



## KM3NeT –INFRADEV – H2020 –739560

### Human capacity building in KM3NeT

*Recommendations for assessing the impact of KM3NeT on the professional careers of its alumni*

#### KM3NeT –INFRADEV GA DELIVERABLE: D5.3

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#### Abstract

This report is the result of an investigation of the feasibility to assess the impact of KM3NeT on the professional careers of its doctoral students and young post-doctoral scientists<sup>1</sup>. Based on surveys among selected group leaders in KM3NeT, the implementation of the policy for Equality, Diversity and Inclusion in KM3NeT (D5.2), which also includes measures for early-career scientists, and lessons learned by other large (astro)particle physics communities, recommendations for the establishment of a policy for human capacity building by KM3NeT are formulated.

<sup>1</sup> Task 5.3 of WP5 - Investigate the potential impact of KM3NeT on human capacity building



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## APPLICATION AREA

This document is a formal deliverable for the GA of the project, applicable to all members of the KM3NeT– INFRADEV project, beneficiaries and third parties, as well as its collaborating projects.



## TERMINOLOGY

CC	Conference Committee (Internal KM3NeT Committee responsible for the assignment of KM3NeT speakers on conferences and for the quality of slides and posters)
EDI	Equality, Diversity and Inclusion
ESFRI	European Strategy Forum on Research Infrastructures
GNN	Global Network of Neutrino telescopes
IB	Institutional Board (KM3NeT governing body)
PMB	Project Management Board of the KM3NeT-INFRADEV project
PSC	Project Steering Committee (KM3NeT Committee of working group leaders)
RI	Research Infrastructure
STEM	Acronym for Science, Technology, Engineering and Mathematics

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## PROJECT SUMMARY

KM3NeT is a large Research Infrastructure that will consist of a network of deep-sea neutrino telescopes in the Mediterranean Sea with user ports for Earth and Sea sciences. Following the appearance of KM3NeT 2.0 on the ESFRI roadmap 2016 and in line with the recommendations of the Assessment Expert Group in 2013, the KM3NeT-INFRADEV project addresses the Coordination and Support Actions (CSA) to prepare a legal entity and appropriate services for KM3NeT, thereby providing a sustainable solution for the operation of the research infrastructure during ten (or more) years. The KM3NeT-INFRADEV is funded by the European Commission's Horizon 2020 framework and its objectives comprise, amongst others, formalising aspects of the role of KM3NeT as a responsible organisation and to investigate possible key performance indicators of the societal impact of KM3NeT (WP5).



## EXECUTIVE SUMMARY

### *Development of a policy for human capacity building by KM3NeT*

The overall objective of WP5 of the KM3NeT-INFRADEV project is to formalise aspects of the role of KM3NeT as a responsible organisation and to investigate the possibility to formulate key indicators of the societal impact of KM3NeT in human capacity building. Deliverables of WP5 include a written *Code of Conduct and Ethical behaviour* (D5.1), a *Policy for Equality, Diversity and Inclusion for KM3NeT* (D5.2) and *Recommendations for assessing the impact of KM3NeT on the professional careers of its alumni* (D5.3, this report).

### *Performance indicators and surveys*

Typical performance indicators for a policy for human capacity building by an scientific organisation are (i) the annual number of theses delivered, (ii) the annual number of conference proceedings and papers in refereed journals and (iii) the existence and quality of a programme for scientific training and personal development with training of skills for a next step in the professional career beyond KM3NeT and (iv) knowledge of the next steps in the professional careers of alumni. Surveys were conducted to establish the current status of the above performance indicators. Structural and sustainable monitoring the performance indicators will require more investment by the Collaboration.

### *Alumni*

Key in quantitatively measuring performance indicators for human capacity building is the contact with alumni as the source of information on their career path beyond KM3NeT. For this, WP5 intended to setup a KM3NeT alumni network. However, after in-depth study of consequences of the new European privacy legislation, the KM3NeT Institutes Board decided to not give permission to store personal data of alumni in a central KM3NeT data base, as long as KM3NeT is not a legal entity. It would bare the risk of prosecuting individual member of the IT group in case of (unintended) violation of the European privacy legislation. Instead, WP5 focused on publicly available data and embedded measures for training the skills of early-career scientists and engineers in the broader EDI-Policy of KM3NeT. In addition first steps toward a sustainable and structured human capacity policy for KM3NeT were prepared. For this, lessons learned by CERN with establishing the High-Energy network of were valuable.

### *Recommendations*

The report is concluded with recommendations for a structural and sustainable policy for human capacity building by KM3NeT.



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## Introduction

This document comprises the investigation of the potential of the role and impact of KM3NeT in human capacity building. In particular, the impact of KM3NeT on the professional careers of the KM3NeT doctoral students and young post-doctoral students has been assessed. For a sustainable future of KM3NeT it is vital to continue attracting the best PhD-students. This requires not only continuous effort to convince university science and technology students of the attractiveness of conducting science research with KM3NeT, it also requires continuous effort to provide the KM3NeT doctoral and young postdoctoral students with skills for a successful professional career beyond KM3NeT in academia or elsewhere. Except scientific skills, these could include project management, personal development, the use of artificial intelligence techniques, science communication and science entrepreneurship. To monitor and measure the effectiveness of the KM3NeT education and training for a successful professional career, performance indicators must be defined and feedback of KM3NeT alumni is indispensable. The latter turned out to be difficult in the light of the European privacy legislation. Instead, the work focused on the position of early-career scientists and engineers in the KM3NeT Collaboration and to create a platform for discussion about their view on how KM3NeT could help them prepare for the next step in their professional career beyond KM3NeT. In the next section, the methodology followed by WP5 to collect information and build the knowledge is described. In the last section, recommendations are formulated for the implementation of a structural and sustainable policy for human capacity building in KM3NeT.

## 1. Methodology

To allow for an estimate of the impact of KM3NeT on human capacity building, WP5 has conducted several activities to collect information about the professional career of KM3NeT alumni. For this, WP5 intended to setup a KM3NeT alumni policy comprising a network with the objectives of (i) offering alumni a platform that could boost their professional careers, (ii) monitoring the careers of alumni beyond KM3NeT and (iii) offering young PhD students and young postdocs in KM3NeT the opportunity to learn about possible professional careers beyond KM3NeT. However, several obstacles were met. In informal discussions with early-career scientists at the kick-off meeting of the KM3NeT-INFRADEV project, it became clear that these young scientists manage to maintain contact with their peers, also beyond their time in KM3NeT. The social media play an important role in this. They felt less the need for an alumni network. Another obstacle was the commitment of KM3NeT to comply with privacy legislation. The WP5 leaders explored the possibilities for collecting and storing personal contact and career data of KM3NeT alumni in a central database. After participation in a conference on the new European Privacy Legislation organised by the Dutch ministry and consultation of legal experts at VU University Amsterdam on storing and using privacy-sensitive data, it turned out to be difficult to collect the personal alumni data without violating the rules of the European Privacy Legislation. Hence, the KM3NeT Institute Board did not endorse the storage of personal data. Consequently, the choice for indicators for monitoring the performance of an alumni policy was limited to those that could be estimated from public data.



## 1.1 Performance indicators

Human capacity building is based on equipping individuals with the knowledge and training that enables them to perform effectively for the organisation and beyond. For a scientific project, typical performance indicators on human capacity building are the average annual number of delivered theses, conference talks or poster presentations and publications in refereed scientific journals. These indicators also measure the scientific impact of the project. In addition, other indicators are the presence and quality of training programs and successful finding a job beyond the project in academia or elsewhere. Since KM3NeT is still at the start of building its deep sea telescopes, these indicators are not yet monitored structurally and some of their values are still moderate. They are expected to ramp up once KM3NeT enters the operational phase with sizable detectors. A structural monitoring of the indicators to assess the impact of KM3NeT on human capacity building is being prepared.

## 1.2 Surveys

### a. KM3NeT presence at scientific conferences

The presence of KM3NeT at scientific conferences is the responsibility of the Conference Committee of the Collaboration. The Committee selects relevant high quality conferences, selects the people that will speak or present a poster on behalf of the Collaboration. A strict reviewing process guarantees a high quality of the presented material. In assigning speakers, the Committee takes care of reasonable distribution over early-career scientists and senior scientists, participating institutes and gender. In Table 1 and Figure 1, an overview of conference participation in the period 2013-2019. Note, that the numbers shown are hand-count, hence, estimated number.

*Table 1 KM3NeT presence at scientific conferences. Note, that numbers are hand counted, hence, numbers are estimates. In particular, the numbers about proceedings is incomplete.*

	2013	2014	2015	2016	2017	2018	2019 <sup>2</sup>	Total	Annual average
# conferences	13	14	10	17	22	36	33	145	21
# talks	30	18	38	22	30	47	44	229	33
# posters	5	9	19	7	13	12	21	86	13
# proceedings	21	4	22	0	3	20	6	86	13
# papers	1	1	1	2	1	1	1	8	1

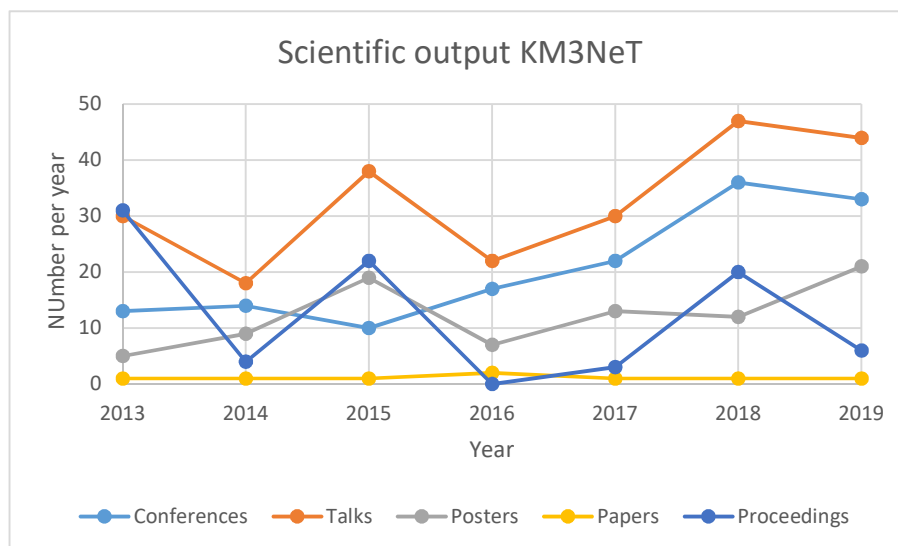
<sup>2</sup> Status of November 2019. Until the end of the year, more proceedings are expected, two papers have been submitted and one paper is accepted, but not yet published. These are not included in the numbers shown.



### b. KM3NeT output in the scientific literature

Conference proceedings and papers in peer reviewed journals are an performance indicator of the scientific impact of an experiment. The quality of KM3NeT proceedings and papers is the responsibility of the Publication Committee. The Committee has a strict reviewing procedure for both proceedings and papers. In Table 1 and Figure 1 the number of proceedings and papers per year in the period 2013-Nov.2019 are shown. Note, that the numbers shown are hand-count, hence, estimated number. In particular, the number of proceedings is incomplete. The average number of papers in refereed scientific journals is one. Since KM3NeT is still at the start of building the telescopes it is expected that these numbers will ramp up with the size of the detectors and the increasing time of data taking. At the time of writing one paper is accepted, but not yet published and two more are submitted. These numbers are not included in Table 1 and Figure 1.

Figure 1 KM3NeT presence at scientific conferences. Note, that numbers are hand counted, hence, numbers are estimates. In particular, the information about the number of proceedings is incomplete.



### c. Existing knowledge about career development of KM3NeT alumni

In order to make an inventory of the existing knowledge about the first career steps of young scientists in and beyond KM3NeT, WP5 conducted several surveys among different sources. To collect aggregated information about PhD students, Postdocs and BSc/MSc students in KM3NeT in the period 2014-2019, an anonymous survey was conducted among selected group leaders, predominantly those that worked at university departments. Information about the education and training programmes that are offered to PhD students at KM3NeT Institutes was acquired also via a selected group leaders.





### *PhD students*

A survey was conducted among 11 selected group leaders in KM3NeT to investigate their aggregated knowledge about the career development of PhD students and young postdocs in their group in the five year period 2014-2019. In this period in the 11 groups a total 15 PhD theses were delivered, of which 7 by female students and 3 by foreigners. Two students (in two different groups) left before delivering a thesis. If these numbers are representative for the current full Collaboration, and with the growth of the Collaboration, it can be estimated that in the near future about 15 PhD theses will be delivered every year. The respondents reported that in the period 2014-2019 nine new doctorates continued their professional career as postdoc in the same field (6), in a related field (2) or in a not-related field (1). Of these, only two moved to a postdoc position abroad. Six new doctorates found a job outside academia, of which three in the information technology industry. Again, if these numbers are representative for the full collaboration and with the growth of the Collaboration, it is estimated that about 10 new doctorates per year will continue as postdoc in academia and about 5 per year will continue in a job elsewhere.

The anonymous survey also addressed the professional training of early-career scientists in the group and the preparation on a career beyond KM3NeT. The workload of the PhD students was reported to be on average 75% research, 15% receiving education, 5% giving lectures and 5% participating in outreach activities. In only 2 groups PhD students were offered training skills in project management and personal development. In almost all groups PhD students were informed about possible next steps in their professional career. In all cases, the group leader was asked by the students to give personal advice. Based on this information, WP5 recommends the KM3NeT management team and institute board to consider organising internal central training on personal development and project management skills.

### *Postdocs*

In the survey also the position of postdocs was investigated. It was reported that in the period 2014-2019 a total of 22 postdocs were working in the 11 groups. Of these postdocs, six were also PhD students in the same group. At the end of their postdoc term, 13 postdocs applied for a permanent or tenure track position, of which 6 in the same group and 9 postdocs found a job outside academia. Extrapolating the numbers to the full Collaboration it is estimated that about 15 postdocs will find a position in academia, while about 10 postdocs will continue their career outside academia.

### *BSc and MSc students*

In the period 2014-Mid-2019, in the 11 groups participating in the survey, 32 BSc or MSc students participated in KM3NeT for their bachelor or master thesis. Of these, twelve continued as PhD student in KM3NeT. Extrapolating these numbers to the full Collaboration, about 35 BSc or MSc students per year can be expected to participate in KM3NeT and that about 15 PhD students per year will be recruited from these undergraduate students.



Table 2 KM3NeT theses delivered and number of postdocs in 11 KM3NeT Institutes in the period 2014 – mid 2019

<b>For 11 groups in the period 2013-mid 2019</b>	Total number	Average per group	Annual average	Remarks
BSc/MSc theses	32	2.9	5.8	12 MSc students continued their career as PhD student in KM3NeT
PhD theses	15	1.3	2.7	8 students continued as postdoc in academia 9 students continued in a position outside academia
Postdocs appointed	22	2	4	13 postdocs applied for tenure 9 postdocs continued in a position outside academia

#### ***d. Inventory of education and training programmes for KM3NeT PhD students***

A survey of the education and training programmes for PhD students in KM3NeT at their universities was conducted among selected Institutes of KM3NeT in Germany, Italy, the Netherlands and Spain.

In Germany at the ECAP institute PhD students enter a graduate school of the Friedrich Alexander University Erlangen-Nürnberg. The school offers a program of scientific courses, but it is not mandatory to follow the courses.

In Italy, in the first and in the second year of the PhD, students follow various courses with a rather formal oral discussion at the end. Usually these are 3-4 courses in the first year and 2-3 in the second for a total of around 180 hours. Courses for personal professional development and for 'soft' skills are not offered.

In the Netherlands at the Nikhef institute, PhD students follow an extensive mandatory program of science and data analysis workshops at the Belgium-Netherlands-Germany school and dedicated topical lectures at the institute. Career days and talks by companies are organised to inform the students about possible jobs outside academia. Courses for personal development and professional skills are offered at the national level by the NWO funding agency or by Universities.

In Spain, at the IFIC institute PhD students participate in a programme of PhD courses of the University of Valencia. The courses are approved by a central evaluation agency. The 'Doctorate School' of the university offers courses for professional skills and career development. PhD students with a grant of the 'La Caixa' foundations follow mandatory general skills courses of the foundation.



### ***e. EDI-Policy measures for early-career scientists***

In the EDI-Policy of KM3NeT, three different measures were included to improve training and status of early-career physicists in KM3NeT and thus contribute to training skills:

- (i) Starting Spring 2019, two early-career scientists were elected in the Institutes Board representing their peers in the Collaboration. This will provide a means of training governance skills and organising and representing their peers. In the newly established Early Career Scientist (ECS) network already setup after first elections in June 2019, young scientists and engineers learn about issues of governance and management of KM3NeT, to formulate their own ideas about the KM3NeT governance and to form a majority view among ECS. One of their first actions was to develop an ECS internal wiki-page with a 'starter's kit' for newcomers to the Collaboration. Their proposal to develop a KM3NeT mentor programme with early-career mentors and mentees and moderately financially supported by the Collaboration. The KM3NeT IB has endorsed the proposal.
- (ii) In the Policy for Equality, Diversity and Inclusion (EDI), the scientific age is one of the key performance indicators for success of the Policy. In particular, a performance indicator for the percentage of young scientists among the Work Group leaders of KM3NeT was set to be reach in 2024. This measure contributes to providing in particular young postdocs on-the-job training of project management and leadership skills. As Working Group leader they will be a member of the Project Steering Committee, which reports directly to the Project Technical Manager of the KM3NeT project.
- (iii) EDI-sessions at each Collaboration meeting were established which are attended by the full Collaboration and in particular by the Spokesperson of the Collaboration. During three EDI-sessions per year, not only issues related to EDI will be discussed, but also issues related to enhancing social and project management skills required for a successful professional career.

Internally and as a result of the implementation of the new EDI-Policy, since 2019 the working environment of early-career scientists in the Collaboration is high on the agenda of both IB and MT. Also among the early-career scientists in the Collaboration awareness has grown that a (better) recognition of their work and a (better) preparation for the next step in their professional career is important.

### ***f. Professional well-being in the KM3NeT Collaboration***

Together with the KM3NeT Committee for Equality, Diversity and Inclusion (EDI), the WP5 leaders conducted in September 2019 a web-based anonymous survey about *professional well-being among* all participants in the KM3NeT Collaboration, of which about 25% responded. Among the respondents representatives of all professional 'classes': early-career scientists and engineers on temporary contracts, senior scientists and engineers on permanent positions and the type of work for KM3NeT, such as hardware, software, data analysis etc. The questions in the survey monitored not only the professional well-being in the Collaboration, but also concerned the aspects important for a career beyond KM3NeT. Generally, the results of the survey showed that the professional well-being in KM3NeT is high. This is an encouraging result, that should be cherished and advocated outside the Collaboration when recruiting young researchers and students. Recommendation for improvement included improvement of internal communication, enhancing the culture of (positive) feedback, more appreciation of the work of engineers and technicians, improving the visibility of work, in particular technical work, outside the Collaboration and reducing possible obstacles for



attending conferences. The results and recommendations are internally published and reported to the KM3NeT management team.

#### *g. Awards for (early-career) scientists*

Within the KM3NeT Collaboration the survey on professional well-being triggered a discussion about a possible award policy for KM3NeT. The discussion about this has not yet been concluded at the time of writing of this report. Obviously, awarding people in a relatively small community as KM3NeT is delicate and requires a transparent and well-defined selection procedures of candidates. When done well, awards will put the spotlight on the work of people and on their attitude in the collaboration and can be a valuable contribution to human capacity building. Currently, the KM3NeT Collaboration participates in the award policy of the Global Neutrino Network (GNN), that annually awards for the best PhD theses. As a preparation on a possible extension of the award policy for KM3NeT, those of the LHC experiments ATLAS and CMS were investigated by WP5. Both collaborations have indeed also annual prizes for PhD students, but also award other achievements such as for good collaborative work on subprojects or on important technical or software work. Key to avoid jealousy in the relatively small communities is to use a well-defined and transparent selection procedure of the winners. The jury are considered indisputable, the nominations are appreciated. With these examples in mind, a formal award policy for KM3NeT is recommended.

### 1.3 Best practices learned from the High-Energy network

In addition to the internal KM3NeT surveys, best practices were collected from contacts with related research organisations such as CERN and large scale (astro)particle physics collaborations. During the INFRADEV project CERN started to setup an alumni network (<https://alumni.cern>). The activities have been closely followed for possible implementation in KM3NeT.

The CERN Alumni Network that provides CERN alumni an opportunity to keep in touch with CERN and with each other. It is considered a mean of fostering ambassadorship for the mission and values of CERN and the scientific collaborations, but in particular it is aimed at supporting CERN alumni in their future career development. The network is still developing and has professional resources for support and organisation. Other differences with KM3NeT are that CERN is an employer and has a much larger community. In practice, the alumni activities of the LHC experiments profit from the existence of the CERN Alumni network.

Via the CERN Alumni Network on voluntary bases professional profiles of alumni are registered. This requires a high level of privacy protection of the web based interfaces to the database with registered personal profiles. The KM3NeT IB decided not to allow storage of personal data in its Collaboration data base, because the Collaboration has no legal authority yet, which creates the risk of being prosecuted of an individual in the IT group of KM3NeT. Once a legal entity is established for KM3NeT, the example of a personal profile registration could be followed.



The CERN Alumni Network offers the opportunity to external recruiters to post vacancies. This option is implemented for KM3NeT by the establishment of the mailing list [jobs@km3net.de](mailto:jobs@km3net.de) of participants in KM3NeT interested in vacancies. Recruiters can send their vacancies to this mailing list.

The CERN Alumni Network organises regional events or events organised at CERN. KM3NeT could consider similar events, e.g. regional events during Collaboration meetings. A first investigation for an Alumni event during the Collaboration meeting in Nantes in June 2019 showed that with the current lack of contact with KM3NeT alumni this is not (yet) feasible.

## 1.4 Digital KM3NeT communication channels

Since it turns out that currently it is difficult to establish contact with KM3NeT Alumni, several communication channels have been set up as a preparation for a more structural and sustainable system of following the professional career of KM3NeT alumni.

### Email

In addition to the standard email list of the KM3NeT Collaboration, two had been added to reach out to alumni and recruiters outside KM3NeT:

- [jobs@km3net.de](mailto:jobs@km3net.de) A portal to which members of the Collaboration can subscribe to view posts of vacancies in academia or elsewhere. External recruiters can post their vacancy in the portal.
- [alumni@km3net.de](mailto:alumni@km3net.de) Mailing list for the exchange of information between the Collaboration and its alumni and for networking between alumni.

### Social media

KM3NeT is an active player in the social media (@km3net), in particular at Twitter, Facebook, Instagram and YouTube. Recently, the new 'KM3NeT Alumni' LinkedIn group has and the Twitter account (@km3netA) have been established. If these would take off, they could develop to support a professional network for the alumni with a portal for recruiting for positions in KM3NeT.

### Website

Also the KM3NeT public website provides alumni information:

- A portal with relevant information for alumni: <https://www.km3net.org/about-km3net/alumni/>
- A portal with relevant information for scientists interested in a position in the KM3NeT groups and for recruiters to post their vacancies.

The communication channels focussing on alumni and recruiters are relatively new. Maintenance of the channels is done by volunteers in the Collaboration. For the maintenance of sustainable communication channels the task should be recognised as service-job for the Collaboration.



## 2 Recommendations

The investigation on the potential of the role and impact of KM3NeT in human capacity building has provided valuable in-sight in the current situation as well lessons learned at other research organisations. This has led to the following recommendations for the establishment of a structural and sustainable policy for human capacity building by the Collaboration:

Human capacity building in the KM3NeT Collaboration comprises of educating and training the individuals in KM3NeT with knowledge and skills that enables them to perform effectively in contributing to the scientific goals of the Collaboration and prepare them for a next step in their professional career. Scientifically, the individuals are well educated at the universities. Also engineers and technician are educated at universities or at their home institute. The level of training in other professional skills is very different in the many groups in the Collaboration. Centrally, the KM3NeT Collaboration offers training for newcomers to learn for example the software environment and tools for data analysis. The recommendation is to extend the scientific training with training in skills such as project management, presentation skills and scientific writing.

### **RECOMMENDATION for strengthening the role of KM3NeT in human capacity building**

Develop an education plan of customized and regular workshops to strengthen the physics and technological education of KM3NeT participants. It is recommended that the organisation of the workshops rotate among the KM3NeT Institutes. Collaboration with the Global Neutrino Network (GNN) may be advantageous for the organisation of a dedicated 'School for neutrino astroparticle physics'.

Develop a training plan to regularly and centrally train professional skills such as project management, working in a culturally diverse collaboration, developing presentation material, writing reports etc. The programme could be implemented by extending each collaboration meeting with one day or by exploiting the EDI-sessions at the Collaboration meeting.

Develop a Collaboration wide programme of recognition of good work. For example, these could be awards or distinctions to set the spotlight on the various groups and individuals that perform well. In particular for early-career physicists, scientific and other work-related awards on their CV is helpful in finding a job. It is recommended to learn from the experience of for instance the LHC experiments.

Consider financial support for the work of the newly established network of Early Career Scientists in KM3NeT.



The best sources of information about the impact of KM3NeT on a professional career are the KM3NeT alumni. Although in academia, it is relatively easy to follow those careers this is more difficult for those in other environments.

**RECOMMENDATIONS for monitoring the effect of KM3NeT on human capacity building**

Repeat annually surveys among group leaders about the next jobs of early-career scientists in their group beyond KM3NeT.

Urge the KM3NeT group leaders to conduct an exit-interview with students and postdocs that leave the group and evaluate with them also the working environment of the KM3NeT Collaboration. An effort should be made to get permission of the person leaving to make an alumni profile of with contact information and information about the job beyond KM3NeT. The information could be collected by filling a standardised form.

Use many communication channels to reach out to alumni. These should at least include a central mailing list for alumni, an alumni portal at the public website, the use of dedicated KM3NeT-alumni accounts on the social media and a dedicated 'KM3NeT Alumni' group at LinkedIn.

Investigate the feasibility of organising special events for alumni.

Consider a dedicated officer for alumni contacts and events.

