

**COST Action**  
**Progress Report at 24 months**  
**(26/10/2021 to 26/10/2023)**

**CA20130: European MIC Network**  
**New paths for science, sustainability and standards**

**Working Group 3 (WG3) Inputs**

#	WG Title	# of participants	WG Leader	Country
3	Development of innovative monitoring technologies	153	Prof. Geert Potters <a href="mailto:geert.potters@hzs.be">geert.potters@hzs.be</a>	Belgium

***This document includes the inputs of WG3 to the Progress Report of CA20130 at 24 months.***

**Summary**

**During its first two years the [WG3 of] Action progressed the achievement of this as described below**

Working group 3 (WG3) increased collaboration in the field of microbiologically influenced corrosion (MIC) not only by partnering up with other CA20130 WGs to deliver MIC dedicated training sessions, but also by having regular meetings with its members on sensors and technologies for MIC monitoring. Through such online and in-person meetings, members from different countries and different technical backgrounds were brought together for an open share of knowledge and mutual benefit where gaps between microbiology and corrosion were bridged.

It is worth stressing the participation of WG3 members in the “Citizen Science” initiative. In Turkey, Prof. Dr. Husnu Gerengi delivered a MIC dedicated magazine article for the general public. In Brazil, Mr. Andre Abilio delivered a MIC dedicated presentation in his home university, the University of Northern Rio de Janeiro. In Germany, other members joined the Long Night of Science, a night in Berlin where scientific events happen all over Berlin. At one of the venues, there was a dedicated booth to MIC where multiple CA20130 members were involved (including WG3’s).

Additionally, strong promotion and recruitment drive has resulted in 153 workgroup members now engaged from more than 35 countries. Also, the build up of a permanent MIC community is evidenced by the assigned technical author co-leads (3 x 4) and sub-group leads (5) who coordinate the WG3 tasks to be delivered. Additionally, the promotion of industry insight and investigation on applicable methods and their SWOT capabilities is paving the way for the assessment of current gaps on monitoring/inspection MIC techniques.

**Table 3.1** lists the objectives and deliverables related to WG3 tasks and their expected schedule within CA20130. The cells highlighted in yellow in **Table 3.1** indicate the progress up to the point in time of this Progress Report (month 24), and the cells highlighted in orange indicate the expected extension in time to deliver task T.3.1.

**Table 3.1: WG3 tasks and their related objectives and deliverables**

WG 3 Development of innovative monitoring technologies			Year 1				Year 2				Year 3				Year 4			
Task	Description	Related deliverables and objectives	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4
T.3.1	Screening of available methods for real time MIC monitoring, publ. of a review or perspective article	D8, RC5, CB1																
T.3.2	Screening of inspection-based MIC monitoring methods, publ. of a review article	D9, RC5, CB1																
T.3.3	Roster of companies with relevant technologies applicable to MIC monitoring	RC5, CB1, CB7																
T.3.4	Roadmap development and gap assessment for MIC monitoring	D5, D6, RC5, CB1, CB7																

## Achievement of MoU objectives, deliverables and additional outputs/ achievements (WG3)

Working Group 3 (WG3) encapsulates three MoU objectives (MO), research coordination objective 5 (RC5, equivalent to MO5), capacity-building objective 1 (CB1, equivalent to MO11), and CB7 (equivalent to MO17) – across four tasks. **Table 3.1** lists WG3 tasks and their related objectives, indicating the expected timeline for execution.

### MoU objectives (of WG3)

<b>MoU objective</b>	MoU objective 5 (MO5, 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.
<b>Type of Objective</b>	Research coordination
<b>Level of progress</b>	30%
<b>Description of progress with achieving the MoU objective</b>	MoU objective 5 (MO5) is responsibility of WG3. MO5's progress is currently at 30% and it has started at two fronts: (1) the development of a survey, from the collaboration of WG1 and WG3, to assess the maturity of MIC related monitoring/inspection techniques; and (2) the review of current standards and literature regarding MIC monitoring/inspection techniques at both the corrosion and microbiological sides. These two fronts are being carried out at three sector levels: energy, industrial water, and infrastructure. The implementation of MO5 may need a 3 to 6 months extension in respect to task T.3.1 (deadline moving from month 36 to month 39-42 – as indicated in the cells highlighted in orange in <b>Table 3.1</b> ); but MO5 progress is on time in respect to tasks T.3.2, T.3.3, and T.3.4. Consequently, MO5 in WG3 is translated into the promotion of industry insight and investigation on applicable methods and their SWOT capabilities.

<b>MoU objective</b>	MoU objective 11 (MO11, 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”.
<b>Type of Objective</b>	Capacity-building
<b>Level of progress</b>	45%
<b>Description of progress with achieving the MoU objective</b>	<p>In the context of WG3, MO11 (CB1) refers to the collaboration and share of knowledge regarding monitoring/inspection techniques between its members. Strong promotion and recruitment drive has resulted in 153 workgroup members now engaged from more than 35 countries. CB1 has been carried out since the very beginning of CA20130 through WG3 general bimonthly meetings where technical presentations are delivered (e.g., presentation by TRAQUA on hydro-geological expertise for ground water; presentation on a SWOT analysis for linear polarisation resistance [LPR]), and the subgroups within WG3 to deliver WG3 tasks. Additionally, WG3 leaders have been actively attending the progress meetings at administrative level in terms of the Core Group Meetings and the MC meetings, and organizing the workshops, summer schools and training schools delivered by EuroMIC, where the benefits of being part of WG3 could be actively shared. Therefore, CB1 is well established at WG3 and based on the means already implemented, the rate of its ongoing progress is expected until the end of CA20130 across all four of WG3 tasks (<b>Table 3.1</b>).</p> <p>Very actively, WG3, in collaboration of other WGs, directly organized the training school in Duzce, Turkey (May 2023) on “Insights into Microbiologically Influenced Corrosion (MIC) surveillance tools, threat assessment and mitigation – Industry Workshop &amp; Training”.</p> <p>In terms of the WG Meetings (i.e., Malaga in March 2022, Berlin in August 2022, and Plovdiv in April 2023), the Lead of WG3 actively engaged with the attendees, discussing actions to move forward within WG3 and the progress of WG3 with CA20130 as a whole.</p>

<b>MoU objective</b>	MoU objective 17 (MO17, CB7): Establish a permanent community and contact network of experts from scientific, academic, industrial, governmental organisations and national/ regional initiatives/ platforms.
<b>Type of Objective</b>	Capacity-building
<b>Level of progress</b>	45%
<b>Description of progress with achieving the MoU objective</b>	In the context of WG3, MO17 (CB7) refers to the very interaction of its members. The very work on WG3 tasks builds the relationships among its members and allow its members to show their value to the overall community. It translates to the present technical author co-leads (3 x 4) and sub-group leads, driving the execution of tasks in WG3. The execution of WG3 tasks are the means where its members not only become better experts but also where they can foment the MIC network and community after and out of CA20130. Therefore, CB7 is well established at WG3 and based on the means already implemented, the rate of its ongoing progress is expected until the end and even after the conclusion of CA20130. Therefore, the implementation of CB7, which relates to T.3.3, and T.3.4, is on time ( <b>Table 3.1</b> ).

### Deliverables (WG3)

Working Group 3 (WG3) encapsulates four deliverables, D5, D6, D8, and D7 – across 4 tasks. **Table 3.1** lists WG3 tasks and their related deliverables, indicating the expected timeline for execution.

<b>Deliverable</b>	Deliverable 5 (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.		
<b>Progress with achieving deliverable</b>	At the conceptualization stage	<b>Month deliverable due</b>	Month 48
<b>Explanation</b>	Deliverable 5 (D5), in the context of WG3, refers to a publication of the gained knowledge from the interaction of CA20130 members regarding monitoring/inspection techniques. Deliverable 5 (D5) is currently at the conceptualization stage, where knowledge is being share and gathered for subsequent draft. Deliverable 5 (D5) is included in T.3.4 and it is yet to start, and with planned completion at month 48 ( <b>Table 3.1</b> ). Please see also <b>Note 3.1</b> .		

<b>Deliverable</b>	Deliverable 6 (D6): MIC-glossary (common language: RC1/CB2) and report on the technology gaps in MIC diagnosis, monitoring and mitigation in dedicated sessions.		
<b>Progress with achieving deliverable</b>	At the conceptualization stage	<b>Month deliverable due</b>	Month 48
Explanation	Deliverable 6 (D6), in the context of WG3, refers to a MIC dedicated glossary and the gaps associated with MIC monitoring/inspection techniques. Similarly to D5, D6 is also included in T.3.4, planned to be delivered at month 48 ( <b>Table 3.1</b> ); and as D5, D6 is currently on the conceptualization stage, but it has already initiated.		

<b>Deliverable</b>	Deliverable 8 (D8): Review or perspective article published on methods for real time MIC monitoring (T.3.1).		
<b>Progress with achieving deliverable</b>	At the conceptualization stage	<b>Month deliverable due</b>	Month 42
Explanation	Deliverable 8 (D8) is dedicated to WG3 and refers to the execution of task T.3.1, a publication on MIC monitoring techniques. Different from what <b>Table 3.1</b> displays, D8/T.3.1 is expected to be delivered between month 39-42, instead of month 36, as previously planned. Deliverable 8 (D8) is currently at the conceptualization stage, where knowledge is being share and gathered among WG3 members for subsequent draft. Please see also <b>Note 3.1</b> .		

<b>Deliverable</b>	Deliverable 9 (D9): Publication of a review article published on inspection-based MIC monitoring methods (T.3.2).		
<b>Progress with achieving deliverable</b>	At the conceptualization stage	<b>Month deliverable due</b>	Month 48
Explanation	Deliverable 9 (D9) is dedicated to WG3 and refers to the execution of task T.3.2, a publication on MIC inspection techniques. As <b>Table 3.1</b> displays, D9/T.3.2 is expected to be delivered by month 48. Deliverable 9 (D9) is currently at the conceptualization stage, where knowledge is being share and gathered among WG3 members for subsequent draft. Please see also <b>Note 3.1</b> .		

**Note 3.1:**

Due to the publication nature of deliverables D5, D8, and D9, the current plan is to merge them into one publication, depending on the final length of the document. Specially because monitoring and inspection techniques are of the same nature when it comes to the acquisition of data. Their difference lies on the time spectrum of when data is acquired (i.e., monitoring data is acquired real time, while inspection data is acquired from time to time between larger intervals).

## Impacts (WG3)

Description of the impact, i.e. what will change, and for whom, as a result of what the Action achieved	Type of impact	Timing of Impact
Working group 3 (WG3) expects to have the following scientific and technological impacts: (1) to provide a review on the capabilities of current methods used to monitor and inspect MIC across different sectors, (2) to stimulate the interest of industry to develop and/or bridge the gaps found by EuroMIC WG3, and (3) to increase the awareness and use of methods already available which are currently overlooked.	Scientific / Technological	At the end of CA20130
In WG3 at least one member is known to have their career advanced to an engineer role due to the awareness of job posts shared by EuroMIC members. Additionally, the participation in WG3 tasks within WG3 and in collaboration with other WGs (e.g., WG1) directly provides advancement in skills and network. Working group 3 (WG3) members are being exposed to different monitoring techniques across corrosion, and biology capabilities (e.g., electrochemical techniques, chemical evaluation techniques) over WG3 technical meetings; and the share of their knowledge in such meetings results in active exchange of expertise, where professionals that did not know each other previously, start discussions and establish links enhancing their networks.	Socioeconomic / Scientific / Technological	Achieved

## Dissemination and exploitation of Action results (other than co-authored Action publications listed previously)

### Dissemination

#### Other dissemination activities (WG3)

Item/activity	Target audience	Outcome	Hyperlink
Some working group 3 (WG3) members are part of AMPP (Association for Materials Protection and Performance; formerly NACE, the (inter)national association of corrosion engineers) standard committee 22 (SC 22) on biodeterioration; and Energy Institute reservoir microbiology forum (RMF). At both organizations, WG3 members translate their MIC expertise into MIC dedicated standards and guidelines.	Energy Sector, engineers, consultants	The learnings from CA20130 are being directly streamlined into standards and disseminated to industry and academia at multiple fronts	<ul style="list-style-type: none"> <li>• <a href="#">AMPP - The Association for Materials Protection and Performance</a></li> <li>• <a href="#">Reservoir Microbiology Forum (RMF) 2023   Energy Institute</a></li> </ul>

## Other matters

### **Difficulties in implementing the Action (from WG3' perspective)**

Regarding WG3, we have a strong group of members, highly interested and competent, which also translates in their busy schedule, which is the current challenge of WG3. Due to time limitations from WG3 members, this translates in overall delays in the delivery of tasks.

### **Endangerment Measures (from WG3' perspective)**

As WG3 members are engaged but busy, the suggestion is to ask for an extension of CA20130, so members can have the opportunity to deliver despite their busy schedules.

### **Sustaining the network beyond the Action (from WG3' perspective)**

One simple idea to implement is to keep a private online document available for the members even after the Action where their emails, LinkedIn profiles, names and affiliations are available and open for updates. This document can be self-maintained by its members and it is an idea applicable to CA20130 as a whole.

On top of the suggested online share document, the relationships being built by the execution of CA20130 is already fomenting continuous collaboration among members that goes beyond the purview of CA20130.

### **Emerging topics/ developments in the field of the Action (from WG3' perspective)**

From the point of view of WG3, the topic of hydrogen and MIC is of emerging interest as the world is moving towards a hydrogen-based economy to reach Net Zero fossil/greenhouse gas emissions. This awareness is shared by other WGs within CA20130, and initiatives are already in place, where open forums and workshops are currently being delivered and EuroMIC members are strongly associated with them (e.g., EuroMIC underground hydrogen storage meeting on October 26, 2023, and the HyLife-CETP Project). One member of WG3 in particular currently work investigating the effects of microorganisms (MIC) to hydrogen embrittlement for underground hydrogen storage (UHS) assets.

The WG3 infrastructure sub-group has focused on MIC interactions in concrete and other building materials as we strive to secure sustainable materials less susceptible to degradation as part of net-zero ambitions. Concrete manufacturing has a sizable carbon footprint hence all that we can do to support industry in this domain and to secure facility integrity is critical. A review article is in development and will be published forthwith to support wider education and agreement on management strategies.