive deeper and further reviews will be published to define knowledge gaps in specific sectors, especially in those that directly affect society and/or the environment (e.g. nuclear, utilities, green energy).

### **Task 1.2: Organization of round table meetings with stakeholders to establish a common language and short intersectoral secondments for fostering interdisciplinarity (RC1, CB1, CB2, CB3, CB5)**

#### **Deliverables:**

*D5: Publication of the gained knowledge from the collaboration in COST Action in book form, digitally or as part of an edition of a scientific journal as well as the publication of educational books. (Deadline: M30) (RC1, RC4, RC5, RC6, CB1, CB2)*

*D6: MIC-glossary (common language: RC1/CB2) and report on the technology gaps in MIC diagnosis, monitoring and mitigation in dedicated sessions. (Deadline: M30) (RC1, RC4, RC5, RC6, CB1, CB2)*

#### **Objectives:**

*RC1 - Define (especially for different disciplines) common terminology for MIC and related processes for the interdisciplinary MIC community of microbiologists, corrosion specialists and engineers, marine biologists, chemists, materials scientists, engineers, managers and regulators.*

*RC4 - Devise a strategy for MIC analysis (i.e. tests and analytical methods) considering differences in the availability of infrastructure and expertise of personnel in various sectors.*

*Define the basic level of analysis for reaching a conclusive identification of MIC and to bring this knowledge to respective standardization committees.*

*RC5 - Screen biofilm and MIC monitoring methods for field of application, assessment of their strengths and weaknesses, as well as their economic feasibility and sustainability. Identify critical knowledge and technology gaps.*

*RC6 - Screen MIC mitigation strategies based on surface functionalisation and dosing of antifouling agent (e.g., biocides) in terms of their efficacy, efficiency, applicability and environmental impact. Identify critical knowledge and technology gaps.*

*CB1 - Create a forum for European MIC community to foster interdisciplinary and intersectoral collaboration and sharing of knowledge, best practices and most impactful developments in MIC in the focus areas of “Diagnosis, Monitoring and Mitigation”.*

*CB2 - Stimulate knowledge and experience sharing between different stakeholders from academia, industry and consultancy by generating a common language, a forum, and most importantly, by building trust between different sectors and between countries*

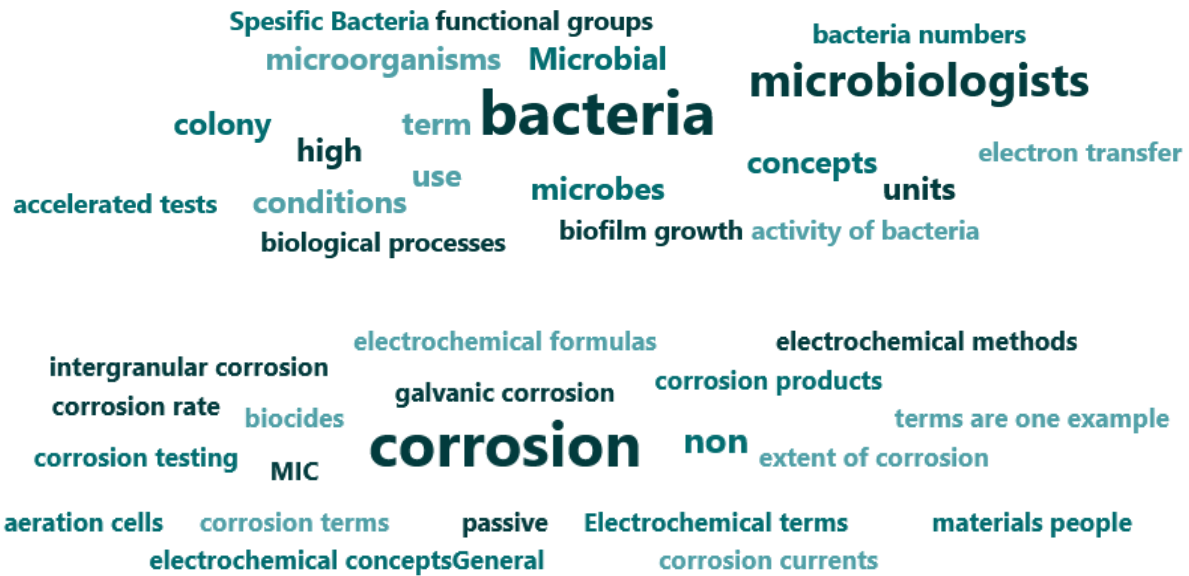
*CB3 - Active involvement of regulatory bodies or policy makers to increase the publicity and importance of MIC in the industry.*

*CB5 - Recruit and train Early Career Investigators (ECI) to boost their career prospects during and after the Action by providing an interdisciplinary network platform and increasing their awareness of practical industrial issues that can benefit from the results of research.*

In the 1<sup>st</sup> GP we have started to survey national case studies and to communicate with different stakeholders. In the 2<sup>nd</sup> GP, WG1 members organized local **round table meetings** and invited interested stakeholders to the MIC courses organized by the COST Action. Unfortunately, this wasn't a successful approach, though some members were able to organize round table meeting of 5-6 people (e.g., in Norway), but we felt it is not efficient enough. Thus, by using a Virtual Mobility grant, we have developed a **survey** (entitled *Round table survey - Corrosion in your sector*), in collaboration with WG3, to target a wider range of stakeholders at conferences, through LinkedIn, national corrosion associations, etc. The survey was then translated first into Hungarian and disseminated at national level. In the 3<sup>rd</sup> GP it will be translated to all languages of our Euro-MIC community and will be disseminated at national levels, too.

The survey (<https://forms.office.com/e/vWESm3FzRj?origin=lprLink>) helps to gain information on how stakeholders handle corrosion issues in their industry/plant/system and how they get information related to corrosion issues, including Microbiologically Influenced Corrosion (MIC). The survey also addresses issues related to technologies in MIC diagnosis, monitoring and mitigation, thus, it will help us identify *technology gaps in MIC diagnosis, monitoring and mitigation* (D6). Respondents can share their contact details and it allows us to reach out to them which helps grow our network in Europe and beyond.

In GP1, we have started to collect contradictory terms from different disciplines by using a survey (<https://forms.office.com/r/PYxJBYYKnJ>). The following terms were identified that are difficult to conceive for either non-biologists or non-material engineers, respectively:



In GP2 we went further and during the training courses, we highlighted the need of a common language. Also, in the FEMS Microbiology Reviews, we highlighted some of the difficulties stemming from using technical terms that don't mean the same for everyone. Also, by using a VM grant, a list of terms, standard definitions were collected from various standards and technical documents. In GP3 we will supplement this list of these terms with definitions/explanations from the perspective of multiple disciplines as well as definitions for lay people to help communication and close the gap between operators and academics. We plan to publish this **MIC glossary** in an open access journal or as a white paper on the Euro-MIC website.

We have started to work on a **book to combine the gained knowledge from the collaboration of our COST Action (D5)**. The book will be published by CRC press, the editors are Andrea Koerdt, Judit Knisz, Elisabete Silva, Scott Wade. Although the deadline for D5 is month 30, we strongly believe that we can gain the most out of this publication if we collect most of the achievements of our COST Action, thus, we will submit the manuscript at the end of GP4 and the contract we have signed also contains this deadline.

**In summary:** T1.2. is partially achieved. Though we identified difficulties with roundtable discussions, we overcome this by preparing a survey. A list of terms is already prepared and deliverable 6 (D6) will be achieved on time at month 30. By analysing the survey, technology gaps in MIC diagnosis, monitoring and mitigation will be identified (D6). Although the publication of the book will be published later than planned, still, it will be delivered within the scope of this Action.

### **Task 1.3: To establish a code-of-conduct and a secure platform for data sharing (RC2, CB1, CB2)**

#### **Objective:**

*RC2 - Compile and assess MIC related case studies in Europe in marine/offshore applications, communal water systems and other industrial facilities to accurately determine the role of MIC in the failure.*

*CB1 - Create a forum for European MIC community to foster interdisciplinary and intersectoral collaboration and sharing of knowledge, best practices, and most impactful developments in MIC in the focus areas of “Diagnosis, Monitoring and Mitigation”.*

*CB2 - Stimulate knowledge and experience sharing between different stakeholders from academia, industry, and consultancy by generating a common language, a forum, and most importantly, by building trust between different sectors and between countries.*

We have developed a **code-of-conduct** for Euro-MIC COST Action participants, including the ethics of data sharing and have published it on the Euro-MIC webpage (<https://www.euro-mic.org/the-euro-mic-cost-action-code-of-conduct/>). We have shared it with all CA20130 participants (see the October newsletter) and everyone who joins to our Action will need to declare that during their work they will adhere to this code.

In GP1 we have inquired from WG1 members what are the type of data that may require a secure platform and some options have been investigated, we have continued this work in GP2. Three different classes of data have been identified and **secure platforms of data sharing** was established.

- 1) Data which could be shared with a community of experts. To facilitate data sharing of such data, EuroMIC has started a community on Zenodo (<https://zenodo.org/communities/microbially-influenced-corrosion/>). Currently, the curation rules are subject to discussion. Zenodo permits data sharing only within the communities and thus serves the purpose of wider sharing. The person sharing would be obvious in this case, unless the person takes care to disguise their identity.
- 2) Data which can be shared with dedicated experts. WG4 has developed a survey (<https://inqueritos.ciencias.ulisboa.pt/index.php/319538>). This survey is hosted on a server of the University of Lisbon and permits description of MIC-related field cases.
- 3) Data which should be shared only with very few individuals, with the option to send in anonymously. To that end, a prototype for data sharing was developed on a self-hosted next cloud; the link is currently not publicly available due to ongoing discussions about exact hosting arrangements and data access arrangements. No whistle-blower level protection has been realised; e.g., for security reasons, IP addresses are still logged. Depending on server hosting arrangement, this solution could be developed into a fully anonymous version.

*Discussions within the consortium have shown that extremely secure data sharing for this type of data is most likely not required. If the concerns are very high for e.g. endangering business interest, data would preferably not be shared. However, by experience from consortium members, many industrial partners are open to some data sharing as long as data cannot be publicly linked to failure cases of this particular company. We will thus focus on this route further in the project.*

#### **T.1.4.: Populate MIC case data with input on metadata from Task T2.1 for the new edition of the “Corrosion Atlas” (M48) (RC2, CB1, CB2)**

*Deliverable: D6: MIC-glossary (common language: RC1/CB2) and report on the technology gaps in MIC diagnosis, monitoring and mitigation in dedicated sessions. (Deadline: M30) (RC1, RC4, RC5, RC6, CB1, CB2)*

##### **Objectives:**

*RC1 - Define (especially for different disciplines) common terminology for MIC and related processes for the interdisciplinary MIC community of microbiologists, corrosion specialists and engineers, marine biologists, chemists, materials scientists, engineers, managers and regulators.*

*RC2 - Compile and assess MIC related case studies in Europe in marine/offshore applications, communal water systems and other industrial facilities to accurately determine the role of MIC in the failure.*

*RC4 - Devise a strategy for MIC analysis (i.e. tests and analytical methods) considering differences in the availability of infrastructure and expertise of personnel in various sectors. Define the basic level of analysis for reaching a conclusive identification of MIC and to bring this knowledge to respective standardization committees.*

*RC6 - Screen MIC mitigation strategies based on surface functionalisation and dosing of antifouling agent (e.g., biocides) in terms of their efficacy, efficiency, applicability and environmental impact. Identify critical knowledge and technology gaps.*

*CB1 - Create a forum for European MIC community to foster interdisciplinary and intersectoral collaboration and sharing of knowledge, best practices and most impactful developments in MIC in the focus areas of “Diagnosis, Monitoring and Mitigation”.*

*CB2 - Stimulate knowledge and experience sharing between different stakeholders from academia, industry and consultancy by generating a common language, a forum, and most importantly, by building trust between different sectors and between countries.*

This task is due to the end of the Action. We expect that the round-table survey will help us to reach out stakeholders who will share their case studies. Also, we developed the format of the platform for secure data sharing that it is similar to the Corrosion Atlas format. Further discussion will be conducted in GP3 about proper collection of case studies. If companies share their cases and agree on its population, it will be easy to transform them into **case studies for the Corrosion Atlas**.

#### **Shared goal among WG1-4: To publish online course materials on MIC mechanisms and diagnosis for failure analysis on the webpage**

*D3: Online course materials on MIC mechanisms and diagnosis for failure analysis published on webpage (M24) (RC3, RC4, RC9, RC10)*

##### **Objectives:**

*RC3 - Define environmental and process related parameters that need to be recorded to enable an adequate and conclusive analysis of the role of MIC in the observed damage or failure.*

*RC4 - Devise a strategy for MIC analysis (i.e. tests and analytical methods) considering differences in the availability of infrastructure and expertise of personnel in various sectors.*

*Define the basic level of analysis for reaching a conclusive identification of MIC and to bring this knowledge to respective standardization committees.*

*RC9 - Develop common test procedures and standards to ensure a valid procedure for MIC damage assessment; standard procedures will ensure that valid comparisons can be made with other cases and that enough supporting data are collected.*

*RC10 - Disseminate and translate current research into practical industry tools and rationales for asset and critical infrastructure integrity management.*

A **free online course material** with a content of over 6 hours was developed with the help of Rick Eckert, Torben Lund Skovhus and Judit Knisz. The course was made publicly available at: <https://mic-academy.mylearnworlds.com/course/cost-assessing-mic> and it is also available on the landing page of the Euro-MIC webpage (<https://www.euro-mic.org/>) as well as from link in the Publications section (<https://www.euro-mic.org/publications/>) from Also it was shared through LinkedIn and other social media platforms. As of the end of October, 134 people have already signed up for and 4 have completed the course and earned a certificate. Report on the free online course is in a separate document.

### **Shared Goal among WG1-4: To organize MIC training courses.**

*Deliverable: D2: Report on the Training Schools (2<sup>nd</sup> and 4<sup>th</sup> year of the COST Action) (M18/M24) (CB4, CB5)*

#### **Objectives:**

*CB4 - Integrate MIC concepts into curricula (undergraduate/graduate) and researcher training.*

*CB5 - Recruit and train Early Career Investigators (ECI) to boost their career prospects during and after the Action by providing an interdisciplinary network platform and increasing their awareness of practical industrial issues that can benefit from the results of research*

A training course outline with different levels were developed and **two courses were successfully completed** in Düzce, Turkey (<http://mic.duzce.edu.tr/>) and in Prague, Czech Republic (<https://ukmki.vscht.cz/aki/mic-summer-school>).

In the 3rd GP a more advanced course will be offered with an emphasis on the application of the MLOE approach and integrated data sharing. The course will be organized in Budapest at the University of Public Service (<https://www.euro-mic.org/events/26-08-2024-budapest-mic-summer-school/>). Report on the training courses is in a separate document.