COST Action
Progress Review at 24 months
(21/10/2016 to 21/10/2018)

CA15216: European Network of Bioadhesion Expertise: Fundamental Knowledge to Inspire Advanced Bonding Technologies

This report is submitted by the Action Rapporteur in fulfilment of the requirements of the rules for COST Action Management, Monitoring and Final Assessment and is confidential to the COST Association and the Management Committee of the Action.

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Summaries

The main aim and objective of the Action is to

bring together experts from different scientific and technical sectors with common interests (1) to identify and characterize diverse bioadhesive systems, (2) to evaluate bonding properties and performance from macro- to nano-scale level and in the long term (3) design artificial blueprints

During its first two years the Action progressed the achievement of this as described below

This project started quite difficult with the change of the Action Chair in the first grant period. Also many MC members are quite new in this topic and their focus and expectation on this COST action are hardly to fulfil sometimes. But this personnel diversity on the other hands also helps partly to become actively involved (through talks or even organisation of conference sessions) in related fields such as tissue engineering, biotechnology, and cosmetics and by this build up new networks contribute to our aims and objectives through common activities and new information.
With regard to the proposed main aims and objectives, we make progress in some areas (mainly WG 1 related) received funding of several national research projects through the ENBA network. These projects will help to identify and characterize some of the bioadhesive systems in detail and use this progress for our ENBA objectives.
While the progress in WG 1 and 3 is steadily increasing, WG 2 is still our weak point in view of "performances in artificial systems". It clearly shows that we were very ambitious here and that research projects but also lighthouse projects and topics are needed to show a substantial contribution within the ENBA grant period and push still inactive members.

The Rapporteur summarised the Action's major outcomes, impacts and successes as follows

ENBA is a rather multidisciplinary COST Action, which has some positive aspects and at the same time is resulting in some issue regarding the engagement of the members with the Action. In addition, this fact also makes difficult to find a common ground and scientific interest that will promote closer interactions and collaborations within the Action members. However there are some areas mostly related to the Work Group 1 (Learning from nature – structure-function relationships) that have achieved significant progresses including a high number of scientific publication and several funded project proposals. The less developed work group is WG2 (Artificial models – understanding bioadhesion in vitro) and may be due to the high expectations of the proposal in terms of achieving in vitro data of the studied bioadhesive systems. Overall the Action is making sufficient progresses towards the generation of a crossdisciplinary EU community on the Bioadhesion field.

The Action Chair has described their plans for addressing issues identified in their report as follows

Underspend or overspend budget
To overcome this problem, major events which require a large budget (Conferences, MC meetings) will be held in the first half of the grant period. A balance check can then be carried out afterwards with adjustments being made to future spending commitments. We learned out lesson from Grant Period 2.

Inactive MC members participating on the MC meeting or planned events
Even if MC members are encouraged to participate by email, phone or directly by colleagues, there are a significant number who seem unwilling to participate actively. This is a major obstruction to the progress of the Action against its MoU goals. To mitigate the effects, we now give the inactive MC members deadlines to confirm or deny their participation at the MC meeting, afterwards nominating an MC substitute instead.

Limited take-up of STSMs, TS
STSM budget has been consistently spent and workshops have been well-reported on by attendees. It is important that not only the MC members but all ENBA participants are informed about such networking tools. The quarterly newsletter has been one way to advertise such opportunities and invite input from the Action participants as to how these opportunities can better work for them.

The Rapporteur summarised the Actions's plans for addressing issues identified in the report

The plans described to maximize the chances to achieve the MoU Objectives are adequate and they try to address all the issues identified during the first part of the Action. Strong actions need to be taken in order to ensure the active participation of the Action members and to recruit new active MC members.

Achievement of MoU objectives, deliverables and additional outputs/ achievements

MoU objectives

The Action reported progress of the following objectives.

MoU objective	Level of progress	Rapporteur assessment
Many organisms are remarkable in their ability to bonds underwater, on rough, dry or dirty substrates, and over a wide range of temperatures. The Action ENBA aims to characterise these adhesive systems, understand their structural and molecular organization, function and determine under which circumstances and surface properties bonding takes place.	76 - 100%	CONFIRMED
Artificial structures and chemical analogues based on the natural system shall be designed and evaluated i) in view of its performance and properties related to the biological system, ii) to provide a better understanding of the key characteristics and iii) to establish protocols and technological systems for a continuing production.	26 - 50%	CONFIRMED
Given the cross-disciplinary nature of bioadhesives, it is unlikely that an individual researcher would be able to tackle such a characterization alone. By knowledge transfer, research visits and easy access to a wide technical variety, ENBA will be the most effective route for the Bioadhesion community.	76 - 100%	CONFIRMED
The Action ENBA aims to strengthen scientific and technological knowledge for young researchers so that they could profit from the wide spectrum of advanced research technologies established in the different laboratories. Participation in conferences shall foster links within ENBA and the wider scientific community/industry working in the bioadhesion field.	26 - 50%	CONFIRMED
Dissemination and exploitation of Action results, methods and instrumental possibilities between participants and external experts are an integral part of ENBA. A dedicated board will coordinate all Dissemination and Exploitation activities and pave the way towards efficient and effective communication on academic, industrial and public level.	51 - 75%	CONFIRMED

Rapporteur assessment of the level of progress reported by the Action.

The Rapporteur confirmed the level of progress reported by the Action for all objectives.

Action explanation regarding MoU objectives reported as 25% or less achieved

The table below shows the Action's explanation and the Rapporteur's analysis thereof for any MoU objectives that the Action reported as 25% or less achieved.

MoU Objective that was reported as 25% or less achieved	Action's explanation	Rapporteur's analysis
The Action did not report any objectives as 25% or less achieved.		

General Assessment of MoU objectives

The level of ambition of the MoU objectives is **Medium**.
Overall, **most MoU Objectives are progressing appropriately**.

Deliverables

The table below shows, for each deliverable, the delivery status reported by the Action and the Rapporteur's comment.

Deliverable	Month deliverable due	Delivery status	Rapporteur Comment
The development of the new model generating hierarchical anti-adhesive surfaces based on biphasic colloid particles.	4	Delivered	The new model for the simulation of hierarchical anti-adhesive surfaces has been successfully developed. This work has resulted in a publication in an indexed journal, even though the impact factor of the journal is not very high the contribution is relevant for the development of the project.
An interactive and keyword-listed web-based database including archive for procedures, protocols, and media will be set up, where COST Action relevant information, results and public outreach could be uploaded.	6	Not foreseen	The Action Chair commented on the difficulties encountered to develop a web-based database with the data already published in the Book Chapter. The Chair indicated that meetings with a web designer are already planned. Therefore it is not fully clear why the design of the online archive once the date is available should be a limiting step, nowadays that are many repositories and already established platforms to deposit Open Access data. Making some efforts it is expected that this deliverable could be finalized within the project.
For testing natural glues in natural environment, there is a strong demand for small, autonomous (as portable as possible) force measurement devices with the resolution at μN. The development of the setup for measurements of low adhesion forces in the field.	4	Not delivered, but expected before end of Action	The plans described are sufficient to ensure the delivery before end of Action. The setup for measurements of low adhesion forces in the field has been already developed and will be published soon in a scientific article.
Preparation of the book "Bio-inspired structured adhesives" for publication by Springer (Editors: L.Heepe, L. Xue, S.N. Gorb).	6	Delivered	This deliverable has been already delivered as a scientific book. The book is a high quality comprehensive report on the current state of the art of Bio-inspired Structured Adhesives.
State-of-art bioadhesion-relevant article in a chemical engineering journal.	12	Not delivered, but expected before end of Action	The plans described seem sufficient to ensure the delivery before end of Action. The action has been active in publishing scientific articles and books related to the Action topic. Therefore, it is reasonable to think that they will deliver as indicated a general State-of-art bioadhesion-relevant article.

Special issue in “Journal of Adhesives”.	24	Not delivered, but expected before end of Action	The plans described are sufficient to ensure the delivery before end of Action. The Action is already planning a special issue in a Journal and has even defined the publication date.
Book at the end of the Action.	36	Delivered	This deliverable has been already delivered as a scientific book. The book is a high quality comprehensive report on the current state of the art of Bio-inspired Structured Adhesives. This book is the same reported in Deliverable 4.

General Assessment of deliverables

The level of ambition of the deliverables is **medium**.
Overall, **most deliverables are progressing appropriately**.

Additional outputs / achievements

Co-authored Action publications

The Action reported 25 publications on the topic of the Action, co-authored by at least two Action participants from two countries participating in the Action. The full list of publications appears in Annex I.

The:

- **Quality** of the Action's co-authored publications is **good**.
  Comment on quality publications form the Action during the first 24 months is good, most of the publications are in specialized journals but there are some publications in general high impact journal including ACS Nano and Acta Biomaterialia.

- **Significance** of the Action's co-authored publications is **good**.
  The significance of the research published is good considering the quantity of publications, the quality of the journals in which the articles have been published and the content of the work related to the proposal.

- **Relevance** to the Action of the Action's co-authored publications is **very good**.
  Similar to the significance of the published research the relevance of the published work in relation to the main topic of the Action is very good, some of the work published, such us a topic specific book that provides a very relevante overview on the current state of the art of Bio-inspired Structured Adhesives.

- **Quantity** of the Action's co-authored publications is **excellent**.
  The quantity of publications produced by the Action in the first 24 months is excellent, with a total of 25 contributions, including books , specialized publications and high impact publications in the field.

Projects and proposals resulting from Action activities

The Action reported the following projects resulting from Action activities involving at least one Action participant.

Title	Main proposer name	Funder
Glue characterization in centipedes	Janek von Byern	National
Bioadhesion of Flatworms	Peter Ladurner	National
Going back to basics: reverse engineering the adhesive of the sea anemone Aiptasia pallida	Nicholas Aldred	National
Adhesive and de-adhesive proteins in sea stars	Birgit Lengerer	Trans-national - The PhD student will work for two years in the lab of Dr. Patrick Flammang (Belgium) and return in the third year to her lab in Austria
Glowing mucus – Characterisation of the unique defence secretion of Latia neritoides (Gastropoda)	Sophie Greistorfer	National
The Molecular Basis of Diatom Adhesion and Motility	Nicole Poulsen	National
In vitro airway screening of muco-adhesive and -penetrating nanoparticles for macromolecular	Havazelet Bianco-Pelez	National

drug delivery targeting		
Barnacle glue proteins: harnessing blue biotechnology for improved surgical adhesives'	Anne Marie Power	National
Development of a UV-C based system for marine biofouling control	Nick Aldred	National

In addition the Action reported 5 proposals resulting from Action activities involving at least one Action participant, and for which the Action networking was necessary.

Relevance of the Action's proposals and/ or projects is **good**.

Quantity of the Action's proposals and/ or projects is **very good**.

Other outputs / achievements

The Action did not report any other outputs / achievements.

Impacts

The Action reported the following impacts (the short- to long-term scientific, technological, and / or socioeconomic changes produced by a COST Action, directly or indirectly, intended or unintended) that have resulted, or might result, from the Action.

Description of the impact	Type of impact	Timing of impact
One impact which has taken place is the case of national funding applications by two or more ENBA Cost Action members collaborating in multi-disciplinary bioadhesion research (see projects resulting from Action activities section)	• Scientific / Technological	Achieved
Validity, relevance and significance (in particular importance and timeliness) of the impact reported by the Action: The ENBA Cost members have applied for several national funding calls, in which they have included other members of the Action as collaborator. Some of these proposals have been funded, which is relevant. Since they are national projects, it is hard to evaluate how much added value had in the proposal the inclusion of collaborators from other countries.		
One impact which might develop is an EU funding proposal by a subset of researchers within the ENBA Cost Action.	• Scientific / Technological	Foreseen by the end of the Action
Validity, relevance and significance (in particular importance and timeliness) of the impact reported by the Action: This will be a key aspect and should be one main objective of the Action. The members of the Action should join efforts in order to achieve an EU collaborative project, which will be a clear positive outcome of the Action networking.		
One impact which has taken place is a bringing-together of bioadhesion-related researchers from across multiple disciplines and countries. This is manifested in a dedicated International Conference (ICBBA3 planned for Nov. 2018 in Israel), as well as in dedicated ResearchGate project, Special Issues on bioadhesion in preparation, etc.	• Scientific / Technological	Foreseen by the end of the Action
Validity, relevance and significance (in particular importance and timeliness) of the impact reported by the Action: The organization of a focused International Conference on Bioadhesion is relevant and significant. To achieve a significant impact it would be good if the Action is able to established a regular Conference within the field, as well as periodic Special Issues in this research topic.		

The extent to which the Action has advanced the careers, skills and networks of researchers including ECIs (as described by the Action) is **very good**.

Stakeholder engagement
Research community:Action participants have spoken at numerous research conferences over the first three GAPs of this Action, raising awareness of the Action research findings and the technical approaches being developed in ENBA. General public, consumers: Since GP 1 huge emphasis was placed upon public engagement and the dissemination of research findings to public stakeholders. Indeed, WG3 is dedicated to this activity and has accumulated a large body of data relating to the dissemination of science to the general public. SMEs and Industry:Communication with industry is still largely unidirectional, with active dissemination by the Action participants and passive engagement by the industry. This is not entirely unexpected, given the early/fundamental stage of the research focus in the Action. Maybe after the end of this Action tangible results could be realized, however in the meantime it is essential to actively maintain the engagement and build up a network. One area where we notably lack progress is engagement with policy makers, which will be essential if bioadhesion could replace harmful products. Within the forthcoming grant period our objective is to contact relevant policy makers (industry associations, national adhesion and sealant agencies) and keep in contact beyond this project period.
The Rapporteur recommended that the following stakeholders should also be engaged by the Action.
There are no any additional stakeholders that should be engaged by the Action. The main relevant stakeholders have been already considered.

General assessment of impacts

The Action's impacts are best described as follows:
Multiple highly significant impacts are reasonably foreseen for the future OR one highly or moderately significant impact is already observed [Very Good]

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

Dissemination

Dissemination meetings funded by the Action

The following Dissemination meeting(s) funded by the Action added value for the Action:

- FEICA Participation, 13-09-2017 - 15-09-2017, Italy
- 12th European Adhesion Conference EURADH 2018, 05-09-2018 - 07-09-2018, Portugal
- International Conference on Chemistry for Beauty and Health, 13-06-2018 - 16-06-2018, Poland

Action website

http://www.enba4.eu

The:

- openness and user-friendliness of the Action website are very good
- content of the Action website (programmes and minutes of all events present, all outputs/ deliverables accessible from website) is very good

The Action website was an effective means of disseminating the Action.

Rapporteur's comment on the website
The Action web site is very good. The website is clear and user friendly. The contents of the Action include the description of the Action; the description of the workgroups; the list of all the action participants including their contact info; all the activities organized by the Action including training schools, STSMs, scientific output and founded projects among others. In addition the website has an intranet that is supposed to be a good tool for the Action members to exchange information. Overall the Action website is an effective tool to disseminate the Action and the activities related to the Action.

Other dissemination activities

The following other dissemination activities reported by the Action were effective and added value

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	"Dias do Futuro" national radio station Antena 1 about sea urchin bioadhesives and their applications by Dr Romana Santos (Portgual)
Hyperlink	https://www.rtp.pt/play/p383/e263798/os-dias-do-futuro

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.

Outcome of the activity	"Planeta Mar" national radio station Antena 2 about ENBA, what it was, what where the goals, who was involved, by Dr Romana Santos(Portgual)
Hyperlink	https://www.rtp.pt/play/p396/e300411/especial

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	"Biosfera" TV show national tv channel RTP2 about biological and biomimetic adhesives by Dr Romana Santos(Portgual)
Hyperlink	https://player.vimeo.com/video/267602976

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	‘Der Standard’ national newspaper in Austria on glow worm adhesives by the MC member Janek von Byern (Austria)
Hyperlink	https://derstandard.at/2000049350375/Neuseelaendische-Gluehwuermchen-angeln-mit-Harnstoff-nach-Muecken

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	‘New Scientist’ international magazine article on glow worm adhesives on glow worm adhesives by the MC member Janek von Byern (Austria)
Hyperlink	https://www.newscientist.com/article/2116354-cave-glow-worms-vomit-long-sticky-urine-threads-to-catch-prey

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	‘Der Standard’ national newspaper article by the MC member Peter Ladurner (Austria) about C. elegans and its glue
Hyperlink	https://derstandard.at/2000080700776/Ungewoehnliches-Wesen-mit-Superkleber-Gen

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	‘National Geographic’ international magazine article on adhesion by the Mc member Dr Sylvia Nurnberger (Austria) and ENBA member Martina Marchetti-Deschmann (Austria)

Hyperlink	https://news.nationalgeographic.com/2018/01/animals-ticks-saliva-health-disease/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	ORF Science' magazine article on salamander adhesion by the Mc member Janek von Byern (Austria)
Hyperlink	https://science.apa.at/rubrik/medizin_und_biotech/Biokleber_als_Alternativen_zu_schaedlichen_Medizin-Klebstoffen_gesucht/SCI_20170228_SCI39371351234725660

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	'ORF Science' magazine article article on adhesion tick by the Mc member Dr Sylvia Nurnberger (Austria) and ENBA member Martina Marchetti-Deschmann (Austria)
Hyperlink	https://science.orf.at/stories/2826760/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	'Der Standard' national newspaper article on adhesion tick by the Mc member Dr Sylvia Nurnberger (Austria) and ENBA member Martina Marchetti-Deschmann (Austria)
Hyperlink	http://derstandard.at/2000052870596/Zecken-Zement-als-Gewebekleber

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	National newspaper article on adhesion tick by the Mc member Dr Sylvia Nurnberger (Austria)and ENBA member Martina Marchetti-Deschmann (Austria)
Hyperlink	http://www.ots.at/presseaussendung/OTS_20170220_OTS0023/zecken-zement-als-moeglicher-biologischer-klebstoff-fuer-menschliches-gewebe

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	'Der Standard' national newspaper article on salamander and glow worm project by MC member Janek von Byern (Austria)
Hyperlink	http://derstandard.at/2000053900545/Zecke-Muschel-Salamander-Die-Natur-produziert-die-besten-Klebstoffe

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	"Tirol heute report" regional TV programme about adhesion research in flatworms and ascidians with MC member Peter Ladurner (Austria) and ENBA member Ute Rothbächer (Austria)
Hyperlink	https://tirol.orf.at/news/stories/2833856/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	„Radiodoktor - das Ö1 Gesundheitsmagazin“ ORF national radio programme about research on ticks by the Mc member Dr Sylvia Nurnberger (Austria) and ENBA member Martina Marchetti-Deschmann (Austria)
Hyperlink	http://oe1.orf.at/programm/461012

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	‘The Conservation’ Blog post on adhesion research by the MC member Nicholas Aldred (UK)
Hyperlink	http://theconversation.com/glues-inspired-by-nature-will-give-us-faster-ships-surgical-adhesives-and-sticky-car-tyres-69505

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	Blog post on anemone research on University lab page by the MC member Nicholas Aldred (UK)
Hyperlink	https://blogs.ncl.ac.uk/ateam/join-us/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	"Know in the unknown" ("Zināmais Nezināmajā") national radio programme, interview with the MC member Arita Dubnika (Latvia) and Jelena Butikova (Latvia) talking about the ENBA network
Hyperlink	http://lr1.lsm.lv/lv/raksts/zinamais-nezinamaja/zinatnieki-macas-no-dabas-plano-darbu-pie-bioadhezivajiem-jeb-sa.a84202/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	“Lidovky.cz” national online diary entry about adhesion research by MC member Michal Žurovec (Czech Republic)
Hyperlink	http://neviditelnypes.lidovky.cz/prirodni-lepidla-0ec-/p_zviretnik.aspx?c=A170110_074625_p_zviretnik_kosa

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	‚New Scientist‘ international science magazine article titled „ticks use sticky pads on their feet to cling on to our skin“ by MC member Dagmar Voigt (Germany)
Hyperlink	https://www.newscientist.com/article/2133290-ticks-use-sticky-pads-on-their-feet-to-cling-on-to-our-skin

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	Industry e-zine interview with industrial ENBA members about adhesives and administration of medical cannabis by the MC member Meir Haber (Israel)
Hyperlink	https://spinoff.com/biota

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	Participation at the BioNanoMed Krems Austria by MC member Alejandro Sosnik (Israel)
Hyperlink	http://www.bionanomed.at/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	Bioinspired Materials 2018 conference by MC member Nicholas Aldred (UK)
Hyperlink	http://www.rsc.org/events/detail/33506/bioinspired-materials-2018-conference

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and

	public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	Participation at the EURADH 2018 - 12th Adhesion European Conference by MC member Romana Santos (Portugal)
Hyperlink	https://paginas.fe.up.pt/~euradh2018/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	Participation at the In-adhesives symposium (Adhesives and their Applications) by the Mc member Janek von Byern (Austria)
Hyperlink	http://www.in-adhesives.com/

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	- "Night of the Museums" in Dresden by the MC member Dagmar Voight (Germany). The Botanical Garden of the Dresden Technical University Dresden) was one of the participating locations. The motto of the garden was "Tierisch was los" which roughly translates as: “besides plants also many animals active in the garden - look at them”). The ENBA exhibits during this evening included "Living in the trap: the sticky Roridula plants and its antiadhesive mirid bug inhabitants", along with posters about the Asparagus beetle eggs, pollinators' attachment on plant surfaces, and Potato beetle attachment. The ENBA icon and web address was provided on all A0 and A3 posters. And visitors were also told about the ENBA network. Almost 1000 visitors were counted during this night
Hyperlink	https://museumsnacht.dresden.de/index_de.php

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	‘Falling Walls’ competition 2017 entry titled ‘Breaking the Wall of Barnacles, Bacteria and Beyond’, won national (Ireland) 1st prize on Sept. 2017 by Joanne Duffy (Ireland) and Anne Marie Power (Ireland).
Hyperlink	https://www.youtube.com/watch?v=QePbwEDI_XY

Item/activity	Publication of the ENBA progress and outcome as (inter)national newspapers, scientific and public magazines, Interviews in TV and Radio, General public relation output
Target Audience	With this dissemination activity the focus is laid mainly on the general national public, school children, colleagues and other research-interested persons to get informed about the topic and their national researchers involved.
Outcome of the activity	Launch of “NovoVerse”, an e-journal for undergraduate research, Joanne Duffy (Ireland) spoke at this launch about the importance of her bioadhesion research and that of others in the University.

Hyperlink	https://www.nuigalway.ie/about-us/news-and-events/news-archive/2017/october2017/nui-galway-launches-firstundergraduate-ejournal-for-student-research-.html

Exploitation activities

No exploitation activities were reported by the Action.

Assessment of Action dissemination and exploitation activities

The effectiveness of the Action’s dissemination and exploitation approach (other than co-authored publications) is assessed as follows

There are no specific Exploitation Activities described in the progress report. However, the Action chair provides and assessment of the effectiveness of the Action's Dissemination and Exploitation Approach. The Chair argues that since the purpose of the Action was to address gaps in basic knowledge and to build a research community, it is not realistic to expect that patents and other commercial outcomes can happen until the end of this COST Action. They expect to obtain those outcomes in the forthcoming years, which seems reasonable. They also indicate that they will maintain constant awareness of progress in our community, and will take necessary steps to protect IP, this is important since the protection of the IP needs to be considered at the very early stages of the technology development. The Action has already produced many scientific publications and it would be good to implement a specific plan at the Action level to analyze the potential of each fundamental development before its publication, so the publication does not compromise future IP protection.

Assessment of Action dissemination and exploitation activities

Most Action activities focusing on dissemination of Action results were effective [Good]

Other matters

Difficulties in implementing the Action

The Action Rapporteur made the following observations regarding difficulties in implementing the Action:

The Action Chair reports on persistent problems related to the inactivity of the MC members. At the proposal preparation stage it is expected to consolidate a core group of members really engaged with the Action that can nucleate the Action activities. Active actions should be taken by the Chair with the support of the funding agency in order to change MC members during the duration of the Action to improve the participation of the participant members.

Emerging topics / developments in the field of the Action

The Action did not report any emerging topics / developments in the field of the Action.

Action Rapporteur

This Second Progress Report was submitted on 2019-01-31 by:
Prof Aitziber Lopez Cortajarena
CIC-biomaGUNE
Spain

Annex 1: List of publications

The Action reported 25 publications on the topic of the Action, co-authored by at least two Action participants from two countries participating in the Action.

Co-authored Action publications - peer-reviewed

Title	Salamanders on the bench – A biocompatibility study of salamander skin secretions in cell cultures
Authors	Janek von Byern; Dietrich Mebs; Egon Heiss; Ursula Dicke; Oliver Wetjen; Kristin Bakkegard; Ingo Grunwald; Susanne Wolbank; Severin Mühleder; Alfred Gugerell; Heidemarie Fuchs; Sylvia Nürnberger
DOI	doi:10.1016/j.toxicon.2017.05.021
Type	Journal article
Published in	Toxicon
Published by	Elsevier BV
ISSN	0041-0101
Links	http://api.elsevier.com/content/article/PII:S0041010117301599?httpAccept=text/xml; http://api.elsevier.com/content/article/PII:S0041010117301599?httpAccept=text/plain

Title	Chemical characterization of the adhesive secretions of the salamander Plethodon shermani (Caudata, Plethodontidae)
Authors	Janek von Byern; Ingo Grunwald; Max Kosok; Ralph A. Saporito; Ursula Dicke; Oliver Wetjen; Karsten Thiel; Kai Borcherding; Thomas Kowalik; Martina Marchetti-Deschmann
DOI	doi:10.1038/s41598-017-05473-z
Type	Journal article
Published in	Scientific Reports
Published by	Springer Nature
ISSN	2045-2322
Links	http://www.nature.com/articles/s41598-017-05473-z; http://www.nature.com/articles/s41598-017-05473-z.pdf

Title	Electrostatic immobilization of antimicrobial peptides on polyethylenimine and their antibacterial effect against Staphylococcus epidermidis
Authors	J. Hernandez-Montelongo; Y.R. Corrales Ureña; D. Machado; M. Lancelloti; M.P. Pinheiro; K. Rischka; P.N. Lisboa-Filho; M.A. Cotta
DOI	doi:10.1016/j.colsurfb.2018.02.002
Type	Journal article
Published in	Colloids and Surfaces B: Biointerfaces
Published by	Elsevier BV
ISSN	0927-7765
Links	http://api.elsevier.com/content/article/PII:S0927776518300717?httpAccept=text/xml; http://api.elsevier.com/content/article/PII:S092777

6518300717?httpAccept=text/plain

Title	Adhesive free-standing multilayer films containing sulfated levan for biomedical applications
Authors	Tiago D. Gomes; Sofia G. Caridade; Maria P. Sousa; Sara Azevedo; Muhammed Y. Kandur; Ebru T. Öner; Natália M. Alves; João F. Mano
DOI	doi:10.1016/j.actbio.2018.01.027
Type	Journal article
Published in	Acta Biomaterialia
Published by	Elsevier BV
ISSN	1742-7061
Subjects	Biotechnology; Biochemistry; Molecular Biology; Biomaterials; Biomedical Engineering; General Medicine
Links	https://api.elsevier.com/content/article/PII:S1742706118300382?httpAccept=text/xml; https://api.elsevier.com/content/article/PII:S1742706118300382?httpAccept=text/plain

Title	Low-friction nanojoint prototype
Authors	Sergei Vlassov; Sven Oras; Mikk Antsov; Jelena Butikova; Rünno Lõhmus; Boris Polyakov
DOI	doi:10.1088/1361-6528/aab163
Type	Journal article
Published in	Nanotechnology
Published by	IOP Publishing
ISSNs	0957-4484; 1361-6528
Links	http://stacks.iop.org/0957-4484/29/i=19/a=195707?key=crossref.cd8472eeac8f8fd36d0055e655cf308e; http://iopscience.iop.org/article/10.1088/1361-6528/aab163/pdf; http://stacks.iop.org/0957-4484/29/i=19/a=195707/pdf; http://iopscience.iop.org/article/10.1088/1361-6528/aab163

Title	Sharply Reduced Biofilm Formation from Cobetia marina and in Black Sea Water on Modified Siloxane Coatings
Authors	Danail Akuzov; Lia Franca; Ingo Grunwald; Todorka Vladkova
DOI	doi:10.3390/coatings8040136
Type	Journal article
Published in	Coatings
Published by	MDPI AG
ISSN	2079-6412
Link	http://www.mdpi.com/2079-6412/8/4/136/pdf

Title	Contribution of different tarsal attachment devices to the overall attachment ability of the stink bug Nezara viridula
Authors	Gianandrea Salerno; Manuela Rebora; Alexander Kovalev; Elena Gorb; Stanislav Gorb
DOI	doi:10.1007/s00359-018-1266-0
Type	Journal article
Published in	Journal of Comparative Physiology A

Published by	Springer Nature
ISSNs	0340-7594; 1432-1351
Subjects	Animal Science and Zoology; Physiology; Ecology, Evolution, Behavior and Systematics; Behavioral Neuroscience
Links	http://link.springer.com/article/10.1007/s00359-018-1266-0/fulltext.html; http://link.springer.com/content/pdf/10.1007/s00359-018-1266-0.pdf

Title	Tarsal attachment devices of the southern green stink bug Nezara viridula (Heteroptera: Pentatomidae)
Authors	Manuela Rebora; Jan Michels; Gianandrea Salerno; Lars Heepe; Elena Gorb; Stanislav Gorb
DOI	doi:10.1002/jmor.20801
Type	Journal article
Published in	Journal of Morphology
Published by	Wiley
ISSN	0362-2525
Links	https://api.wiley.com/onlinelibrary/tdm/v1/articles/10.1002%2Fjmor.20801; http://onlinelibrary.wiley.com/wol1/doi/10.1002/jmor.20801/fullpdf

Title	Attachment ability of the polyphagous bug Nezara viridula (Heteroptera: Pentatomidae) to different host plant surfaces
Authors	Gianandrea Salerno; Manuela Rebora; Elena Gorb; Stanislav Gorb
DOI	doi:10.1038/s41598-018-29175-2
Type	Journal article
Published in	Scientific Reports
Published by	Springer Nature
ISSN	2045-2322
Subject	Multidisciplinary
Links	http://www.nature.com/articles/s41598-018-29175-2.pdf; http://www.nature.com/articles/s41598-018-29175-2

Title	Mucoadhesive assessment of different antifungal nanoformulations
Authors	L Roque; J Alopaeus; Claudia Reis; P Rijo; J Molpeceres; E Hagesaether; I Tho; Catarina Reis
DOI	doi:10.1088/1748-3190/aad488
Type	Journal article
Published in	Bioinspiration & Biomimetics
Published by	IOP Publishing
ISSN	1748-3190
Subjects	Biotechnology; Biophysics; Molecular Medicine; Engineering (miscellaneous); Biochemistry
Links	http://stacks.iop.org/1748-3190/13/i=5/a=055001?key=crossref.70f3d64d66c0c9628b1ca5c6dd2229ff; http://iopscience.iop.org/article/10.1088/1748-3190/aad488/pdf; http://stacks.iop.org/1748-3190/13/i=5/a=055001/

pdf;
http://iopscience.iop.org/article/10.1088/1748-3190/aad488

- Development of a biodhesive nanoformulation with *Glycyrrhiza glabra* L. extract against *Candida albicans*
- The structural and chemical basis of temporary adhesion in the sea star *Asterina gibbosa*
- Examples of bioadhesives for defence and predation. In Gorb S.N. & Gorb E.V. (eds.): *Functional Surfaces in Biology III, Biologically-Inspired Systems 10*, Springer International Publishing, Cham
- Bioadhesives. In da Silva, L.F., Oechsner, A. and Adams, R.(eds.), *Handbook of Adhesion Technology,* Springer International Publishing, Cham
- Bacterial Adhesion on Polyelectrolyte Multilayers, In Budimir, A. (eds.), *Fighting Antimicrobial Resistance*, IAPC
- Adhesives for Medical Applications' In Hofer (eds), *Green Chemistry for Surface Coatings, Inks and Adhesives: Sustainable Application*, Royal Society of Chemistry

Title	Formation and composition of adsorbates on hydrophobic carbon surfaces from aqueous laccase-maltodextrin mixture suspension
Authors	Yendry Regina Corrales Ureña; Paulo Noronha Lisboa-Filho; Michael Szardenings; Linda Gätjen; Paul-Ludwig Michael Noeske; Klaus Rischka
DOI	doi:10.1016/j.apsusc.2016.05.097
Type	Journal article
Published in	Applied Surface Science
Published by	Elsevier BV
ISSN	0169-4332
Links	http://api.elsevier.com/content/article/PII:S0169433216311163?httpAccept=text/xml; http://api.elsevier.com/content/article/PII:S0169433216311163?httpAccept=text/plain

Title	Interfactant action of an amphiphilic polymer upon directing graphene oxide layer formation on sapphire substrates
Authors	Yendry Regina Corrales Ureña; Welchy Leite Cavalcanti; Marko Soltau; Karolina Villalobos; Klaus Rischka; Paul-Ludwig Michael Noeske; Kai Brune; Stefan Dieckhoff
DOI	doi:10.1186/s40563-017-0089-5
Type	Journal article
Published in	Applied Adhesion Science
Published by	Springer Nature
ISSN	2196-4351
Links	http://link.springer.com/content/pdf/10.1186/s40563-017-0089-5.pdf; http://link.springer.com/article/10.1186/s40563-017-0089-5/fulltext.html

Title	Influences of the pH on the adsorption properties of an antimicrobial peptide on titanium surfaces

Authors	Yendry Regina Corrales Ureña; Linda Wittig; Matheus Vieira Nascimento; Juliano Luiz Faccioni; Paulo Noronha Lisboa Filho; Klaus Rischka
DOI	doi:10.1186/s40563-015-0032-6
Type	Journal article
Published in	Applied Adhesion Science
Published by	Springer Nature
ISSN	2196-4351
Link	http://link.springer.com/content/pdf/10.1186/s40563-015-0032-6

Title	Extracellular micro and nanostructures forming the velvet worm solidified adhesive secretion
Authors	Yendry Regina Corrales-Ureña; Angie Sanchez; Reinaldo Pereira; Klaus Rischka; Thomas Kowalik; José Vega-Baudrit
DOI	doi:10.1088/2053-1591/aa9940
Type	Journal article
Published in	Materials Research Express
Published by	IOP Publishing
ISSN	2053-1591
Links	http://stacks.iop.org/2053-1591/4/i=12/a=125013?key=crossref.0076c5d610681db54631b31c82a9bfe4; http://iopscience.iop.org/article/10.1088/2053-1591/aa9940/pdf; http://stacks.iop.org/2053-1591/4/i=12/a=125013/pdf; http://iopscience.iop.org/article/10.1088/2053-1591/aa9940

Title	Bioadhesive polymeric nanoparticles as strategy to improve the treatment of yeast infections in oral cavity: in-vitro and ex-vivo studies
Authors	Luís Roque; Pedro Castro; Jesús Molpeceres; Ana S. Viana; Amílcar Roberto; Cláudia Reis; Patrícia Rijo; Ingunn Tho; Bruno Sarmento; Catarina Reis
DOI	doi:10.1016/j.eurpolymj.2018.04.032
Type	Journal article
Published in	European Polymer Journal
Published by	Elsevier BV
ISSN	0014-3057
Subjects	Organic Chemistry; General Physics and Astronomy; Polymers and Plastics
Links	https://api.elsevier.com/content/article/PII:S0014305718303975?httpAccept=text/xml; https://api.elsevier.com/content/article/PII:S0014305718303975?httpAccept=text/plain

Title	Properties of temporary adhesion systems of marine and freshwater organisms
Authors	Birgit Lengerer; Peter Ladurner
DOI	doi:10.1242/jeb.182717
Type	Journal article
Published in	The Journal of Experimental Biology
Published by	The Company of Biologists

ISSNs	0022-0949; 1477-9145
Subjects	Insect Science; Animal Science and Zoology; Aquatic Science; Physiology; Ecology, Evolution, Behavior and Systematics; Molecular Biology
Link	https://syndication.highwire.org/content/doi/10.1242/jeb.182717
Title	Light-Triggered Drug Release from 3D-Printed Magnetic Chitosan Microswimmers
Authors	Ugur Bozuyuk; Oncay Yasa; I. Ceren Yasa; Hakan Ceylan; Seda Kizilel; Metin Sitti
DOI	doi:10.1021/acsnano.8b05997
Type	Journal article
Published in	ACS Nano
Published by	American Chemical Society (ACS)
ISSNs	1936-0851; 1936-086X
Subjects	General Engineering; General Physics and Astronomy; General Materials Science
Link	http://pubs.acs.org/doi/pdf/10.1021/acsnano.8b05997
Title	Numerical simulation of colloidal self-assembly of super-hydrophobic arachnid cerotegument structures
Authors	Alexander É. Filippov; Jonas O. Wolff; Michael Seiter; Stanislav N. Gorb
DOI	doi:10.1016/j.jtbi.2017.07.001
Type	Journal article
Published in	Journal of Theoretical Biology
Published by	Elsevier BV
ISSN	0022-5193
Subjects	General Biochemistry, Genetics and Molecular Biology; Modelling and Simulation; Statistics and Probability; General Immunology and Microbiology; Applied Mathematics; General Agricultural and Biological Sciences; General Medicine
Links	https://api.elsevier.com/content/article/PII:S0022519317303260?httpAccept=text/xml; https://api.elsevier.com/content/article/PII:S0022519317303260?httpAccept=text/plain

Co-authored Action publications - other

- Actividad antimicrobiana de nanopartículas de óxido de Zinc (ZnO) con diferentes morfologías sintetizadas empleando ultrasonido