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ARTICLE

Young professionals in radiation protection: challenges and perspectives – Outcomes of an international survey

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Abstract – The Young Club of the French Society for Radiation Protection (SFRP), supported by the Rising Generations Group of the United Kingdom Society for Radiation Protection (SRP), teamed up to develop a survey targeted at the young professionals in radiation protection. Data about the background and training, current job and position was collected and provides an overview of the demographic of this group of professionals. The survey was also designed as a place where young people can express their views and opinions about initiatives set up by the employer and the national radiation protection society, and area they would like these organisations to develop further. Several key themes emerged from the answers of the respondents: notably, a high wish for more training in radiation protection – under different arrangements, ways to foster and secure future young professionals and a desire and mechanism for encouraging collaboration and networking between young professionals. Besides the statistical data, the messages from the survey will help to assess the effectiveness of initiatives in place, identify new ones and encourage future initiatives to foster and secure the young professionals in radiation protection.

Keywords: Young Generation Network / survey / radiation protection national society / IRPA / young professionals

1 Introduction

Several initiatives aimed to support the young professionals in radiation protection have been launched by many radiation protection national societies (RP societies), for example, in the United Kingdom (SRP, 2018), in Japan (JHPS, 2018) and in France (Paquet, 2016; SFRP, 2018). In a number of cases this has included the RP society creating their own national Young Generation Network (YGN, or equivalent) in order to better identify and address the situations and expectations of this part of their members. This topic is also being considered at an international level by IRPA (International Radiation Protection Association) who created the IRPA YGN in 2016 (IRPA, 2016), with its formal launch at the IRPA regional congresses in 2018 (IRPA, 2018). Employers in the radiation protection sector have also arranged initiatives especially targeted at their young professionals.

Considering that there is limited data available on the young professionals in radiation protection, and also on the implementation and effectiveness of initiatives intended to support and foster the young professionals, the Young Club of the French Society for Radiation Protection, supported by the Rising Generations Group of the United Kingdom's Society for Radiation Protection (and under the guidance of the IRPA YGN), teamed up to develop and launch a survey targeted at the young professionals and scientists in radiation protection. The aim of the survey was to gain a greater understanding about this group of professionals: demographic, background, current job and position, and also allow these early career professionals to express their views and opinions about their work in radiation protection and initiatives set up by their employers and their RP societies.

2 Methodology

The survey was disseminated in the form of a web-based questionnaire. The survey was available online from July to December 2017 and advertised through the IRPA network of RP societies, other networks, and direct contacts with YGN. After being informed about the objectives of the survey and the

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limits to participate[1], the respondents were asked 29 questions. At the end, the respondents were invited to share the questionnaire between the other young professionals in radiation protection.

The first set of questions was provided to gather general information about the demographic of the respondents (such as the age and the initial background), their employment (describing the current job and sector of activity) and an outline on working in radiation protection (existence of a specific training, level of annual individual exposure). Next, the second set of questions assessed what initiatives for young professionals were set up by the respondent's employer and by their national RP society, and in contrast, what future initiatives they would like to see from these organisations. The last set of questions allowed the respondent to identify any other ideas or areas for further development.

After the closure of the survey in December 2017, the information was stored in a separate Excel database. It should be noted that the young professionals from one country (China) were not able to access the web questionnaire online and sent their answers directly by email to the survey manager.

A control of coherence has been performed and some odd data (for salary) have been deleted. Some variables have been recoded for the sake of presentation and also to guarantee anonymity: for the questions aiming at gathering figures (*i.e.* level of annual individual exposure and salary), the answers have been put into ranges, the size of which has been chosen according to the collected data. Most of the questionnaire was based on multiple-choices questions (one answer or several answers allowed) and some open questions.

In general, the statistical analyses have been limited to the description of the results expressed in number of answers and in frequency. For the set of questions designed to assess what are the initiatives set up by the employer and the RP societies, and the expectations towards them, an analysis has been made to see if some factors (precisely age, sex, current job and country/region of origin) could have an influence on the response. The dependence of the response to these factors has been tested using the Pearson χ^2 test[2].

3 Results

3.1 Main characteristics of the respondents and their employment

The survey received 256 answers from 27 countries, with large discrepancies in numbers. Notably, there is a strong representation from China (around 18% of the respondents) and notably, from Chinese people working in a research institute (13%). Globally, Asia (China, Japan, South Korea) and Europe (notably, Belgium, France, Germany and Switzerland) are most represented in the survey.

Tables 1 and 2 present some of the characteristics of the respondents and characteristics of their employment. All the results of the survey have been put online and are freely accessible at https://tabsoft.co/2IalFEO.

The respondents are largely male and between 25 and 35 years old. Two thirds are classified for working with ionizing radiation and for 85% of them their exposure is < 1 mSv/year. The maximum annual dose reported is 20 mSv.

3.1.1 Background and training

Majority of the respondents had studied towards becoming an engineer, followed by technician and lastly to a doctorate/PhD level (around 17%). Around 10% of the respondents aimed at becoming workers/employees or are still studying. The main study topics of the initial studies are very diverse: radiation protection is the top topic (30%), but, also physics, chemistry, biology or mechanics. So, there are many ways that lead to radiation protection, however, they tend to be scientific in nature. For the majority of respondents, radiation protection is the primary role of their job. It should be noted that 6 respondents have specified that radiation protection is aligned with their job, but, not at the heart of it (for instance: Medical Physicist).

3.1.2 Current job and position

Around a third of the respondents are working for a private company, another third for their State (either directly or in a company with State funding) and the last third are working for other employers like hospitals and universities. The main sectors of activity are electricity production (27%), followed by research (20%), medical (16%) and regulatory matters (12%) – this indicates that the survey reached a large range of people.

A large majority (73%) of the respondents hold a tenure or permanent contract. Most of them (60%) do not have managerial or financial responsibilities in their work, but, around 20% do have hierarchical responsibilities and 12% have both hierarchical and financial responsibilities. The average and median annual salaries are close to 40 000 € and no job is particularly more represented in the highest earning range ($> 50\,000$ €). The maximum salary reaches 160 000 €. It should be noted that the answer rate to this question is rather low (200 answers total) and that several answers cannot be analysed (*e.g.* odd value).

3.2 Perception of working in the field of radiation protection and the initiative specifically set up for young professionals

At this point, questions were asked to assess the view of the respondents about working in the field of radiation protection. A key output of the survey was that more than 2/3 of the respondents were satisfied or are very satisfied to work in the radiation protection field and 93% of them intend to continue to do so for the next 5 years. But, 26% of the respondents are neutral or even not satisfied about their current work.

[1] Below 35 years of age and/or less than 10 years of experience in radiation protection, which are usual limits in most national YGNs.

[2] The objective behind a Pearson χ^2 test is to calculate an indicator (the χ^2) by comparing the original table (number of answers distributed for the factors; classes of age, classes of sex, etc.) with a theoretical table calculated by considering the equal distribution of the results. The closer the χ^2 to a threshold value, the closer the actual and the theoretical results are (hence providing an indication of independents). The threshold value depends on the size of the table and the level of confidence we want to achieve in the test (5% was chosen in this study).

Table 1. Description of the respondents of the survey.

Main characteristics of the respondents	Number (%)
Age (years)	
20–24	21 (8.0%)
25–29	89 (35.0%)
30–35	119 (46.7%)
> 35	26 (10.3%)
Sex	
Male	172 (67.0%)
Female	84 (33.0%)
Country (of origin)	
China	46 (18.3%)
France	25 (10.0%)
Germany	25 (10.0%)
Switzerland	25 (10.0%)
Belgium	19 (7.6%)
Japan	15 (6.0.%)
Spain	15 (6.0%)
Austria	7 (2.8%)
Czech Republic	7 (2.8%)
South Korea	7 (2.8%)
United States of America	7 (2.8%)
Finland	6 (2.4%)
Italy	6 (2.4%)
United Kingdom	6 (2.4%)
Romania	5 (2.0%)
Slovenia	5 (2.0%)
Australia	4 (1.6%)
Canada	4 (1.6%)
Ghana	3 (1.2%)
The Netherlands	3 (1.2%)
Brazil	2 (0.8%)
Hungary	2 (0.8%)
Sweden	2 (0.8%)
Argentina	1 (0.4%)
Bosnia	1 (0.4%)
Cyprus	1 (0.4%)
Portugal	1 (0.4%)
United Arab Emirates	1 (0.4%)
Are you a classified worker?	
Yes	182 (71.4%)
No	73 (28.6%)
Level of annual exposure (mSv/year)	
0	64 (40.0%)
0–0.1	31 (19.4%)
0.1–1	40 (25.0%)
1–5	21 (13.0%)
> 5	4 (2.5%)
Initial background	
Engineer	82 (32.0%)
Technician	48 (18.7%)
Doctor/PhD	43 (16.8%)
Other	31 (12.1%)
Still studying	30 (11.7%)
Worker/employee	22 (8.6%)

Table 2. Description of the employment of the respondents of the survey.

Main characteristics of the employment	Number (%)
Current job [a]	
Engineer	79 (32.6%)
Doctor/PhD	50 (20.7%)
Technician	43 (17.8%)
Worker/employee	40 (16.5%)
Still studying	17 (7.0%)
Other	13 (5.4%)
Type of contract	
Tenure or permanent	186 (73.0%)
Non-tenure or fixed term	48 (19.0%)
Thesis under contract	21 (8.0%)
Responsibilities	
No responsibility	155 (60.8%)
Hierarchical responsibilities	55 (21.6%)
Hierarchical and budget responsibilities	31 (12.1%)
Budget responsibilities	14 (5.5%)
Main employer	
Private company/organization	72 (28.0%)
Research institute	66 (25.7%)
Company with State funding	38 (14.8%)
State	30 (11.7%)
University, teaching centre, etc.	22 (8.6%)
Hospital, medical centre, etc.	21 (8.2%)
Association, NGO	8 (3.0%)

[a] It is interesting to compare the respondents' goal position (initial background) with their current job at the time of the survey: 84% of the current Engineers have studied to become so; the rate is 75% for the Technician, 66% for Doctors/PhD and down to 50% for Workers. This means that almost half the Workers have not studied for this position.

The survey was then used to gain visibility of what initiatives employers and national RP societies have set up for their younger professionals and also the expectations of the young professionals towards them. A set of four multiple-choices questions was offered to the respondents and Figures 1 and 2 report the % of respondents that ticked the actions set up by and wished from, respectively, the employer (Fig. 1) and the RP society (Fig. 2).

The main points regarding employer support are:

– most of the companies have set up training programmes for their young professionals especially technical training, and also to a lesser extent, soft skills training and mentorship and tutorship schemes. But, there is still a high desire for further training and education in radiation protection: technical training is the primary focus (46% of the respondent selected it) and soft skills and mentorship/tutorship closely follow (around 30%). And a statistic (not shown in Tab. 1 or Fig. 1) is that around 35% of the respondents did not undergo any specific training in radiation protection, but, have learnt in "on the job" and this is reported as being very difficult;

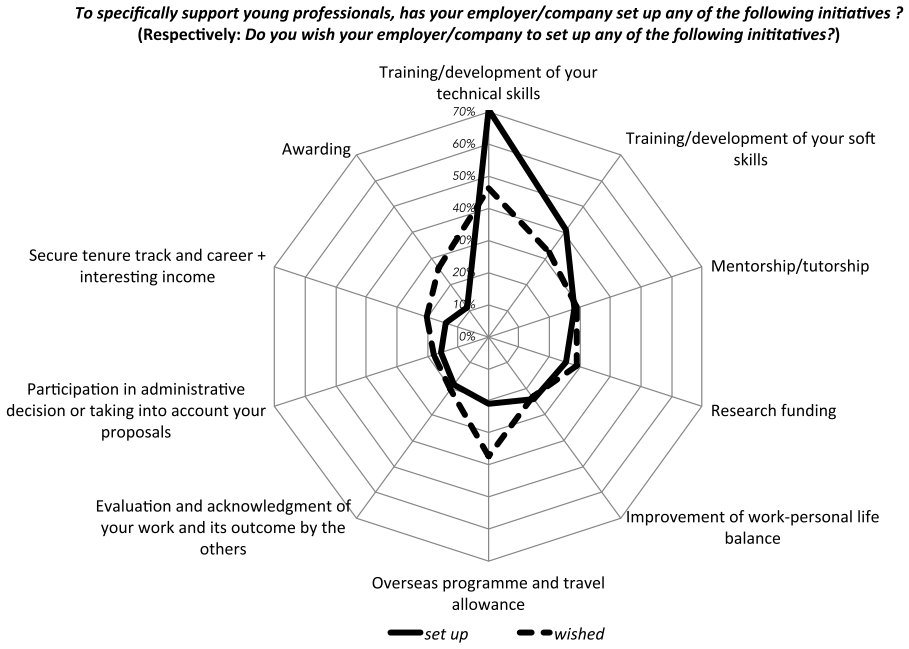

Fig. 1. Actions set up by and wished from the employer (% of respondents who selected the action).

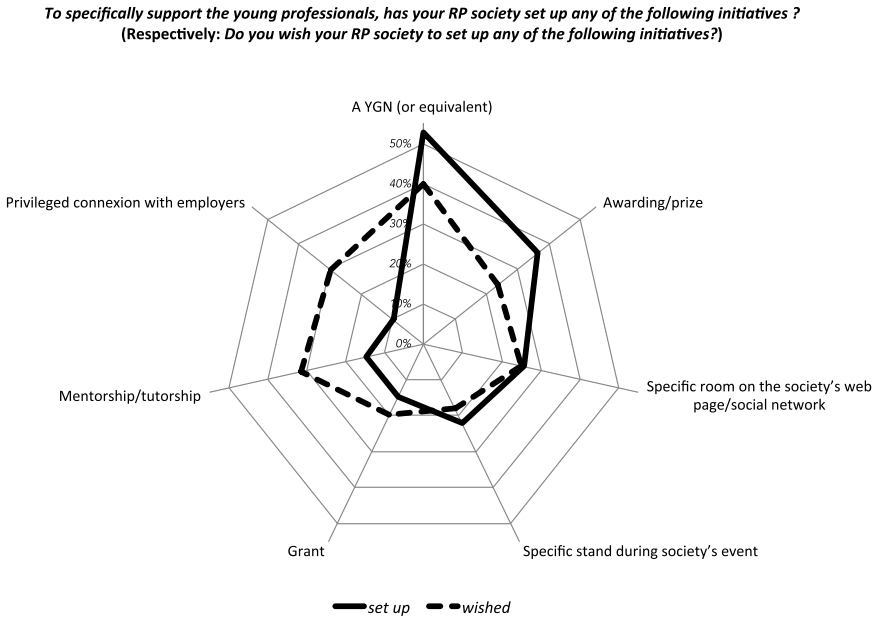

Fig. 2. Actions set up by and wished from the RP societies (% of respondents who selected the action).

– travelling allowance and overseas programmes are rarely implemented but, highly desired (this is the 2nd wish);
– the other actions, dealing with economic incentives (research funding, award scheme, rewarding incomes) and the culture of the organisation (work-personal life balance, participation in decision and acknowledgment of the work) are only present for less than 25% of the respondents. Around 30% of the respondents would like these initiatives to be put forward.

Regarding RP societies:
– it was often reported that the societies have set up a YGN (half of the respondents), as well as an awarding/prizes based system (36%) and allocated specific area for YGN members on their society website (26%) and/or stand during events (22%);
– other initiatives are more rarely implemented (< 15%);
– moreover, 12% of the respondents explicitly answered that nothing has been implemented by their RP society;

Table 3. Result of the independence test of the view of the respondents about the actions specifically set up for the young generation against age, sex, current job and region of origin.

	χ^2 (Threshold value)			
	Age	Sex	Current job	Region[a]
Results regarding actions set up by the employer	39.83 (40.11)	9.26 (16.92)	19.19 (40.11)	**34.04** (28.97)
Results regarding actions wished from the employer	23.83 (40.11)	4.96 (16.92)	39.90 (40.11)	**39.12** (16.92)
Results regarding actions set up by the RP society	22.80 (28.87)	2.93 (12.59)	22.04 (28.87)	13.12 (21)
Results regarding actions wished from the RP society	14.90 (28.87)	2.55 (12.59)	24.45 (28.87)	**45.63** (21)

[a] Because they were not enough answers from several countries to ensure statistical significance, the 27 countries have been distributed in 3 regions: "Region Europe": Austria, Belgium, Bosnia, Cyprus, Czech Republic, Finland, France, Germany, Hungary, Italy, Portugal, Romania, Slovenia, Spain, Sweden, Switzerland, The Netherland and United Kingdom, "Region Asia": China, Japan and South Korea, and "Region Others": Argentina, Australia, Brazil, Canada, Ghana, United Arab Emirates and United States of America.

– a YGN (1st wish) and specific space at events and on the webpages are still highly desired and this illustrates a strong need where there is no YGN;
– privileged connections with employers and a mentorship/tutorship programme with more experienced members of the RP society are both rarely implemented but, are highly desired by the respondents: these are, respectively, the 2nd and 3rd wishes.

3.3 Factors that may explain the answer of the respondents

An independency Pearson χ^2 test has been performed to see if the responses presented in Section 3.2 depend on the age, the sex, the current job or the country/region of the respondents. The results of the test are presented in Table 3. The χ^2 are compared to the threshold value (in bracket) and those above are in bold font.

The test shows that the views of the respondents about the initiatives set up by the employer and by the RP societies, as well as the wishes towards them, are not statistically linked with their age, sex and current job (at 95% confidence). However, the answers about these actions (with the exception of actions implemented by the RP society) are linked with the region of the respondents. More precisely, it appears that the answers from the Asia region are quite different from the answers from the two other regions. Research funding is much more represented in actions implemented by the employer and also wished from them (this is probably due to a high representation of respondents from research institution). Improvement of work-personal life balance is also much more whished. When it comes to initiatives wished from RP societies, a YGN is less frequently wished than in other region (a formal YGN is indeed set up in China, Japan and South Korea) and privileged connection with employers is (surprisingly) far less sort after compared to the other regions.

4 Discussion

The survey reached a large panel of respondents considering the diversity of countries, background, current job, employer and the sectors of activities. Because the dissemination of the survey was not driven (the survey disseminated "by itself" or targeted connections), there is a potential bias in the selection and so the collected data are representative of the group of respondents and can only be regarded as indicative. Despite this limitation, this is the first survey that collected large data about the young professionals in the field of radiation protection.

At the scale of the respondents, the survey allows us to share the initiatives set up by the employers and by the RP societies, as well as the areas for improvement. The answers do not appear to be statistically linked with the age, the sex and the current job and this should provide some confidence that they are widely shared among the young professionals. However, the initiative set up and wished for are statistically different depending on the region of origin of the respondents; notably, responses from the region of Asia are different compared to the other regions. These different points of view are possibly due to local circumstances or an over-representation of certain categories of respondents. Due to the low representation of certain countries, groups of countries have to be constituted. In the same way, the total number of respondents does not allow a high level of stratification of the data (ex. views from one category of professionals and from one country) but, this was not the primary objective of this survey.

5 Conclusion and perspectives

The survey collected information about the young professionals in radiation protection across a number of countries and professions. Looking at the number of countries reached, and the very diverse reported jobs, employers or sector of activities, it appears that the survey disseminated well. Despite the limited representation, it provides a picture of the main characteristics of the young professionals in radiation protection and should provide a useful insight.

The survey presented the opportunity to gain visibility of the initiatives that employers and RP societies have specifically set up for their younger professionals and the initiatives the young professionals would like to see taken forward.

Training is an overriding issue. Different arrangements for training have been implemented by employers but, there is a

clear demand of the respondents to improve their understanding and increase their competencies. Learning on the job is reported as very difficult. A mentorship/tutorship scheme is also desired from the RP societies. Reinforcing the participation and the representation of the young professionals in conferences (national and international), at refresher and training courses are other ways to tackle the issue, as it was reported from the open questions.

How to foster and secure the future of the young professionals is another key topic. Privileged connections with employers are hardly implemented by RP societies but, highly desired. Initiatives that could be implemented by the employers and were desired by respondents have been collected: overseas programme and travel allowance appear frequently, and to a lesser extent, initiatives dealing with economic incentive and stronger position in their employment organisation. From the last open question, the importance of communication with students (to increase the visibility of the sector and careers and to ensure a shift in radiation protection demographics) and also the public (because its perception shapes the politics and the future use of radiation) is highlighted.

The topic of networking for the young professionals was also noted. Several RP societies have set up a YGN and provided specific area on their websites or at events dedicated to their young professionals. Where this is not in place, this is highly desired. Desire for more contact, at national and international levels, and forum for discussion, debate and exchange? *e.g.* at the occasion of conferences, has been reported.

Besides the statistical data about the young professionals in radiation protection and the feedback of initiatives set-up and desired, the survey has incidentally helped to identify and establish contact with a large panel of young professionals across the world, share different initiatives between young professional networks and "reboot" the IRPA YGN (IRPA, 2018). Several results of the survey should be used as potential ways to foster the young generation and also encourage initiatives and common actions. As such, putting them under discussion – *e.g.* at the level of YGN, RP societies and also IRPA – and reflection should help to assess the effectiveness of initiatives in place, identify new ones and think about their implementation (and by who) in the future.

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