

Brussels, 17 May 2024

COST 024/24

DECISION

Subject: Memorandum of Understanding for the implementation of the COST Action “Searching for Nanostructured or pOre fOrming Peptides for therapY” (SNOOPY) CA23111

The COST Member Countries will find attached the Memorandum of Understanding for the COST Action Searching for Nanostructured or pOre fOrming Peptides for therapY approved by the Committee of Senior Officials through written procedure on 17 May 2024.

MEMORANDUM OF UNDERSTANDING

For the implementation of a COST Action designated as

COST Action CA23111

SEARCHING FOR NANOSTRUCTURED OR PORE FORMING PEPTIDES FOR THERAPY (SNOOPY)

The COST Members through the present Memorandum of Understanding (MoU) wish to undertake joint activities of mutual interest and declare their common intention to participate in the COST Action, referred to above and described in the Technical Annex of this MoU.

The Action will be carried out in accordance with the set of COST Implementation Rules approved by the Committee of Senior Officials (CSO), or any document amending or replacing them.

The main aim and objective of the Action is to create a network of experts and innovators from diverse disciplines and nations to overcome existing barriers to predict and implement bioactive peptides' ability to self-assemble into functional nanostructures, including those at the interface with membranes, potentially forming pores and channels, for health. This will be achieved through the specific objectives detailed in the Technical Annex.

The present MoU enters into force on the date of the approval of the COST Action by the CSO.

OVERVIEW

Summary

The COST Action SNOOPY will bring together a network of experts and young researchers from diverse disciplines (chemistry, biology, biochemistry, materials science, nanotechnology, medicine, physics) to overcome existing barriers to predict and implement bioactive peptides' ability to self-assemble into functional nanostructures, including those at the interface with membranes, potentially forming pores and channels. This is a fast-growing field with enormous potential for therapy (including targeted cancer therapy, drug delivery, amyloidosis inhibition, regenerative medicine, membrane channels, and antimicrobials), and for the development of nanotechnological tools that could include potential use in diagnostics, optics, catalysis, and bioelectronics. Theoreticians and experimentalists of the SNOOPY Action will synergize to enable in silico predictions of self-assembly behavior, as well as to develop new advanced characterization methods, and to produce them and test them too. The expertise gathered by the Action will be applied to train and build the career of younger members. The geopolitical balance of the Action is strategically set to level the gap between COST Members, and to make of its diversity a tactical asset to boost creativity and foster new ideas. The Action will have socioeconomical impact through the search for new diagnostic and therapeutic solutions to address some of the most formidable challenges of the society (e.g., advance our understanding of amyloidoses and antimicrobial resistance), to assist scientists and industry in the development of new technologies (e.g., peptide nanostructures as vaccine adjuvants) and to develop more sustainable processes (e.g., greener peptide synthesis, or using peptides as biodegradable substitutes to polluting alternatives).

Areas of Expertise Relevant for the Action	Keywords
<ul style="list-style-type: none"> ● Chemical sciences: Supramolecular chemistry ● Nano-technology: Nano-technology for pharmaceutical applications ● Biological sciences: Biophysics 	<ul style="list-style-type: none"> ● peptides ● nanostructures ● antimicrobial ● amyloids ● self-assembly

Specific Objectives

To achieve the main objective described in this MoU, the following specific objectives shall be accomplished:

Research Coordination

- Search and study bioactive peptides and their nano-assemblies for enhanced performance in disease prevention, diagnosis, imaging and/or treatment, such as the targeted delivery of bioactives, boosting of the immune response, correct interaction with proteins and other biomolecules to generate new means of therapy.
- Investigate the link between AMPs and amyloids especially from the nanomorphological point of view, and ideally at the interface with lipid membranes.
- Facilitate the standardization of practices and nanomaterials characterization based on inputs from researchers and enterprises.
- Facilitate technological transfer and/or knowledge transfer through the collaborative work established within the Action between participants from academia and industry.
- Promote knowledge dissemination to YRIs and beyond to the general public, through various channels, social media, Action website, publications, and events.

Capacity Building

- Establish interdisciplinary, multidisciplinary and/or transdisciplinary teams to facilitate the creation of a common language towards effective collaboration and creation of effective bridges across disciplines including bioactive peptides, peptide assemblies, and peptide nanostructures.
- Promote research collaborations where diversity (e.g., age, gender, geographical, discipline, etc.) will foster creativity and inclusiveness.
- Promote the training, visibility, and integration of scientists from Inclusiveness Target Countries (ITCs).
- Train and mentor YRIs who share common interests on any scientific aspect related to peptides and their nanostructures through thematic workshops and training schools.
- Promote gender balance and support YRIs, and females to maximize diversity and inclusiveness.

TECHNICAL ANNEX

1. S&T EXCELLENCE

1.1. SOUNDNESS OF THE CHALLENGE

1.1.1. DESCRIPTION OF THE STATE OF THE ART

Peptide therapeutics: The global market of peptide therapeutics was estimated to be worth 47.7 billion USD in 2022, and projected to increase at 6.9% CAGR over the next ten years, also thanks to the growing demand for novel therapeutics, according to the analysis by Global Market Insights. Indeed, peptide therapeutics have been enjoying a renaissance in recent years, thanks to the great advancements made in the field that enabled overcoming what were once key barriers for their effective use in medical treatments. The chemistry of peptides is well-understood, and the great progress of late have enabled a significant leap forward, to increase their bioavailability, potency, efficiency, and shelf- life [1]. Besides, their oral administration has been made possible through their protection against rapid enzymatic degradation by using lipid-based nanocarriers, such as liposomes, micelles, solid lipid nanoparticles, oil-in-water nanoemulsions, and self-emulsifying drug delivery systems [2]. Applications vary, and bioactive peptides have demonstrated great potential to address some of the most challenging needs in therapy. For example, cell-penetrating peptides enable the targeted delivery of therapeutics into cells and they have entered clinical trials. In particular, their conjugation with anticancer drugs has attracted wide interest to develop targeted treatments and reduce side effects. Furthermore, the use of tumor homing peptides and the exploitation of the tumor microenvironment have enabled great progress to develop new treatments. They can specifically target protein-protein interactions that play a key role in intracellular signaling cascades, which are associated with the survival of tumor cells and, thus, cancer progression [3]. Vaccines is another area that has greatly benefited from peptides, and recently also from peptide nanostructures to boost the immune response, also targeting cancer [4]. However, there are still big gaps in the understanding of peptide selectivity, and the use of peptide nanostructures for therapy is just emerging and is considerably underdeveloped.

Peptide nanostructures: Self-assembling peptide sequences have been reported since the 1990s through the LEGO design that alternated hydrophilic and hydrophobic residues to enable the formation of amphiphilic assemblies, which found ample applications especially as soft biomaterials in medicine [5]. However, it is with the discovery of the strong propensity towards self-assembly of a simple building block, such as diphenylalanine [6] that the quest for self-assembling short motifs able to form a variety of nanostructures has exploded [7]. This is because dipeptides can be produced by a variety of means, including biotechnology and liquid-phase synthesis, and are mostly commercially available too. Therefore, this field became accessible also to researchers devoid of peptide-synthesis skills, opening the way to multidisciplinary collaborative research that involved scientists from a variety of fields, spanning from medicine to biophysics, materials science, and nanotechnology [8]. Other popular approaches include the use of aromatic N-caps to favor their stacking through the establishment of π - π interactions, such as the convenient fluorenylmethoxycarbonyl (Fmoc) group that is commercially available already attached to all amino acids for solid peptide synthesis (SPPS) [9], but also others [10]. Besides, the use of non-canonical amino acids [11] and heterochiral sequences with D- and L-amino acids at different positions can be convenient to increase peptide resistance against enzymatic degradation [12]. The possibility to obtain smart systems from such simple biomolecules that can undergo several cycles of assembly and disassembly sparked interest in areas spanning from drug delivery [13], to imaging [14], cell culture [15], catalysis [16], protein crystallization [17], and even environmental remediation [18]. Furthermore, another exciting area includes the possibility to direct cellular responses [19] also thanks to the encoding of biological messages in sequences as short as three amino acids [20], for instance for the mimicry of the extracellular matrix [21]. Finally, the development of novel vaccines that exploit peptide nanostructures to boost the immune response is yet another area of great research interest that is very timely for the current challenges of our modern society [22]. However, despite the vast amount of literature on the topic in the last two decades, the design rules from sequence to self-assembly outcome are still elusive and mainly experimentally driven.

Antimicrobial peptides (AMPs): The World Health Organization (WHO) has declared antimicrobial resistance (AMR) as one of the top-10 global health threats that needs urgent action. In particular, the search is very active towards innovative antimicrobials, including antibiotics, antivirals, antifungal and antiparasites, to provide new and effective treatments for the alarmingly increasing number of infections that do not respond to traditional drugs anymore. Indeed, AMR has been increasing globally against many classes of frequently used antibiotics. As an example, ciprofloxacin, which is commonly used to treat infections of the urinary tract, shows AMR up to nearly 93% for *Escherichia coli* and up to nearly 80% for *Klebsiella pneumoniae*. Both of these bacteria are Gram-negatives that are normally found in the gastrointestinal tract, but they can also develop infections that are life-threatening, and often this occurs in hospitals [23]. At present, colistin is the only last-resort treatment that is still effective against multi-drug-resistant (MDR) Enterobacteriaceae [24]. Colistin is a classic example of AMPs, although many others are well-known and widely studied too. This polycationic cyclopeptide is able to bind anions, such as the phosphates that are displayed by the lipopolysaccharide (LPS) of Gram-negative bacilli. Colistin can displace calcium and magnesium cations, thus resulting in the impairment of the LPS three-dimensional structure and, consequently, leading to the alteration of membrane permeability [25]. Importantly, colistin can synergize with other antibiotics and their combined use in therapy increases the AM activity, with the additional benefit of reducing the emergence of AMR, too [26]. Furthermore, colistin is remarkably active on biofilms, being effective also on bacteria that are inactive metabolically, such as those that are encased in the core of the biofilm [27]. However, AMR is emerging even to colistin, and for this reason many researchers are actively engaged in a joint effort to address this challenge [28]. It is, thus, apparent that colistin can be considered the last available resource against the so-called “superbugs”, and effective research to rapidly find other AMPs could lead to potentially superior alternatives in the fight against resistant infections globally. Interestingly, many AMPs have been found to form nanostructures at the membrane interface, but often the details have not yet been elucidated, and the mechanism of action remains unclear, impeding their further development and amelioration so that significantly more AMPs can enter the clinic.

The link between amyloid and AMPs: Amyloids have been attracting great attention since the discovery of their involvement in a plethora of pathological processes. These include various forms of neurodegenerative diseases, spanning from Alzheimer’s to Parkinson’s and Huntington’s. Besides, new diseases continue to emerge for they can be associated with some form of amyloidosis, such as various cardiopathies [29]. Furthermore, there are also many proteins and polypeptides with important physiological roles and relevance to therapy, whose activity can be altered or reduced because they misfold and fibrillate, such as insulin [30]. However, many gaps still exist on what are the exact processes pertaining amyloid fibrillation, and what are the most effective strategies to reduce the pathological consequences. Importantly, new physiological roles are emerging for many amyloids, such as the antimicrobial activity reported for many polypeptides that are typically associated with diseases (e.g., Alzheimer’s amyloid beta). These findings are shedding new light on the failure of amyloid fibrillation inhibitors in clinical trials, and are providing a very interesting link between the nanomorphologies and the antimicrobial activity that could be relevant to develop new AMPs [31].

Application of *in silico* and machine learning models for the modelling and prediction of functional peptides & peptide nanostructures: The 20 gene-encoded amino acids, together with a variety of non-natural ones, constitute a versatile toolbox to obtain peptides with high chemical and structural diversity. The number of possible permutations grows exponentially with the peptide length, depending also on the number of amino acids per position. If all the 20 proteinogenic amino acids are used in r positions, there are 20^r possible permutations. Due to the huge sequence space available even for short sequences, it is challenging to establish meaningful relationships between sequence (primary structure) and function. To improve the exploration of this large space and predict peptides’ ability to self-assemble into nanostructures, several *in silico* methods including molecular dynamics (MD) simulations and, more recently, artificial intelligence methods such as Machine or Deep Learning (hereafter ML, DL) have been exploited. Machine learning (ML) is a niche in data science and a subset of artificial intelligence that computationally searches for patterns or regularities in data, enabling us to understand a phenomenon or to make predictions in the near future. By learning from data, ML/DL use the theory of statistics to build a mathematical model and to make up for the lack of knowledge. These methods are very useful to find solutions to problems for which the amount and dimensionality of data is too overwhelming to comprehend. The analysis of chemical search space is such a problem.

Moreover, chemistry costs both time and physical resources, resulting in a limit on the number of

experiments and the speed at which they can be performed. To date, artificial intelligence has been applied to a variety of chemical problems to maximize the chance of successful and rapid solving of complex issues [32,33]. ML and evolutionary algorithms are being increasingly proposed to address various challenges of peptide chemistry related to the design and identification of peptides with a desired function, including the prediction of antimicrobial, antiviral and anticancer activities [34-38]. However, data scarcity, unbalanced datasets, lack of standardized experimental procedures and labeling, lack of reported/published data of negative results slows down the efficient application of ML to accurate peptide function prediction and generalization of the acquired knowledge. A combination of MD and ML methods will help to speed-up the process of therapeutic peptide discovery and allow for a greener and sustainable peptide development process.

1.1.2. DESCRIPTION OF THE CHALLENGE (MAIN AIM)

The advent of machine-learning (ML) methods has demonstrated great potential to speed up scientific discovery and holds great promise to enable the identification of clear design rules for the development of the next-generation peptide-based therapeutics. These will include not only nanostructure-forming peptides, but also membrane-active peptides to enable targeted delivery into cells, as well as the development of new therapeutic paradigms, or instance through the control of cellular transport. However, key questions remain unanswered:

1. How can peptide self-assembly be predicted from the peptide sequence and its physico-chemical parameters?
2. Are there common bioactive features (e.g., immunogenicity, AM activity, cytotoxicity) that can be related to peptide-assembly nanomorphology and nanostructured surface properties?
3. Which models can correctly represent the main types of self-assembly and disassembly from an energetic point of view?
4. What is the exact relationship between peptide assemblies and their physico-chemical properties and responsiveness, such as the ability to enable proton and electron transfer?
5. What are the key physico-chemical parameters for drugs or biomolecules to effectively bind to peptide-assembled nanostructures as new means of diagnosis and therapy, including sustained drug release using peptide nanostructures as vehicles?
6. How can peptide self-assembly be generally controlled and directed towards specific outcomes in the cell milieu for targeted therapy (e.g., amyloidosis, cancer)?

This COST Action aims to build **inventories** of peptide nanostructures relevant to physiological conditions through the data mining search of the scientific literature as well as the new knowledge that is being created by experts in the field. The **sequence mapping** of peptide nanostructures will also be realized and organized based on the type of experimental data (e.g., X-ray crystallography, high-resolution electron microscopy, small-angle X-ray scattering, etc.), and on the type of peptide modification (if any), and experimental conditions used. Furthermore, **general standards** will be identified to provide guidelines and recommendations for researchers working in the field, both for *in silico* and experimental protocols. Indeed, on one hand, a key strength of this research area is its multidisciplinary nature that has attracted the interest from researchers belonging to very different disciplines. On the other hand, an important weakness is the lack of unified terminology across disciplines, thus requiring a collective effort to agree on common definitions and terms and to establish a standardized scientific vocabulary for this field.

Furthermore, this Action aims to find the missing links between amyloids and antimicrobial activity, to better understand the physiological role played by protein amyloids, as well as the mechanism of action of many antimicrobial peptides through the formation of nanostructures and pores at membrane interfaces. These nanomorphologies could open the way to new therapeutic means by enabling the future design of channels that can insert in the cell membranes and control transport. Other emerging areas that could benefit in the future from the fundamental knowledge generated by the COST Action SNOOPY are those relevant to the use of peptide nanostructures as vaccine adjuvants, oncology and targeted cancer treatment, and, thus, cancer vaccines too.

These challenges require a multidisciplinary approach and SNOOPY aims to bring together scientists from very different disciplines, such as physics and biophysics, organic chemistry and supramolecular chemistry, biochemistry and molecular biology, microbiology and immunology, medicine, computer science, nanotechnology and biomaterials science.

Relevance and timeliness:

In the last few decades, the literature on bioactive peptides, peptide therapeutics, and peptide nanostructures has literally exploded. The European Research Council has funded several projects on these topics in light of their enormous potential to address some of the most important challenges of our modern society. The importance of peptides is clear also from the existence of several national and international dedicated societies, such as the European Peptide Society (EPS), the American Peptide Society (APS), the Australian Peptide Society (AusPep), the Japanese Peptide Society (JPS), and the UK-based Protein and Peptide Science Group (PPSG) of the Royal Society of Chemistry. Several related COST Actions have been funded in the past to cover specific parts related to SNOOPY, such as B12 - Development of New Radiotracers for the *In-Vivo* Assessment of Biological Functions and Drug Interactions (2000-2005) that also studied radiolabeled bioactive peptides, FA0602 - Bioactive food components, mitochondrial function and health (2007-2011) and FA1005 - Improving health properties of food by sharing our knowledge on the digestive process (INFOGEST) (2011-2015) that also studied bioactive peptides from food, BM1104 - Mass Spectrometry Imaging: New Tools for Healthcare Research (2011-2015) that looked also at peptide-based diagnostic tools for medicine, D22 - Protein- lipid Interaction (2000-2006) that studied also polypeptide-membrane interactions, CM0803 - Functional peptidomimetic foldamers: from unnatural amino acids to self-assembling nanomaterials (2009-2013) that studied peptide-related and peptide-inspired nanoassemblies, and BM1405 - Non-globular proteins - from sequence to structure, function and application in molecular physiopathology (NGP-NET) on amyloids (2015-2019). Currently, related COST Actions include: CA19144 - European Venom Network (EUVEN) that will run for another year, and CA18217 - European Network for Optimization of Veterinary Antimicrobial Treatment (ENOVAT) that has ended in May 2024. Besides, the present emergency on AMR has prompted COST to create even ad hoc events on antimicrobials, such as the COST Connect on future outlooks on antimicrobial resistance held in 2022 that gathered experts across Actions and beyond.

1.2. PROGRESS BEYOND THE STATE OF THE ART

1.2.1. APPROACH TO THE CHALLENGE AND PROGRESS BEYOND THE STATE OF THE ART

The SNOOPY Action will advance the state-of-the-art by tackling the therapeutic peptide development from many different perspectives given the multi-disciplinary team, as described above. SNOOPY will provide a unique platform to transform and translate the area of peptide therapeutics towards the new-generation of diagnostic, therapeutic, and technological solutions in healthcare and beyond. In particular, SNOOPY will place the **focus on nanomorphological aspects** of peptide nanostructures, and how new properties emerging at the nanoscale can be key determinants of physical, chemical, and biological properties of the assemblies, as well as their fate in vivo. A holistic approach will be provided to find common features at the nanoscale between AMPs, amyloids, and peptide therapeutics especially when they get in contact with cells, their membranes, and their organelles, also thanks to **advanced computational methods, including data mining, machine-learning, and molecular dynamics simulations, as described above.** Until now, individual investigations have been carried out on all these specific research areas: AMPs, amyloids, peptide therapeutics, targeting peptides, cell- penetrating peptides, peptide epitopes in vaccines, peptide nanostructures as vaccine adjuvants, cancer vaccines, peptide nanostructures to kill cancer cells. **SNOOPY aims to bring together scientists working in all these areas to foster interdisciplinary communication and the coordinated study of bioactive peptides and their nanostructures, to unravel the key features emerging at the nanoscale to make a qualitative leap in the application of peptides in healthcare and technology.** The Action aims at widening the participation also for industrial and medical end-users to further guide SNOOPY activities to meet the real-life requirements to make a qualitative leap in healthcare and technology products. SNOOPY will create a virtual research institute across Europe and beyond for the production of the **next-generation peptide nanotherapeutics and nanodevices, which are inherently biodegradable** and could prove to be precious alternatives for **more sustainable industries of the future.** Besides, the active collaboration between academia and industry will also promote the innovation and growth of the latter, by offering expertise, and useful feedback on products and the needs of researchers working on and with peptides and related products. The **multivalency of peptide nanostructures will also enable the application of biomimicry principles to increase the efficiency of the desired effects**, such as biological recognition for diagnostics, targeting, and so on. The expertise brought in by chemists and physicists will enable new designs at the molecular level, while

collaboration with life-science experts will ensure that such designs are best fit for purpose to unravel their biological fate. The Action also benefits from beamline scientists' availability that will bring peptide researchers from all walks of science closer to the effective use of **EU large infrastructures** to fully exploit the potential of advanced characterization methods to answer the most difficult research questions pertaining peptide therapeutics and peptide nanostructures. The combination of profound knowledge in medicine, oncology, immunology, microbiology, molecular and cell biology, with advanced in silico and analytical tools will enable a qualitative leap forward, towards the understanding of the biochemical and biophysical properties of the peptide nanoprobe that will be produced within the Action SNOOPY. As examples, SNOOPY will develop and apply the most modern techniques of spectroscopy, microscopy, thermogravimetry, calorimetry, in vitro and in vivo studies to fully decipher the peptide nanostructure-biomolecule binding activity at the exciting interface with living tissues at the nanoscale.

1.2.2. OBJECTIVES

1.2.2.1. Research Coordination Objectives

This COST Action will create various networking opportunities to establish new multidisciplinary working teams that will include scientists, industrialists, and various experts, stakeholders, and Younger Researchers & Innovators (YRIs) across Europe to bring forward a common language and make a qualitative leap in the research related to peptides at the boundary of nanotechnology, chemistry, physics, (bio)materials science, and medicine.

The Action plan will include the establishment of common approaches to identify general standards and best practices for the study, design, production, and characterization of bioactive peptides and their assemblies. Specifically, the COST Action SNOOPY will:

1. Search and study bioactive peptide and their nano-assemblies for enhanced performance in disease prevention, diagnosis, and treatment, such as the targeted delivery of bioactives, boosting of the immune response, correct interaction with proteins and other biomolecules to generate new means of therapy.
2. Investigate the link between AMPs and amyloids especially from the nanomorphological point of view, and ideally at the interface with lipid membranes.
3. Facilitate the standardization of practices and nanomaterials characterization based on inputs from researchers and enterprises.
4. Facilitate technological transfer and/or knowledge transfer through the collaborative work established within the Action between participants from academia and industry.
5. To promote knowledge dissemination to YRIs and beyond to the general public, through various channels, media, publications, and events.

1.2.2.2. Capacity-building Objectives

It is only in recent years that researchers from the disciplines of peptide chemistry, biophysics, nanotechnology, computer science, materials science, and biomedical research have started working together. The COST Action SNOOPY will harness the experience in all these disciplines related to peptide science to advance our understanding of the prediction, characterization, and implementation of bioactive peptides and peptide-based nanostructures, for therapy, diagnosis, and beyond.

Specific Capacity-building objectives:

1. Establish interdisciplinary, multidisciplinary and/or transdisciplinary teams to facilitate the creation of a common language towards effective collaboration and creation of effective bridges across disciplines including bioactive peptides, peptide assemblies, and peptide nanostructures.
2. Promote research collaborations where diversity (e.g., age, gender, geographical, discipline, etc.) will foster creativity and inclusiveness.
3. To promote the training, visibility, and integration of scientists from Inclusiveness Target Countries (ITCs).
4. To train and mentor YRIs who share common interests on any scientific aspect related to peptides and their nanostructures through thematic workshops and training

schools.

5. To promote gender balance and support YRIs, and females to maximise diversity and inclusiveness.

In particular, the metrics below will be used to monitor the progress of the Action, which aims to reach the following numbers:

- **12-20 industrial/private entities** to take part in the Action to promote technological transfer and assist industries in their development and amelioration of best practices and sustainable procedures
- **32-40 STSMs** that will be monitored to ensure diversity, inclusiveness, and balance (gender, geographical location, ITCs, etc.) in line with the COST Mission
- **50-60** publications that will prioritize quality (instead of quantity) and will acknowledge COST encouraging collaborative studies that include at least 2-3 different COST Members.
- **2-3** workshops with different Working Groups (WGs) to foster collaboration
- **3-4** training schools for YRIs on theoretical and experimental aspects of peptide research
- **40-60% gender balance** will be insured across the COST Action activities
- **>50%** YRIs will be reached as participants

2. NETWORKING EXCELLENCE

2.1. ADDED VALUE OF NETWORKING IN S&T EXCELLENCE

2.1.1. ADDED VALUE IN RELATION TO EXISTING EFFORTS AT EUROPEAN AND/OR INTERNATIONAL LEVEL

Collectively, this Action builds on the novel strategy of applying DM, ML, MD techniques to discover patterns in existing data and to accelerate the discovery of new antimicrobial peptides. The multidisciplinary approach of this Action bridging the theoretical with the experimental methods will make a difference in the design of peptide therapeutics and it will allow to better understand the correlation between AMP and Alzheimer disease. Moreover, this approach will lead to a more detailed and generalized understanding of the potential of peptide sequences and their assemblies to reach function. The combination with advanced techniques available at large facilities and with the focus on working at the nanoscale to fully exploit nanotechnology and the related expertise through a holistic approach will make SNOOPY unique relative to ongoing and past initiatives on bioactive peptides.

In the past, COST funded several Actions that looked at specific aspects related to the theme of SNOOPY, such as B12 (2000-2005) pertaining radiolabeling of bioactive peptides, FA0602 (2007-2011) and FA1005 (2011-2015) focusing on food bioactive peptides, BM1104 (2011-2015) investigating the use of peptides to develop new diagnostic tools for medicine, D22 (2000-2006) elucidating polypeptide- membrane interactions, CM0803 (2009-2013) studying nanostructures from peptide analogs and derivatives, and BM1405 (NGP-NET) tackling protein amyloids (2015-2019). The knowledge generated through all these collaborative efforts will constitute part of the scientific basis for the COST Action SNOOPY. Besides, ongoing COST Actions can work in synergy with SNOOPY, such as CA19144 that also tackles peptide venoms and CA18217 on veterinary antimicrobials that ended recently (2024) will provide further knowledge.

The key added value is that SNOOPY will put the emphasis of nanomorphological aspects of bioactive peptides, and their ability to self-assemble into nanostructures in physiological and pathological contexts, such as the cell milieu, cell membranes, and organelles. SNOOPY will also focus on the possibility to form membrane pores by self-assembling peptides, and establishing key links between different areas covered by present and past initiatives, such as toxic peptides and antimicrobial peptides that interact with membranes and their components. The aim is to link peptide sequence and properties with nanomorphology and bioactivity to delineate specific peptide classes that in the future could be used for various purposes, especially tackling antimicrobials, amyloids, and potentially vaccine adjuvants. Finally, this Action has the potential to address important Sustainable Development Goals (UN): SDG 3 (good health and well-being), SDG4 (quality education), SDG5 (gender equality), SDG6 (clean water and sanitation), SDG9 (industry, innovation,

and infrastructure), SD11 (sustainable cities and communities), SDG12 (responsible consumption and production), SDG14 (life below water), SDG15 (life on land), and SDG17 (partnerships for the goals). Key aspects of sustainability will be monitored and encouraged throughout the Action activities.

2.2. ADDED VALUE OF NETWORKING IN IMPACT

2.2.1. SECURING THE CRITICAL MASS, EXPERTISE AND GEOGRAPHICAL BALANCE WITHIN THE COST MEMBERS AND BEYOND

The planned investigations and the educational activities will expand the expertise of COST Action SNOOPY participants, with critical mass in the field of therapeutic peptides research with a special focus on the antimicrobial resistance and Alzheimer's disease, in Europe, especially in less resourceful countries and among YRIs. SNOOPY is well-aligned with the COST Mission of spreading excellence and widening participation that is one of the Goals of Horizon Europe. The geographical distribution is strategic because it will gather experts in peptide chemistry and peptide self-assembly that will provide their precious expertise to the YRIs. **The Action plans to increase the participation of YRIs through the planned activities of the 4- year term. YRIs will be the core of the Action and with their enthusiasm, fresh ideas, and curiosity will shape SNOOPY, whose name was indeed chosen to reflect these aspects.**

Furthermore, throughout its 4 years of activity, the Action aims to increase the participation of ITCs. As the Action will start, the establishment of a dedicated website and profiles on social media will provide an instrumental platform to give visibility to SNOOPY and all of its activities, thus lowering the barriers to participation from scientists and experts from industry in ITCs.

Importantly, the Action will focus efforts in organizing activities in ITCs, which could prove to be a two- fold strategic choice. Firstly, to promote participation of the local scientists and stakeholders, thus increasing the critical mass within the ITC of choice, and widening awareness of the COST program and the opportunity it creates, thus ultimately facilitating ITC participation in future COST Actions. Secondly, participation will be encouraged from neighboring countries so as to enlarge the ITC participation and attract new COST Members from those regions. Indeed, long-distance travel could be a general barrier to wide participation from less resourceful ITCs, and organizing events that are geographically close to them could be a winning strategy to attract new participants from there.

In terms of expertise, previous COST Actions were focused on specific aspects that provide part of the basis of SNOOPY, as explained more in detail at the end of the section 1.1.2. By contrast, SNOOPY will focus on nanomorphogy as a general feature that links peptide molecules and their study to their bioactivity in pathologically and physiologically relevant conditions. This general approach will bring together a diverse set of expertise. At the fundamental end of the spectrum, participants will have expertise in computer science, theoretical and experimental physics and biophysics, advanced spectroscopy and characterization methods, organic and supramolecular chemistry, nanotechnology, biochemistry and biology, and basic medicine and immunology. At the applied end of the spectrum, participants will have expertise ranging from biomaterials science, to oncology, vaccine development, antimicrobials, diagnostic tools, drug delivery, clinical medicine and beyond. Overall, SNOOPY will provide a unique opportunity to bring scientists from all these disciplines around the same table, in a collective effort to provide a new point of view to address the unresolved challenges that still stand in the understanding of amyloids and antimicrobials to provide new therapeutic and diagnostic solutions. YRIs will be the core of SNOOPY activities, also through their participation in STSMs that will nurture SNOOPY with fresh ideas and young vitality to take the status quo of peptide therapeutics to significantly higher levels.

2.2.2. INVOLVEMENT OF STAKEHOLDERS

The critical points that require further effort to ensure the success of SNOOPY in securing a stronger private participation have been identified. These include the importance of providing evidence and a solid track record of SNOOPY activities (as outlined above through the dedicated website and profiles on social media) that can be accessed freely online from anywhere at any time. Another strategic choice will be the approach taken to contact private partners and showcase the opportunities they could benefit from by taking part in SNOOPY, from the generation of new ideas through collaborative networking, to the possibility of innovation and amelioration thanks to the expertise gathered by SNOOPY, to the greater visibility and the possibility to reach new clients and grow. To this end, the Action will include an **Industrial Partner Coordinator** that will encourage the

participation of private entities through focused events and channels of communication. These types of activities will promote not only technological transfer and innovation of the private sector, but they will also facilitate the **training and employment of YRIs**, and will promote industrial growth by enabling the reach of new clients and increasing visibility. The management of relationships with industry will also benefit from the advisory role of the University technology transfer offices that have wide experience in intellectual property management and relationships between academia and industry.

In particular, the Action thus plans to reach the critical mass of industrial participation and further grow in terms of active ITCs during the first two years, so that during the following two years, when participants will become aware of each other's expertise, needs, activities, and plans, SNOOPY will focus on the preparation of joint proposals and joint publications. Technological transfer from academia to industry will also be encouraged, and **focused activities that target industrial participation will be organized**.

Another group of important stakeholders includes **YRIs**, who will benefit from dedicated resources:

- to ensure they constitute >30% of the participants to meetings and events, as well as
- to encourage their active participation in STSMs, workshops, and training schools.

The **STSM Coordinator** will play a key role to promote the organization and funding of at least 32 STSMs ensuring diverse participants, countries, institutions, and disciplines. These activities will be the core of the Action to enable the transfer of the know-how and expertise between research groups across COST Members, including Cooperating and Partner States.

Finally, the **Science Communication Coordinator** will promote knowledge dissemination within the field and beyond, to the general society. The Action will establish relationships with the media to ensure effective engagement of the public at large.

3. IMPACT

3.1. IMPACT TO SCIENCE, SOCIETY AND COMPETITIVENESS, AND POTENTIAL FOR INNOVATION/BREAKTHROUGHS

3.1.1. SCIENTIFIC, TECHNOLOGICAL, AND/OR SOCIOECONOMIC IMPACTS (INCLUDING POTENTIAL INNOVATIONS AND/OR BREAKTHROUGHS)

Scientific & technological impact: The COST Action SNOOPY will bring together leading experts from diverse disciplines to tackle important challenges of the society through the generation of new ideas and collaborative research that is well-set to have an important scientific impact globally. Firstly, computer scientists, physicists and theoreticians will work together with experimentalists to apply the most modern machine-learning and *in-silico* methods to speed-up scientific discoveries. Secondly, the application of novel bioactive peptides and peptide nanostructures is envisaged mainly for healthcare,

but also beyond, for instance for bioelectronics and biodegradable electronics. Regarding healthcare, key advancements in the areas of biotherapeutics could have a tremendous impact in many diseases that currently do not have a treatment. Advancements in the understanding of amyloidosis, the physiological roles for amyloids, and the physio-pathological processes that involve amyloid peptide nanostructures could have a profound impact to find new ideas to address the current failure of amyloidosis inhibition in clinical trials. Ultimately, the networking activities of SNOOPY could facilitate the finding of new therapeutic strategies for a variety of diseases directly or indirectly linked to amyloids, such as: various forms of neurodegeneration, cardiopathies, diabetes, and more. Scientific advancements in understanding the nanostructures formed by AMPs in contact with membranes, and the related biological consequences spanning from AM activity to cytotoxicity, could facilitate the identification of new and improved AMPs and enable a leap forward to address the key challenge of AMR that is an urgent threat as declared by the WHO. Besides, peptide nanostructures have raised interest as vaccine adjuvants to boost immunogenic response, and also for targeted cancer therapy (e.g., the selective targeting of cancer cells, and also the selective formation of toxic nanostructures around or inside cancer cells). Taken together, collaborative research areas in these fields could have a profound impact in the emerging area of cancer vaccine development. Indeed, the Action will include expertise in clinical medicine and oncology, as well as in fundamental science for vaccine development. SNOOPY aims to bring together the expertise in these fields and attract further expertise in the area of cancer vaccine development, which is not yet

directly related to the center theme of peptide nanostructures. Lastly, the Action will gather expertise at the frontiers of knowledge to study emerging physico-chemical properties of peptide nanostructures, including luminescence, electron and proton transfer and conductivity, thus paving the way for potential breakthroughs in bioimaging and diagnostics, bioelectronics, and possibly even towards the development of future biodegradable alternatives to polluting electronics.

Socio-economic impact: The scientific area of peptide nanostructures has grown exponentially over the last two decades thanks to its enormous potential for socio-economic impact. As described above from a scientific and technological point of view, this COST Action is well-set to develop new solutions to potentially address some of the most important challenges of our society, such as: new diagnostic and therapeutic approaches for chronic diseases, such as diabetes, but also degenerative diseases, including various forms of neurodegeneration that is extremely important for the aging society, as demonstrated by the establishment of the EU Joint Program on Neurodegenerative Research (JPND) that focuses on the clinical aspects and is thus complementary and synergistic to the fundamental and applied science that this COST Action will support. Furthermore, antimicrobial resistance is a big problem that society is facing today and is one of the main causes of the socio-economic crisis in the world. According to WHO, emerging infectious diseases pose a significant global health challenge by affecting millions of people worldwide, making a negative global impact on healthcare and socioeconomic development. The COST Action SNOOPY will provide a different focus, relative to previous COST Actions, on AMPs by positioning the nanostructural features at the center of the investigations that aim to link peptide sequence and physico-chemical properties to bioactivity, including AM activity. Any advancement in this area could have a tremendous impact on the socio-economic burden posed by infectious diseases, especially those that are hospital-acquired, and the increasing spreading of AMR. Another important area of scientific development with great potential for socio-economic impact and profound breakthroughs pertains oncology and vaccine development, which, taken together, could lead to new advancements in the leading-edge research on cancer vaccines. While this Action does not directly focus on this exciting area, it deals with fundamental science that in the future could be taken up by leaders in cancer vaccine development. The Action plans to attract expertise in this area during the first two years. Lastly, the advancement of knowledge in the physical and electronic properties of peptide nanostructures could provide the basis for future developments in the area of bioelectronics and biodegradable electronics, which could revolutionize our society that has witnessed an exponential growth of personal electronic devices. Also in this case, the Action is not directly focused on the commercial development of this emerging and exciting field, yet it gathers expertise and knowledge that could provide a useful basis in the future for its implementation through future activities.

3.2. MEASURES TO MAXIMISE IMPACT

3.2.1. KNOWLEDGE CREATION, TRANSFER OF KNOWLEDGE AND CAREER DEVELOPMENT

The network will support communication and sharing of knowledge across all member nations, at the European level and beyond. This will allow the exchange of YRIs among the network members leading to free knowledge sharing and training. In addition, attendance at prestigious conference programs will be possible through travel funding within the Action aimed at the career development of YRIs based in ITCs.

The network includes different research fields from peptide chemistry to biology and modern characterization equipment that will lead to cutting-edge science and technology and encourage collaborations among the COST Members, allowing the training of YRIs with an emphasis on graduate students and PostDocs, in an inter- and cross-disciplinary setting. The inclusion of large facilities within the Action will provide an unmissable opportunity to train YRIs on the most modern techniques and to maximize the visibility and awareness across Europe of such advanced infrastructure. Furthermore, the participation of research scientists spanning from theoretical physics to advanced spectroscopy is well- set to facilitate the innovation and development of advanced characterization techniques to address the needs of experimental scientists, spanning from chemists to biologists, immunologists and oncologists, through the communication enabled by the Action. Data mining techniques will significantly improve the efficiency of database query, to rapidly extract key information and create new knowledge. The training of YRIs will then ensure their acquisition of this precious expertise to develop the new generation of future science leaders.

Applications for experimental time at EU large infrastructures, including synchrotron facilities, will be encouraged; researchers, especially YRIs and those from ITCs, will be trained on how to write successful proposals and to learn what kind of scientific questions can be addressed by using such

advanced techniques.

The transfer of knowledge within SNOOPY will be realized by using several channels, such as: STSMs, workshops, training schools, and meetings. **Webinars will be organized to impart the fundamental concepts for the effective use of different techniques to inexperienced researchers, to facilitate their subsequent experimental training for instance through STSMs and training schools.** In this manner, SNOOPY will foster interdisciplinary interactions during in-person events, such meetings and workshops, but also STSMs to ensure a more efficient planning and sharing of expertise within the Action. The Action will work hard to increase the diversity of its participants from all possible points of view (e.g., age, ethnicity, gender, country, discipline) to provide an equal platform with very different role models across the spectrum of the members of the societies. In particular, the Action will appoint a **Training & Development Coordinator** that will oversee these aspects of the Action and will establish a **Board of Mentors** that will be available to provide their guidance and advice to YRIs. All selection criteria will be defined by the Management Committee after the launch of the Action, ensuring however good gender balance and geographic diversity. These aspects will be overseen by the **Diversity and Inclusiveness Coordinator** that will be appointed within the Action and that will educate Action participants on relevant aspects of conscious and unconscious bias, equity and equality, and available resources, approaches and measures to target existing issues on these important aspects. Questionnaires will be used to gather key data and constructive feedback as the Action proceeds.

3.2.2. PLAN FOR DISSEMINATION AND/OR EXPLOITATION AND DIALOGUE WITH THE GENERAL PUBLIC OR POLICY

The dissemination activities will be overseen by a **Science Communication Coordinator** and they will be performed by Action participants through various channels including:

- A **dedicated website** for the Action and its activities
- Dedicated **Action profiles on social media** (e.g., LinkedIn, X/Twitter, Instagram) that will be linked to those of the Action participants to boost visibility
- **E-newsletter** every 3-6 months to all Action participants to inform them about ongoing & planned activities, publications that acknowledge the Action, related events & opportunities
- The **Management Committee will meet twice a year**, of which at least one meeting will be planned as in-person/hybrid as needed
- Each **Working Group (WG)** will organize additional meetings/workshops once a year. They could be organized in connection with the MC meetings or separately
- **YRIs and ITCs will be promoted** not only through Training Schools, STSMs and oral participation to MC and WG meetings, but also through **highlights** during the various communication and dissemination activities
- **International peers will be invited** to the Action events to promote its further growth
- **International peer-reviewed publications** will be produced from joint collaborations and will acknowledge the Action. **Open access** will be ensured in various forms, such as using gold or platinum journals, and internationally recognized free archives (e.g., BioRxiv, ChemRxiv, etc.)
- **Participation to international conferences will be supported for YRIs from ITCs**
- **Press releases & media communication** will be encouraged and promoted, also thanks to the Action expertise in active engagement in these activities to communicate with the public at large.

4. IMPLEMENTATION

4.1. COHERENCE AND EFFECTIVENESS OF THE WORK PLAN

4.1.1. DESCRIPTION OF WORKING GROUPS, TASKS AND ACTIVITIES

This Action will include 4 WGs that will be interconnected to ensure collaborative interactions throughout the Action participants in a cohesive manner. They include:

WG1: Computational methods for assessment of peptides & peptide nanostructures

Objective O1.1: Development of *in silico* and ML approaches to assist with the prediction and design of bioactive peptides and peptide nanostructures

Tasks:

T1.1 MD-based approaches to study the evolution of peptide nanostructures when interacting with membranes and in the cell milieu. The data extracted from this task will constitute a high-quality dataset for T1.3.

T1.2 Data Mining (DM) approaches for effective database search to collect accurate data allowing for the identification and development of bioactive peptides & peptide nanostructures not investigated in T1.1.

T1.3 ML approaches to speed up the design and development of bioactive peptides & peptide nanostructures, using the data produced in T1.1 and T1.2

Milestones M1.1: WG1 progress and the information developed from it will be disseminated in yearly meetings and will be rendered available to stakeholders to enable its use for the understanding and development of bioactive peptides, peptide nanostructures, and related products, whilst respecting Intellectual Property as required. The Action network is key to work across disciplines towards common language and recommended procedures and standards to ensure reproducibility of relevant **computational** processes and their appropriate description.

WG2: Production and characterization of bioactive peptides & peptide nanostructures

Objective O2.1: To improve the production of bioactive peptides & peptide nanostructures, in terms of efficiency and/or sustainability and/or environmental impact and use of resources; and to improve the use and application of advanced characterization techniques to advance knowledge on bioactive peptides & related nanostructures

Tasks:

T2.1 Amelioration in the production of bioactive peptides (by chemical synthesis, biotechnological tools, extraction, or other methods) and peptide nanostructures (nanofibrils, nanoparticles, nanotubes, etc.)

T2.3 Amelioration in the purification of peptides & peptide nanostructures

T2.4 Development of advanced characterization techniques and related protocols and applications to study bioactive peptides & related nanostructures

T2.5 Development of unified standards and protocols for best practices pertaining the characterization of bioactive peptides & related nanostructures

Milestone M2.1: WG2 progress and the information developed from it will be disseminated in yearly meetings and will be rendered available to stakeholders to enable its use for the understanding and development of bioactive peptides, peptide nanostructures, and related products, whilst respecting Intellectual Property as required. The Action network is key to work across disciplines towards common language and recommended procedures and standards to ensure reproducibility of relevant **experimental and characterization** processes and their appropriate description.

WG3: Biological studies and applications of peptides & related nanostructures

Objective O4.1: To advance the knowledge pertaining the biological study of bioactive peptides & peptide nanostructures and consequently advance the applications of bioactive peptides & peptide nanostructures for healthcare (prevention, therapy & diagnosis), as well as technological uses.

Tasks:

T3.1 Biological study of AMPs and related nanostructures, such as membrane-pore forming peptides

T3.2 Biological study of amyloids & related nanostructures, including vaccine adjuvants

T3.3 Biological study of bioactive peptides & related nanostructures for targeted therapy, drug release, and oncology

T3.4 To advance the application of bioactive peptides & peptide nanostructures in healthcare and modern technologies

Milestone M3.1: WG3 progress and the information developed from it will be disseminated in yearly meetings and will be rendered available to stakeholders to enable its use for the understanding and development of bioactive peptides, peptide nanostructures, and related products, whilst respecting Intellectual Property as required. The Action network is key to work across disciplines towards common language and recommended procedures and standards to ensure reproducibility of relevant **biological** processes and their appropriate description and to ensure reproducible and reliable performance of the application products.

WG4: Communication & Dissemination

Objective O4.1: To ensure continuous and effective dissemination within and beyond the Action throughout its duration

Tasks:

T4.1 To organize online communication on social media, official website and mailing lists within and outside the Action, including relationships with the media to boost visibility of the Action

T4.2 To organize and promote communication through in-person meetings, and “science speed dating” to match expertise including soft skills and team building, and social moments at MC meetings

T4.3 To organize and prepare suitable activities for training schools in line with MC decisions, webinars, and workshops for Action participants

Milestones M4.1: WG4 progress and related activities will be disseminated in yearly meetings, highlighting contributions and participation of YRIs and ITCs and will be rendered available to stakeholders to enable its use to efficiently train and develop the careers of scientists and stakeholders interested in the understanding and development of bioactive peptides, peptide nanostructures, and related products. The Action network is key to ensure multi- disciplinary training and shaping of a cohort of adaptable scientists with multicultural exposure to favor the social cohesiveness and integration within COST Members, Cooperating and Partner Members.

4.1.2. DESCRIPTION OF DELIVERABLES AND TIMEFRAME

Given the wide scope of the activities of the 4 WGs, general deliverables have been identified to monitor progress as follows:

Deliverable	WG	Description	Month	Type
D1	1	Data extracted using computational methods (MD, DM) that will constitute a structured dataset to allow for ML predictions of bioactive peptides or peptide nanostructures	12	Dataset
D2	1	MD methods collected and conveyed in publications	24	Publications
D3	1	Bioactive peptides or peptide nanostructures identified by ML	36	Publications
D4	2	Guidelines for best practices pertaining the characterization of bioactive peptides & related nanostructures	18	Guidelines
D5	2	Development of advanced synthesis and characterization techniques for peptides and peptide nanostructures	30	Protocols

D6	3	Roadmap on the biological applications of peptides and peptide nanostructures	42	Roadmap
D7	1, 2, 3	Proceedings of the SNOOPY Action workshops	18, 36	Proceedings
D8	1, 2, 3	Scientific research and review articles describing the methods and findings	24, 48	Publications
D9	4	SNOOPY website launched and publicly available	6	Web site
D10	4	Social media profiles for SNOOPY created	3	Media outlet

4.1.3. RISK ANALYSIS AND CONTINGENCY PLANS

The main objective of SNOOPY is to effectively bring together a wide and diverse group of scientists, public and private partners, and stakeholders from various disciplines and countries to advance the understanding and development of bioactive peptides and peptide nanostructures for healthcare and technological applications. Therefore, the following risks have been identified:

Risk1. Lack of diversity in the background disciplines of active participants to the Action

Contingency Plan: The MC will take corrective measures, send out specific (reimbursed) invitations to fill the gaps, and connect with those scientists ahead of planned meetings and activities to understand better their needs and how to motivate them to take an active participation.

Risk2. Few requests for STSMs

Contingency Plan: The MC will encourage the establishment of collaborations through the creation of a database with available and missing expertise for each participant, and willingness to host researchers, as well as organize “science speed dating” events to facilitate matching for STSMs. Communication prior to and after STSMs will be intensified, also giving the opportunities to STSM participants to showcase their results through presentations, to inspire other Action participants on possible STSM activities and the fruits they bear.

Risk3. Few industrial active participants.

Contingency Plan: Corrective measures have already been planned as described above in section 2.2.2. The Action Core Group aims to involve industrial partners highlighting their potential benefits, and will send specific (reimbursed) invitations to promote their active participation. Ad hoc events will be organized to focus on the needs of industry and favour bridging to academic partners.

Risk4: Low participation from ITCs.

Contingency Plan: The MC will focus on encouraging ITC participation in various ways, including selected (reimbursed invitations), and actively establishing collaborations and advising on expertise-matching activities to promote STSMs, training, and participation. Participants from ITCs will be encouraged and supported to host Action events.

Risk5: Inadequate budget spending leading to over-expenditure or unused resources.

Contingency Plan: Each activity and meeting will be carefully planned well ahead to improve the accuracy of cost estimation. Participants will be encouraged to enter into the e-COST platform their foreseen expenditures well ahead of the event, so as to take corrective measures in time. Resource allocation to STSMs will be re-modulated accordingly, depending on the level of expenditures on the other activities. Last-calls of STSMs will be created in case of unallocated resources.

4.1.4. GANTT DIAGRAM

	Year 1	Year 2	Year 3	Year 4
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	M M 1 - 4	M M 5 - 8	M M 9 - 1 2	M M 13 - 16	M M 1 7 - 2 0	M M 21 - 24	M M 25 - 28	M M 2 9 - 3 2	M M 33 - 36	M M 37 - 40	M M 4 1 - 4 4	M M 45 - 48
Meetings	KO M	W G		MC	I M	MC/W G	MC	I M	MC/W G	MC		MC/W G
STSMs	2-3 STSM calls per year depending on budget use											
Deliverables	D10	D9	D1		D4, D7	D2, D8		D5	D3, D7		D6	D8
Training					1-2 WS			1-2 WS		1-2 WS		

KOM = Kick-Off meeting (MC1) (month 1)

MC = MC meeting

IM = industry-focused meeting

WG = WG meeting (MC/WG, possibility to have both, MC if needed for important decisions to take) IM= Industry-focused meeting

WS = workshop/training school

D = deliverables

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