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## A CASE STUDY ON THE INDUSTRIAL RISK MANAGEMENT (IRM) POST-MASTER ACADEMIC EDUCATION PROGRAM OF MINES PARIS UNIVERSITY

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## A CASE STUDY ON THE INDUSTRIAL RISK MANAGEMENT (IRM) POST-MASTER ACADEMIC EDUCATION PROGRAM OF MINES PARIS UNIVERSITY

This paper presents the results of an academic safety education program case study. Since 2004, more than 300 students have graduated from the Industrial Risk Management (IRM) post-master program. The program addresses Occupational Health and Safety and Industrial Safety topics. Students are recruited from a large panel of Master Programs, going from Safety, Health, and Quality to Environmental Studies. Students then follow a 500-hour program, and they do a 1000-hour internship. Most of the students find a job related to one of those two domains.

The general idea behind this case study is to reflect on the relation between a safety education program and the safety professional (alumni of the program): how a student turns out to become a safety professional, how the safety professional looks back to his education in regard of his current professional situation in the safety domain. The results of this case study have direct implications for the organisation of the IRM program and academic safety education programs in general. In this paper we will focus on the alumni of the IRM program: What are they? What are they doing? What is expected of them? To what extent did their training and education influence them? What is the fundamental knowledge they think need to master when taking up a job? What kind of knowledge and competencies do they use, and do they need in their job?

This case study was based on several methodologies. More than a hundred alumni participated to a survey in 2017. A focus group with several alumni was organized in 2018. A “before” and “after” graduation survey was done. A fundamental knowledge assessment was done in 2019 on one cohort of students and their feedback on this test was collected. A critical reflection about learning in the safety field and quality analysis of safety education programs is made and perspectives about future curricula are proposed. Finally, the results of those studies enable us to re-engineer academic safety professional education programs. Further perspectives deal with the role of safety professionals in their organisations and with a reflexion on their contributions to safety.

*Keywords: professionalization in safety, safety fundamental knowledge, academic safety education programs, professional socialization.*

## 1. Introduction

In literature, several authors have described professionalization of safety. One of the first publications on safety practitioners was done in the '60s (Harper, Rockwell, et Weaver 1962). Andrew Hale has taken the lead on the topic since the '70s (Atherley et Hale 1975) and several other authors have worked on it as well. An important contribution has been made by identifying the missions of the safety practitioner (Arezes et Swuste 2012; Chang, Chen, et Wu 2012; Hale et al. 2005; Meyer 2015; Wu 2011). Limburg worked on identifying the skills safety practitioners need (Limburg 1995). Marshall and Mackey, Swuste and Arnoldy, and Pryor researched the education of safety practitioners (Marshall et Mackey 1995; Pryor 2016; Swuste et Arnoldy 2003). Arezes and Swuste investigated the emergence of (post) academic courses in occupational safety and health in Portugal (Arezes et Swuste 2013). In their paper, Wybo and Van Wassenhove present the creation of a post master program (IRM program) focusing on safety and education (Wybo et Van Wassenhove 2016).

To this day, and since 2004, the post-master Industrial Risk Management (IRM) has awarded a diploma to more than 300 students. This academic safety program addresses Occupational Health and Safety and Industrial Safety topics. Most of the students find a job related to one of those two domains. The program is recruiting candidates holding a diploma among a large panel of Master Programs, going from Risk Management, Safety, Health, and Quality, to Environmental Studies.

This contribution to the journal Safety Science will present the results of a case study done the last few years (2017 - 2020) on the students and the alumni of the IRM program.

## 2. Questioning safety professionalization

General questions arising about safety practitioners are: *“Safety practitioners, what are their characteristics? What are they doing? What is expected of them? What was the contribution of their training and education on their current job? What is the fundamental knowledge a safety practitioner needs to master when taking up a job? What kind of knowledge and competencies do they use and need in their job?”* But first, we propose to verify if being a safety practitioner or working in the safety domain is a real “profession”.

### 2.1. Professionalization and profession

In literature, different approaches to characterize a profession exist (Abbott 1988; Champy 2012; Demazière et Gadea 2009; Wilenski 1964). In their paper, Ferguson and Ramsay present three common

admitted characteristics of a profession (Ferguson et Ramsay 2010):

1. The existence of a « Body of Knowledge » that is taught by recognized education programs.
2. A professional organization that can decide on the level of qualification of a professional.
3. A code of professional ethics.

Concerning the body of knowledge, several authors already worked on fundamental knowledge and competences for safety practitioners. An important job has been done by the Safety Institute of Australia (SIA) (Hale, Hudson, et Pryor 2020; Pryor 2019; Pryor, Hale, et Hudson 2019) by developing the core body of knowledge for the general OHS practitioner. However, this only concerns the occupational health and safety domain. These elements of the Body of Knowledge are also the core knowledge taught by most of the academic safety education programs (like the IRM program).

Several professional organisations in the field of safety exist, like NEBOSH (National Examination Board in Occupational Safety and Health, United Kingdom), ASSE (American Society of Safety Engineers), now known as ASSP (American Society of Safety Professionals), BCSP, (Board of Certified Safety Professionals, United States of America), SIA (Safety Institute of Australia). Those organisations deliver memberships, certifications, awards, and honors which certify the level of qualification of a safety practitioner. Paul Swuste described the organisation of the safety practitioners in the Netherlands over a timespan of 70 years (Swuste et al. 2019). The ‘Nederlandse Vereniging voor Veiligheidskunde, NVVK’ (Dutch Association of Safety Science) is nowadays a knowledge platform for and by safety experts in the Netherlands.

Regarding the ethics of the profession, there is no doubt that the occupational health and safety profession has a strong ethical guideline, preserving the health and safety of the human beings they work with, thanks to their activity. Kuespert has conducted a gap analysis of codes of conduct or codes of ethics of several professional organisations regarding safety (Kuespert 2017).

According to the three characteristics presented, working in safety is now in 2022 undoubtedly a profession and we can speak of “safety professionals”.

### 2.2. Missions of the safety professional

In an organization, the safety professional has missions attributed to his profession. In literature we can find information about the missions of safety professionals. We advise consulting Wybo and Van Wassenhove, for an overview (Wybo et Van Wassenhove

2016). But other questions that arise are how the safety practitioner looks at those missions, the importance he gives to them and what is expected from his organisation regarding those missions, what kind of interactions he has with other actors and stakeholders in an organisation. There is not very much literature that addresses those questions. David Provan and colleagues have investigated the role of safety professionals in organizations (Provan, Dekker, et Rae 2017, 2018). To take up his profession and realise his missions, the safety professional must be educated and trained. Nowadays, most of the safety professionals have followed an academic education specialized in the safety domain.

### 2.3. Questioning safety education programs

“Safety education” in literature covers several topics. One of the topics is the safety education of employees and workers and we can find a reasonably lot of research on this topic. Very recently, Yang and Miang present the use of modern technologies like virtual reality (VR) (Yang et Miang Goh 2022) to tackle the problem of workforce’s OHS education. Chatigny reflects on the OHS part in initial vocational trainings of the workforce (Chatigny 2022) and Gajek et al analyses the process safety education of future employee 4.0 in Industry 4.0 (Gajek et al. 2022). Concerning education programs that prepare safety professionals, a lot of research is done in the process safety domain, especially for chemical engineers (they can take up a job as safety professional in industrial risk). Process safety is one of the competencies of chemical engineers so the topic is addressed regularly in the journal *Education for Chemical Engineers* (Kouwenhoven 2021; Perrin et Laurent 2020; Pollock et Sorensen 2021; Yao, Yan, et Hu 2022). The journal *Process Safety Progress* addresses also from time to time the topic of safety engineering education (Ma et al. 2021). But few literature is dealing in particular with initial safety education programs that encompasses occupational health and safety and process safety. Research on such safety education has recently gained in interest. Paul Swuste wonders about safety education quality assessment (Swuste et van Dijk 2019). Another paper of Swuste describes the proposition of nine European safety education program directors for the model of a quality (post) graduate safety education program (Swuste et al. 2021). One of the major issues in this quality assessment is the choice of learning objectives. What kind of knowledge and competences a graduate student must master at the end of a safety education program? And logically, what kind of knowledge and competences a student must master when entering this education program? Post graduate safety education is mostly a one- or two-year program. Students entering the program come from various backgrounds, chemical engineers, process engineers, master in quality and environment, master in public health, master in occupational health and safety, master in ergonomics and even master in law (see table 1). All those students are lacking knowledge and

competences but on different levels and in different fields. When they complete the safety program, most of the knowledge they used to lack, and competences are acquired by the students, but not all of them and not on the same level and in the same fields. Several solutions exist to face this problem. This is one of the questions we want to tackle with our case study on the IRM program.

### 2.4. Research question

The general idea behind this case study is to reflect on the relation between a safety education program and the safety professional (alumni of the program): **how a IRM student turns out to become a safety professional and how this safety professional looks back to his education in regard of his current professional situation in an organization?** Several questions emerge: *What are IRM safety professionals doing in their organization? What is expected of them? To what extent did their training and education influence them? What is the fundamental knowledge they think need to master when taking up a job? What kind of knowledge and competencies do they use and do they need in their job?* The results of this case study have direct implications for the organisation of the IRM program and academic safety education programs in general. In the next section, we will give a short presentation of the IRM program.

## 3. Industrial Risk Management Post-Master Program

### 3.1 Presentation of the program

MINES Paris university was created in the late 18th Century - by Louis XVI - with the aim of training high-level professionals to support the rapid development of industry and mines. Among the missions of those “engineers” (the word didn’t exist at that time) was the objective of minimizing risks associated with those new technologies. Fast-forward, in 2002, the decision was taken by the direction of MINES Paris to build a full-time post-master program to train HSE professionals for the industry. The design of the curriculum was achieved by analysis of academic literature and current practices, in close cooperation with companies’ representatives. The contents of the training and the pedagogical methods are designed to meet the needs of the industrial sector. The aim is training managers. The program was finally launched in 2004 by the Center for Research on Risks and Crises (CRC) of MINES Paris. The curriculum contained six main components:

- Safety regulations: understanding the organization of the HSE regulations (national, European), knowing the most important tools used to comply with regulations
- Hazard and risk assessment: knowing the most important methods and tools used for hazard

and risk analysis (like HAZOP, PRA, bow tie diagrams, accident analysis, etc.);

- HSE management systems: understanding the conception and implementation of HSE management systems, knowing the most important certifications (OHSAS 18000, ISO 45000, etc.);
- Human and organizational aspects: knowing and understanding the issues going from human error to psychosocial risks;
- Management and leadership aspects: knowing how to communicate and how to manage people;
- Emergency and crisis management: knowing and understanding methods and tools for emergency and crisis management (emergency plans, business continuity plans, crisis communication, etc.)

Lectures, exercises, and practical work are provided and supervised by a faculty group composed of an equal number of academics and professionals. Case studies and project teamwork are designed, for example: occupational risk identification for a company (chemical laboratory, cosmetics production site, mechanics' workshop...), major risk modeling for industrial sites (gas storage site), safety management audits (contractor issues), rehabilitation projects of polluted sites, comparing psychosocial risk evaluation methods, human error analysis for accidents... (Foussard et Van Wassenhove 2019). The program includes 500 hours of teaching time. Most of the students have a one-year apprenticeship with an industrial partner, working on a practical problem for this industrial partner.

### 3.2 Diversity in IRM candidates' background

Nowadays, every industrial company is part of a global network, uniting several entities into networks all over the world: production and logistics sites, administrative, research and development sites, suppliers, and customers. Managers and staff must be able to work in teams composed of a variety of nationalities, cultures, and backgrounds, hence the need to develop interpersonal skills and a high degree of open-mindedness.

To address this important aspect, each cohort of students for the post-master IRM program was built as a mixed team, gathering students from different backgrounds (engineering sciences, social science, business and management science) and from different origins and cultures. This diversity is obtained by a general communication for the program. As a result, candidates of various backgrounds apply to the program. The selection

committee investigates each application and pays special attention to the suitability of the candidate's professional project. By making them work together on different projects, making them part of different small teams for each project, and playing the role of team leader and team member alternatively, they have many opportunities to understand and learn to value their differences, and to make an efficient use of each individual skill, hence proving that such a diversity is valuable to produce better results.

This diversity is appreciated by the students and is indicated as a positive point of the program by the students in the final program evaluation. Whilst there are many pros, some cons can be observed about this diversity; students with a professional experience can tend to be "bossy" towards students who follow the program directly after their master's degree. Students with a social science background can have difficulties to follow the technical courses of the program and some language/cultural problems can arise. However, the main difficulty might well be the difference in knowledge and competency level for HSE and risk fields, of those future safety professionals. This diversity of the academic background of the IRM students tends, however, to lessen as industrial partners prefer more and more students who already have a background in Health, Safety or Environmental Studies. The academic background of the 2019-2020 cohort is presented in table 1.

Table 1: Academic background of the 36 IRM students, cohort 2019-2020.

Academic background	Number of students
Master in Health, Safety and Environment	1
Master in Health	4
Master in Environmental Studies	6
Master Risk Management/HSE	10
Master Quality, Safety, Environment	2
Master in mechanics, fire protection engineering	1
HSE engineer	4
Chemical engineer	1
Process engineer	1
Mining engineer	1

Bachelor in Health, Safety and Environment	1
Master in law (insurance)	1
Master in geology	1
Master in communications, professional firefighter	1
Engineer in telecommunications	1
<b>Total cohort 2019-2020</b>	<b>36</b>

### 3.3. Alumni of the IRM program

Since the beginning of the program in 2004, and by the end of 2020, more than 300 students graduated from the program. Most of them are occupying a job as safety professionals. All industrial sectors are affected, and the former students can deal with occupational health and safety, process safety, environmental issues, or all those topics. They have careers in international companies in France or abroad, but they can also work for local companies. The contact information of the alumni of the program are collected in a database. Regularly, they are contacted to keep in touch with the director of the program, and to keep their information up to date. An association of IRM alumni has been created, they share job offers on LinkedIn and they organize regularly special events or after-works.

### 4. Methodology

To tackle the research questions mentioned above, the case study methodology combined several qualitative and quantitative research devices (Figure 1). There was a general survey of the IRM alumni. A focus group with six alumni was organized to investigate some results of the general survey. There was a small perception survey submitted to the candidates who entered the program, and the same perception survey was submitted again once the students had completed the program. Two fundamental safety knowledge evaluations on students of the program (in the beginning and at the end of the theoretical program) were realized.

We will discuss the methodologies and the specific research questions they tackled in the next sections. The general approach is resumed in figure 1.

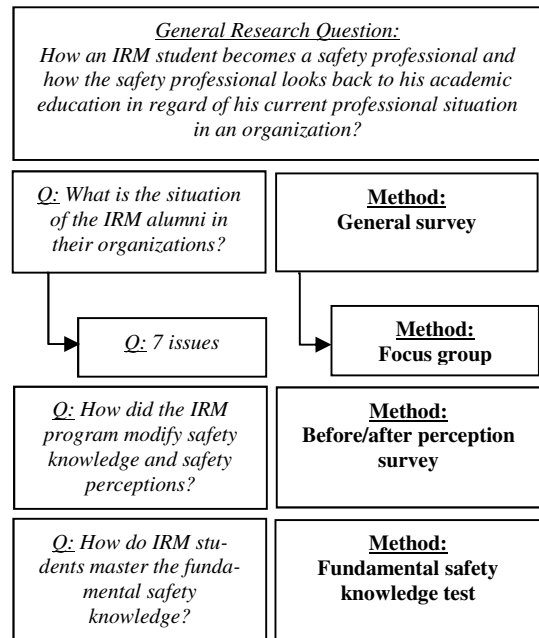


Figure 1: Case study methodology.

#### 4.1 General survey methodology

A general survey of the IRM alumni was organized to collect data to reflect on their situation in their professional organizations (Van Wassenhove et Foussard 2018):

*What are IRM alumni doing in their organization? What is expected of them? To what extent did their training and education influence them? What is the fundamental knowledge they think need to master when taking up a job? What kind of knowledge and competencies do they use, and do they need in their job?*

The survey was composed of several questions, structured as follows: 1. Questions about the student's identity; 2. Questions about their career since the IRM graduation; 3. Questions about their professional activity; 4. Questions about the usefulness of the IRM program and 5. Free comments. The survey was tested on a few alumni, their comments permitted to modify, clarify, and improve the questions of the survey. The survey was electronically and personally sent in November 2017 to each of the by then 197 alumni of the program. The survey was closed in January 2018. Quantitative and qualitative (verbatim) analyses were done with the results.

## 4.2 Focus group methodology

Based on the elements of the general survey, a focus group with MRI alumni was organized. The methodology was based on Attal-Vidal & Iribarne (Attal-Vidal et Iribarne 2012). Focus groups are group discussions to react jointly on specific themes with precise objectives (or imprecise in the sociology of "open" research). Focus groups are preferred over interviews when participants have common experiences like the IRM alumni such that a process of mutual sensemaking can take place. These targeted studies provide a better understanding of a given topic (a complex issue). For example, theme ideas for research on safety professionalization might be: power and behaviors with other actors in the organization; safety components; evaluation of the academic education impact. Focus groups make it possible to either discover and explore a topic, or to target a specific precise problem. They are complementary with other methodological approaches. Focus groups of an "exploration and discovery" type can be followed for confirmation by quantitative surveys, by observations, or by individual in-depth interviews. Focus groups can also target a particular issue after a discovery method, for example an exploratory quantitative survey. In our case study, a general exploratory quantitative survey was carried out (see 4.1). The results made it possible to establish a set of issues/hypotheses to be analyzed and these issues were further discussed by a focus group.

The composition of the focus group was made on a voluntary basis and the availability of IRM alumni. Based on a shortlisting of representative alumni, a group of around fifteen people was approached. Of the available people who were able to free themselves one afternoon and were mobile, while respecting the parity between men and women, finally, six people were selected. With professional and geographic constraints, bringing together the right people to organize a focus group a given afternoon in the week was difficult. It was decided to do only one focus group on the topic. The focus group was carried out in a semi-directive mode. A semi-directive interview is a qualitative survey technique that makes it possible to orient in part (semi-directive) the discourse of the people interviewed around different topics defined beforehand by the interviewer in an interview guide. A non-directive interview takes place freely from a question. We can consider that the focus group was semi-directive (7 topics to tackle) but each topic took place in a non-directive mode freely from the question associated with the assumptions. The entire focus group discussion was recorded, and a transcription was made.

The focus group methodology attempt to bring more data for the general research questions proposed for the online survey. The results of the online survey on the professional context of IRM alumni identified seven issues to be treated more in depth by a focus

group. These issues were organized into assumptions (H) and associated questions (Q):

H1: Occupational Health and Safety and Industrial Safety are two different fields. Q1: In your opinion, are OHS and IS two separated fields in organizations?

H2: There are tensions between the importance given to safety missions by safety professionals and the importance they are given by their organization. Q2: For the following professional missions, do you often feel a tension between important missions according to your personal conviction, the importance given by your organization and the actual time spent on the activity: 1. Development of safety culture, 2. Analyzing accidents, doing field visits, planning the continuity of the activity, 3. Safety performance measurement, 4. Ensuring regulatory watch, managing insurance and risk financing.

H3: Training is an important mission; however, safety professionals lack teaching/pedagogical skills. Q3: Do you think you need skills and knowledge to build / organize / deliver safety trainings?

H4: The activity of a safety professional is characterized by: 1. Interaction with many actors, 2. A wide variety of objects and subjects to be covered, 3. Freedom of autonomy and initiative, 4. Heterogeneous tasks with different periodicities in parallel - Frequent field interactions. Q4: What are the characteristics of your professional activity?

H5: The vision on the elements that contribute to safety differs between safety professionals and their organization; the organization pays more attention to "formal" safety (compliance with procedures, existence of SMS, regulatory compliance, consultation between administration and residents, safe design of the system). Q5: What are the components of safety for you? What are those of your organization? Why?

H6: The safety professional lacks management skills: leadership, strategic planning, business management, translating accident data into policy and translating policies into action. Q6: What skills do you want to use more? And why don't you master them?

H7: Evaluation of IRM program. Q7: What were the most relevant and significant benefits of the post-master IRM program?

## 4.3 Before and after program attendance survey methodology

This section describes the methodology for a perception study with IRM students before and after the theoretical academic training of the program. This before/after IRM education survey was organized to gain knowledge on the impact of the IRM program on students.

*To what extent did the IRM program modified the safety knowledge and safety perceptions of students?*

The methodology of this survey is based on a semi-quantitative approach. The survey, which had two phases, was done with the 31 students of the 2017-2018 promotion of the IRM program; phase 1: survey lasting 45 minutes, self-taken before entering the IRM program, during the period from April to June 2017, phase 2: identical self-taken survey after the theoretical training of the IRM program, end of March 2018. The questionnaire aimed at collecting information such as: the students' general knowledge of risks; the representations of safety; their perception of the safety profession; and finally, safety training. At the end of the data collection phase, a statistical, descriptive analysis was performed on all the parameters collected, according to the subgroups of interest (before / after the IRM theoretical training program). The quantitative parameters were described by: counts with valid / missing value, average, standard deviation, median, minimum and maximum. The qualitative parameters were described by: the associated frequencies and percentages, and the amount of missing data. Percentages were calculated upon the population with no missing data. Also, an exploratory textual analysis (textmining) was carried out on two very conceptual variables to describe the recurrence and the links between the identified keywords. The objective was to detect significant changes in language, particularly, the use of structured concepts quoted before and after the training. The analysis of the results before / after the IRM program made it possible to put the impact of the training into perspective.

#### **4.4 Fundamental safety knowledge experimentation**

To tackle the problem due to the diversity of the academic background of the candidates of the IRM program, mentioned in the description of the program, we questioned fundamental safety knowledge:

*How do IRM students master the fundamental safety knowledge?*

To build an overview of the fundamental safety knowledge, we started with the INSHPO Capability Framework (International Network of Safety and Health Professional Organizations), it represents a collaboration with the largest scope of contributors. It also integrates work from EUSafe and the BoK (Book of Knowledge). The structure and organization of Knowledge proposed by INSHPO was used as a standard to compare other references: INRS (Institut National de Recherche et de Sécurité pour la prévention des accidents du travail et des maladies professionnelles, France), HSE (Health and Safety Executive, NEBOSH certification, (National Examination Board in Occupational Safety and Health,

United Kingdom), ASSE (American Society of Safety Engineers, now became ASSP American Society of Safety Professionals), BCSP, (Board of Certified Safety Professionals, United States of America), SIA (Safety Institute of Australia), Bok, (Body of Knowledge, Australia). One supplementary column was added to propose items or themes that were not present under any reference (because specific to the French legal context for example).

All fundamental knowledge topics were finally reduced to only four categories.

1. Science: Knowledge of engineering science (such as mathematics, physics, chemistry...) and social science (such as psychology, ergonomics...).
2. Hazard and Risk: Contains all hazards and risks in terms of occupational health and safety, process safety, security, and cybersecurity.
3. Regulations: French, European and international regulations, Certifications (ISO).
4. Management: Management systems, safety culture models, emergency, and crisis management.

The logic behind this is the following: Science is the fundamental knowledge to understand phenomena. This knowledge allows the understanding of hazards and to "conceive risk". Risk is treated in a regulatory frame and finally, risk is managed. This represents about 15 pages of tables of "safety professional knowledge items" sorted into the four categories. The next step was to index the knowledge items with five different levels:

1. Fundamental science knowledge (high school or bachelor level) – considered acquired by IRM candidates
2. Fundamental safety knowledge, a prerequisite to understand the content of the IRM program – considered acquired by IRM candidates
3. Fundamental safety knowledge that will be acquired while doing the IRM program
4. Safety knowledge acquired while doing the IRM program
5. Safety knowledge expert level, not tackled in IRM program

The knowledge items were indexed according to five levels. This was done by four people in a five-hour meeting: a professional safety expert (Occupational Health and Safety and Process Safety), the director of the IRM program, a lecturer of the IRM program and a junior safety professional who is alumni of the IRM program. 36 knowledge items were identified at level

two: fundamental safety knowledge, a prerequisite to understand IRM program. This is the basic level of knowledge a master's student in safety must know.

To test the level two (fundamental safety knowledge, a prerequisite), examinations had to be developed. It was immediately decided to create an examination made of open questions. Based on the 36 fundamental themes, 56 questions were conceived. The NEBOSH examinations for the general certificate and for process safety management were used as basis for the questions. Some examples are:

“What does P.I.D. mean?” (Process Instrumentation Diagram)

“What is the difference between a P.I.D. and a P.F.D.? (P.FD. = Process Flow Diagram)

“What does ALARP mean?” (As Low As Reasonably Possible)

“What are the two dimensions of the risk matrix?” (Occurrence and Gravity)

For a second test, 37 multiple choice questions were created. Each question was attached to one of the 36 knowledge items and for each of the 36 items, a documentation was supplied so that the students could afterwards update their knowledge in autonomy. A senior safety professional (expert process safety and occupational health and safety) co-wrote the questions. The questions were submitted to another senior safety professional, who is also expert in the two fields (OHS and IS). It appeared that for the first series of questions, not all of them were easy to interpret. Senior expert safety professionals can have a particular vision of their field (and of what is or is not important), and that vision is not common to all senior experts; they tend to put different stresses on what is really important to them. This could be an interesting topic to investigate in the future.

## 5. Results

This part presents the most important results of the four research devices.

### 5.1 Survey

We had 105 respondents (for a total of 197 alumni at the moment of the survey). Several alumni were not reachable; among them most were students of the first cohorts or foreign students of the program (mainly from China). The survey was reported as “difficult” and “time consuming” by the alumni. Finally, this can be considered as normal: as a lot of questions encouraged the respondents to think critically about their professional practices and their roles in their organisations, this takes time and introspection. Several personal solicitations by the director of the program were necessary to motivate

alumni to complete and finalise the survey. The response rate is relatively good, with more than one in two responding to the survey. Recent cohorts responded the most to the survey. Unfortunately, due to their shorter professional experience, their feedback is to be regarded as perhaps a little less relevant. Table 2 presents the results of the characteristics of the IRM alumni professional activity.

Table 2: Characteristics of the IRM alumni professional activity.

Characteristics of professional activity	
Female-male professionals	35-65%
Average age in years (sd 5,8)	30.1 years
French nationality	70%
Professionally active	93%
One professional experience	39%
Two professional experiences	26.7%
Three professional experiences	16.2%
Four or more experiences	11.4%
Not yet professional experience (only internships)	6.7%
Works in energy sector	24%
Works in consultancy	20%
Works in chemical or pharmaceutical sector	10%
Works in construction sector	8%
No training after IRM program	90%
Internal training, Msc programs or PhD after IRM program	10%

80% of the respondents were still active in risk management (others took positions in maintenance, production, or general direction). For further analysis, we only took into consideration the people who are still in the risk management sector. Table 3 presents a summary of the principal results of the characteristics of the safety professional activity.

Table 3: Characteristics of the safety professional activity.

Table 4 presents the importance of the interactions with other actors of the organisation.

Table 4: Importance interactions with other actors

Ranking importance interactions other actors
1.Direction
2.Production managers
3. (Field-)workers
4.Maintenance
5.Communication department
6.Legal department
7.Purchasing department
8.Civilians living nearby

and stakeholders of the organization.

The characterization of the safety profession is also done by identifying the tasks of a safety professional. We asked the alumni to rank the tasks based on those identified by Wybo & Van Wassenhove (Wybo et Van Wassenhove 2016) by the importance they give each task, the importance their organisation gives it and the time spent on each task. The most important elements for our safety professionals (and this also coincides with the most time-consuming activities) are « Risk analysis », « Field visits/inspections », « Incident and accident analysis » and « Informing and advising the direction ». The mission « Developing a safety culture » is important in the eyes of safety professionals, but in the meantime, they think that their organisation gives less importance to this activity.

The survey next suggests a list of items that can be considered as contributing to the general safety level of an organisation. The safety professionals were asked to identify the items that were, in their eyes, the most important for safety, and then the items their organisation considers the most important. The three most important contributions to safety for the respondents of our survey were: “Engagement of top management”, “Engagement of middle management” and “Research for ultimate causes of accidents and incidents “. The top three of the safety professionals’ perceived most important items considered by their organisations are: “regulatory compliance”, “a safe conception of the technical system” and “the existence of a safety management system”. Coincident with the results presented above, safety culture is mentioned as important for safety in the

Characteristics of safety professional activity	
On production site	50%
On corporate level	35%
Have HSE director as superior	33%
Have production director or general manager as superior	40%
Have a team to manage	40%

eyes of the safety professionals but they perceive that a lesser importance is given by the organisation to this item.

Safety professionals are major actors in terms of safety trainings in organisations. 70% of the respondents do play a significant role in their organisations’ safety education programs. They themselves do provide safety trainings: they create the contents of safety trainings, and they audit the needs for safety trainings in organisations.

The next part of the survey dealt with the competencies (and knowledge) mastered by safety professionals and the competencies (and knowledge) they would like to master or master more. There was a significant difference for the items: “Leadership”, “Emergency and crisis management”, “Transposition of safety indicators into a safety policy”, “Strategic planning”, “Knowledge about the company’s general business, financial and management activities “, “New communication technologies” and “Transposition of politics into concrete actions”. We also asked our safety professionals to evaluate several characteristics of the safety profession. Respondents rated a set of suggested characteristics from 1 to 10. Overall, it appears that the profession has a very strong relational component, the topics they cover are varied, and safety professionals have a great deal of autonomy in their organization, with a good recognition within the organization. The worst rated characteristic was “A professional position isolated in the organisation that has few concerns for safety”.

The last part details the importance of the courses of the program. There was noticeable tendency to identify specific useful or useless courses in the program. Logically, the first important courses mentioned were about the core knowledge of safety professionals: risk analysis methods.

## 5.2 Focus group

We’ll present here a synthesis of the discussions among the participants about the seven topics of the focus group.

H1: Occupational Health and Safety and Industrial Safety are two different fields.

There was no clear consensus about this theme. In France, OHS and IS each depend on a specific regulation (and a different Ministry). The focus group members agreed that risks do not bother with those boundaries. IS is considered as more “technical” by the focus group members as OHS is more “human factor” related. They agree that someone with a IS background could do OHS, but that someone with a pure OHS background would have a lot of difficulties to do IS (or process safety). For them, there is nevertheless a problem of risk vocabulary in companies.

H2: There are tensions between the importance given to missions by safety professionals and by their organization.

The participants of the focus group mentioned several safety related topics that create tensions with their organisation. The first is safety training, this is seen as a safety pillar, but production mostly comes first regarding to operator availability for safety trainings. So, to them, “*safety first*” mostly is a false statement because in reality, production has priority, thus, a safety professional has to make safety compatible with production (e.g. no waste of time, and no waste of money). Another topic is pre-task risk analysis. It is important for safety but in several organisations, this is not done because time just lacks. The focus group participants underlined the importance of the organisational attachment of the safety function, the nearer the general direction, the better. To implement safety culture, the safety professional can rely on their safety management system, but without the support and exemplarity of the top management, this mission will be hard to accomplish. The IRM safety professionals preferred to be more on the field or at the workshop, to discuss with people, to create a relationship based on trust, to learn the technical reality of operators, to create a professional network in the company. They would like to do accidents investigations more deeply and to do more safety trainings. They would like to do less reporting (some say their reporting is not dealt with at corporate level anyway!) and less reunions and meetings.

H3: Training is an important mission; however, safety professionals lack teaching/pedagogical skills.

All six participants are safety trainers, some even carry out “training the trainer” sessions. They learned on the spot, improving with time. But they are aware that being an expert in something does not necessarily mean you are a good teacher, and sometimes one does not realize this. None of them uses pedagogic tools such as defining pedagogic objectives for their trainings.

H4: Characterization of the activity of a safety professional.

They all agreed that a safety professional interacts with many actors in the organisation. All agreed that a safety professional must cover a wide variety of objects and topics. Globally, the participants agree that they have an important degree of freedom, autonomy and initiative, but this depends on whether the safety professional is on site or if he/she is at corporate level. All agreed that they have heterogeneous tasks with different periodicities in parallel. This is seen as a difficulty, but it also makes their work interesting. It would be nice sometimes to have the time to concentrate only on one mission. Often being disturbed for ‘emergencies’, having responsibilities and not having time to think things through is said to be tiring. They frequently interact with the field’s actors. They also characterize their job as having a lot of responsibilities, partly because they are also in interaction with the administration for legal issues. One remark from a female safety professional focused on being a woman; when you're a woman, you may be seen more as a social worker; people come by to make all their complaints (safety and not safety related) and you must do a lot of listening. Although this may not be related to the safety function, it could affect all the local manager positions in the field. They deal with all types of complaints. For people who are at the headquarters, this is less the case.

H5: The vision on the elements that contribute to safety differs between the safety professional and their organization.

This was a difficult question for the focus group members. The discussion moved quickly to formal safety systems (imposed by organizations). All regulations and procedures must be applied, there was no discussion about it, although it was different for certifications (like ISO). Most professionals of the group agreed that certification does not equal safety, and is just paperwork that matters for company’s clients, despite it not reflecting the reality of the field/workplace. One person summed-up the difference as follows: “*The company is concerned by its image and the responsibilities of the top management, and it takes actions to protect its assets. Safety professionals are concerned by the safety, health, and lives of the workers and we act as such.*” There was a general silence of agreement in the group.

H6: The safety professional lacks general management/business skills.

Focus group participants mentioned in first place skills to manage a team (team management, conflict management), how to react with the board of directors, and project management (time management). Some companies have internal

trainings (organized with business schools). The discussion drifted, in a second phase, on the technical skills of their industrial sector. The oil and gas sector is very organized, and gives new managers the opportunity to learn all the technical aspects of their industry. Newcomers must take up several different work activities on the field to learn all technical issues. Other companies in other sectors do not assist (safety) newcomers; one safety professional took MOOCs (Massive Online Open Course) during the weekends to gain the technical knowledge needed to be creditable on the field afterwards.

H7: Evaluation of the IRM program.

The first comment was that the classes given by safety professionals and the discussions with safety professionals during the curriculum were very useful to them. The second point that is mentioned is that the curriculum has given students the ability to use critical thinking skills, of taking a step back on risk management practices. A third comment is that it is more profitable to already have had a professional experience or having a professional experience while doing the curriculum (evolution of the IRM program since 2014 with the introduction of apprenticeships). One participant said that he did the training as a full-time student without apprenticeship, but he thinks it is a pity to do this training without professional experience. Now, he sees a lot of things in his work, and is thinking: *"It's a shame, when I was in class, I didn't realize the importance of some courses, which I do now. Now, I'm a little frustrated, and I go regularly back to courses from the program to remember things... »*.

### 5.3 Before and after training cohort survey

Regarding the initial training of the students, most of the students already have knowledge in the field of Occupational Health and Safety (OHS), Environment or Industrial Risks. It can therefore be assumed that they have a certain general knowledge of the field/profession.

A first question probes students' general knowledge and culture of industrial risks. It was requested to mention two industrial accidents with their date of occurrence. Before the MR MSI training, 10 students (32.3%) had made at least one error or imprecision in the date or nature of the mentioned industrial accidents. However, after training, no errors or inaccuracies appeared. Unsurprisingly, the accidents that were highlighted by the students during the second investigation are the accidents that were dealt with in class.

The next question probed students' professional experience and was probably a little difficult to answer. The question tried to estimate the maturity of the student by their view on theory and practice. *"Have you ever been exposed to a situation (during*

*your internships for example) which involved making adaptations in relation to what you have been taught?"*. Most of the students answered during the first wave "yes" (77,4%), the rest did not specify (22,6%). The "yes" responses increased during the second wave, no-one did not specify but strangely enough, two "no" answers were given (6,5%) during the second wave.

To probe the knowledge and perception of concepts related to risks and safety, several open questions were asked. First, *"In your opinion, what are the most important risks for a company?"* Before the training, students mention accidents, work, and the environment. After the training, students mention industrial risks and OSH. Moreover, there is a significant change in language: more structured concepts are mentioned after the training (OHS, industrial risks) than the simpler words used before. It should also be noted that the environment is less mentioned after training. Before the IRM training there is little connection between keywords and contextual words. After the IRM training there are more links between keywords (rather conceptual) and contextual words.

The second question was perhaps more difficult *"What does safety mean for you?"* There is a similarity in the words used before and after the training, but we observe the appearance of OHS as a key term. There is also a significant change in language after IRM training. The "risk" concept is less encountered after the training, but the "hazard" concept does appear. After the training we also notice more links between keywords (rather conceptual) and contextual. There are more verbs as keywords: ensure, avoid, protect, control.

The next question dealt with a set of statements; the student was asked to indicate with which he agreed; several answers were possible. More than 9 out of 10 students agree that risks can never be 100% controlled, both before and after training. Moreover, the proportion of students who consider safety as an absolute priority in the professional world goes down from 80.6% before training to 58.1% after training. It should be noted that after the training no longer any student agreed with the idea that ISO / OHSAS standards allow all risks to be controlled. Only one student among the 31 agreed before and after that when complying with regulations, all risks are controlled (we are not sure if it is the same student in the two occurrences).

The next question concerned the duality between regulatory compliance and safety: *"Which concession would you rather make between implementing regulations without improving safety and seeking safety at the risk of being non-compliant?"* Before the IRM training, more than 5 out of 10 students (58.1%) chose looking for safety at the risk of being non-compliant with the regulations. This proportion

increases to 74.2% after training. Note, the proportion of students who did not answer the question decreased from 29.0% to 16.1% after training.

The next part of the questionnaire probes the students' perceptions of the safety profession, by asking what skills are necessary, what tasks are to be performed, which interactions with other actors happen in the organization.

*"What do you think are the most important skills for a risk manager?"* Technical skills are the most important, followed by human and relational skills. After the training, synthesis and analytical skills improved.

*"According to you, what missions or tasks would you have to carry out as a safety professional in an organization?"* Risk analysis and assessment is considered to be at the core of business and this perception is further reinforced after training. Awareness and the training of staff come second and is also gaining importance after the IRM program. Regulatory watch takes third position after training and reporting also becomes more important.

*"With whom will you deal the most in your HSE position?"* The management and production / workers are the most important actors. Management is put at the top. The results show that there is no variation in the hierarchy of the first 6 positions (Management, Production Manager, workers, State Inspection Services, Maintenance Department, Human Resources). But there is a significant decrease in rank for the "Communication Service".

*"What skills are you looking to acquire through MS MRI training?"* and *"What skills have you acquired through the MS MRI training?"* Most students had already had courses in risk management and aimed an improvement in this knowledge and skills, which they obviously find in the IRM academic education program. They also acquired skills in project management or teamwork. The term "professionalization", which is not really a skill, has all but disappeared.

#### 5.4 Fundamental knowledge experimentation

Two examinations were organized for the students of the 2019-2020 cohort. The students were told that it was a self-evaluation of their fundamental HSE knowledge level.

A first examination was done at the beginning of the program, 35 students took it (one absentee). It was an open question examination of 56 questions. After the test, a feedback collection was organized, and students could report their impressions. Later on, we organized a group correction, and each student corrected his own examination. We did not collect

the documents afterwards; each student kept their copy. What mattered to us was the global score of the group for each question, not students' individual scores. The students received documentation on the fundamental knowledge fields so they could work on their weaknesses by themselves.

The second examination was a multiple-choice question list of 37 questions that tested the knowledge on the same corpus. This was organized three months after the first examination and its purpose was to stimulate the students to work on the weaknesses in their fundamental knowledge. The students did not know beforehand when and if this second examination would be held. 33 students took the second examination (three absentees due to illness).

#### 5.4.1 Examination 1

The results are presented in figure 2 (percentages with right answer).

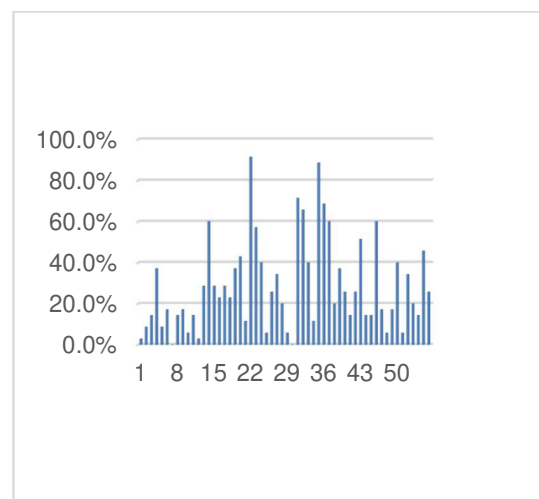


Figure 2: Results first examination (56 questions).

Three days after the examination, written feedback (composed of four questions and the opportunity to leave a comment) was organized.

##### 1. The questions were too difficult?

Most of the students (23/35) found the examination too difficult for them but they recognized the relevance of the examination. They said it gave them the opportunity to check their level of knowledge compared to the standards of a safety professional. 12 of them did not find it too difficult.

##### 2. The examination was too long

Most of the students (28/35) did not find the examination and the time given to take it (two hours)

too long. The general setting of the examination was considered very adequate by the students.

3. *The questions were representative of my past education*

19 students agreed with the fact that the questions were in line with the knowledge they acquired in their past curriculum. 16 students mentioned important lack of knowledge due to their past education, mostly concerning process safety.

4. *Will the technical expertise tested be useful to me in the future?*

Not a single student mentioned the fact that the knowledge tested does not correspond to what they will use in their future career. This sounds logical, we presented the test and its fields as the fundamental knowledge for safety professionals. It was in that regard somehow impossible for them to refute this.

**5.4.2 Examination 2**

The results for the second examination are presented in figure 3 (percentages with right answer).

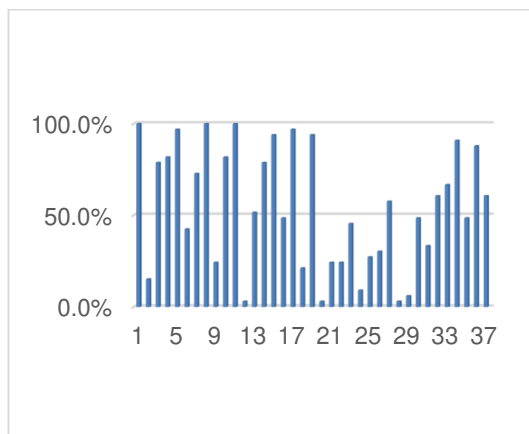


Figure 3: Results second examination (37 questions).

**5. General discussion**

We will discuss here the results of our case study regarding the research questions (figure 1). The IRM alumni survey gave us insights about the professional context of our IRM alumni doing the job of a safety professional and the impact of the IRM safety education program. Those results enabled us to discuss several hypotheses in a focus group setup. We will here start to take up those focus group hypotheses and discuss the impact of the results for each of them and finish with questioning the fundamental safety knowledge and impact of the IRM program on the IRM alumni.

*Occupational Health and Safety and Industrial Safety are two different areas.*

OSH and IS are based on the same general methodology of risk management. If IS has an overtone of process safety, which means a significant technical knowledge (physics, chemistry, etc.), OSH has a more human or relational connotation. IS seems more difficult to “access” without solid scientific knowledge. However, the two areas are interrelated and dealing with them separately does not seem appropriate. As such, teaching them together in a training session seems to be relevant although it makes it more difficult for a program director to build the curriculum.

This topic echoes the BP Texas City accident (Hopkins 2008). Hopkins presents a very readable and detailed account of the malfunctioning of a (safety) management system that is focusing on lost time injuries as key performance indicator, rather than process hazards where the CEO was linking BP’s technical integrity problems to personal injury statistics. There could be a problem of risk vocabulary/definitions at top level management in companies. Focus group participants stated on a problem of risk vocabulary in organisations/(top)management. This could partly explain the next hypothesis.

*There are tensions between the importance given to missions by safety professionals and by their organization.*

Overall, the IRM professional would like to spend more time on the field, analyzing incidents / accidents and training people. In fact, reporting and meetings take too long, production takes precedence despite the “safety first” messages and safety culture is too “top down” or normative. Those elements give echo to recent tendencies like Sidney Dekker’s « safety differently » (2015) where the author states that it might be time to trust people more than we trust bureaucracy, protocol and process. The mission « Developing a safety culture » is important in the eyes of safety professionals, but in the meantime, they think that their organisation gives less importance to this activity. This might be explained because of the difficulty for safety professionals to create and improve a safety culture in an organisation: management isn’t showing full exemplarity and is relying too much on top-down safety management systems. « Control and reporting » seem to be important for organisations; however, IRM safety professionals consider this of lesser importance. They globally would like to spend less time on safety bureaucracy (Dekker 2014; Størkersen et al. 2020).

*Safety training is an important task; however, safety professionals lack teaching skills.*

All IRM alumni of the focus group were trainers. They provide safety trainings, they create the contents of safety trainings, and they audit the needs for safety

trainings in organisations. Almost all of them had learned "on the job", improving their skills through practice, using pragmatic approaches without the help of pedagogical theories (or andragogy). The input of pedagogical theory in a course of professional safety is probably highly necessary. This topic is never addressed in safety curricula. It is thus important that safety education programs do consider this aspect (adult education or andragogy) in their curriculum.

#### *Characteristics of a safety professional's activity.*

Overall, it appears that the profession has a very strong relational component, which confirms the results of other research (Guennoc 2019; Guennoc, Chauvin, et Le Coze 2019). The IRM alumni are unanimous on an interaction with many actors, a great diversity of objects and subjects to be covered, the fact of having heterogeneous tasks with different periodicities in parallel and frequent interactions with the field. Freedom of autonomy and initiative depends on their hierarchy's stance (corporate or on site, for example). The need to be flexible and to be available for emergencies was emphasized. However, it is sometimes difficult to do substantive work. Those elements can help directors of safety training programs to organise the curriculum in a way that it would correspond as much as possible to the actual life context of real safety professionals. The worst rated characteristic was "A professional position isolated in the organisation that has few concerns for safety". By putting these results into perspective with Karasek's occupational stress model (Leka, Van Wassenhove, et Jain 2015; Van Wassenhove 2014), these conditions are ideal for the professionals to be happy doing their job, and are subject to little psychosocial risks or job strain (stress). These results may contradict the argument that the particular position of the safety professional in their organization (between management and field operators, subject to contradictions) would make them vulnerable to the effects of job strain. This surprising aspect needs to be investigated further.

#### *The vision on the elements that contribute to safety between the safety professional and their organization is different.*

It was difficult for people to answer this question. Overall, the organization pays attention to safety formalized in a management system or through the establishment of standards. The professionals who are more in contact with the field are sensitive to training, communication, trust, pedagogy. Again, this echoes some aspects of Sidney Dekker's "safety differently" theory (Dekker 2015). It could be argued that the company is putting things in place to protect the company, its image, its responsibility (and that of its managers) and on the field, things are put in place to protect people's lives and health. And this could lead up to contradictions. Here we enter the domain

of professional ethics. This issue is never really treated in safety education curricula. This could be a subject for further research.

The next topic concerned safety contributions. The IRM alumni were asked to identify the items that were, in their eyes, most important for safety and items their organisation considers the most important. Coincident with the results presented above, safety culture is mentioned as important for safety in the eyes of the safety professionals. They perceive that a lesser importance is given by the organisation to this item. The three most important contributions to safety for IRM alumni were: "Engagement of top management", "Engagement of middle management" and "Research for ultimate causes of accidents and incidents". The top three of IRM Alumni's perceived most important items considered by their organisations are: "regulatory compliance", "a safe conception of the technical system" and "the existence of a safety management system". This could be explained by the fact that organisations are keener on a technical and regulation-based approach of safety whereas the safety professionals would have a more human oriented approach to safety. We also notice a different perception (by comparing the average scores) given to the importance of "emergency and crisis exercises" and "sharing experience from incidents and accidents". This could be caused by the difficulty faced by safety professionals to organise those types of activities in their organisations. These situations can be considered as very common in organizations, safety education programs must prepare future safety professionals to cope with this kind of situations to avoid future frustrations.

#### *The safety professional lacks management skills (leadership, strategic planning, business management, translating accident data into policy and translating policies into action).*

Overall, IRM alumni want (to use) more skills (and therefore, have training) in management. Moreover, technical skills specific to industry are also needed and wanted. Where management courses can be delivered as part of a safety training, it is too broad to deal with technologies from all sectors. It is suitable for the professional to self-study (MOOCs, online courses, books, etc.). On the other hand, the ability to learn independently must be taught in training. Differences between competencies (and knowledge) mastered by safety professionals and competencies (and knowledge) they would like to master or master more were observed for the items: "Leadership", "Emergency and crisis management", "Transposition of safety indicators into a safety policy", "Strategic planning", "Knowledge about the company's general business, financial and management activities", "New communication technologies" and "Transposition of politics into concrete actions". With the survey, we do not know if IRM alumni cannot master these skills

(because of a lack of time or being not a priority for their organisation) or if they do not know how to master them (because a lack of skills). In any case, these elements make it possible to reflect on current courses of academic HSE training by integrating or reinforcing these topics.

#### *Evaluation of IRM training.*

IRM alumni agreed that the major advantage of the IRM training lies in learning a "risk management logic" and acquiring a great capacity for putting things into perspective and to be able to have a holistic view. The interventions of various professional speakers during the program bring a plurality of opinions that allow development of a critical view on professional practices. The IRM program allows students to build the capacity to take a step back and to develop critical thinking. Other safety education programs stress also this point (Swuste et Sillem 2018). The IRM students thus have the capacity to work in different sectors or fields. Another comment was that the classes given by safety professionals and the discussions with safety professionals during the curriculum were very useful to IRM students. We suppose that this helps in the socialisation process of the future safety professional. How to achieve eliciting forms of identity and enhancing professional socialisation is discussed more in detail in the paper by Foussard et al (Foussard, Van Wassenhove, et Denis-Remis 2021).

#### *Fundamental safety knowledge and impact of the IRM program*

The educational backgrounds of IRM students are different. This is a strength for the education program but a difficulty faced by a program director. They have to identify learning objectives based on fundamental knowledge requirements to develop the learning pathway to achieve the objectives. A 500-hour post master program cannot deal with all the knowledge items encountered by or imposed upon a safety professional (Van Wassenhove et Foussard 2020). Choices must be made. It is therefore useful for the students to inform them about the choices made and to give them a general overview of all the knowledge: what is fundamental, what will be taught during the program and what will be necessary for them to learn by themselves. However, the main target of fundamental knowledge testing is to give students the opportunity to assess themselves.

The results of the first fundamental knowledge test were rather poor (figure 2) but it did not come off as a surprise. The content of the examination was in a great amount focused on industrial risk (or process safety). Most of the students had an occupational health and safety background, so several subjects were new to them. It also appeared that answering to a question "out of the context" is very difficult for students. Maybe the questions must be more

"introduced" or "contextualized". Some questions (and associated answers) were the vision of one professional expert and represent his vision only. Some questions were too technical and are normally not known by heart by a safety professional. Knowing by heart specific and detailed technical knowledge might not be the best sign pointing to a good safety professional. A good safety professional perhaps knows where to quickly find the information suited to their needs. For instance, it is important to know the general regulations about noise on the work floor and where to find this regulation rather than to know exactly each noise limit.

The results for the second examination were far better, but still not excellent (Figure 3). Some questions were a bit tricky (or confusing). The group correction (each student made the correction of their own document, we did not collect the copies afterwards, each student kept their copy) revealed that some questions must be addressed better. Questions addressed must aim at the right amount of "detail" in terms of fundamental knowledge. They should not be too general (because too simple) and not too detailed either (too difficult). Despite the bad results, the feedback of the students was very positive. But what is the relevance of such kind of knowledge testing? It would be interesting to test the knowledge of a broader panel of safety professionals, and to compare the obtained results to the students' results. This could give us insights on what kind of knowledge safety professionals master and how they cope with a personal lack of knowledge or skills. The safety professional's network could be of an important help to cope with this kind of problems. Hence the importance of professional associations or a network of alumni.

Now we can address some general remarks for safety education programs: they might focus too strongly on technical aspects pertaining to the safety professionals' body of knowledge. Strategic, holistic management view may be lacking, but also the reflexivity on the role of the safety professional in an organization (Provan et al. 2017, 2018). The work done by the team of the BoK (Paul et Pearse 2016) are gradually taking into account those aspects. The Bok now has chapters like "professional attributes" (working in organizations, leadership and ethics). Students are regularly asking program directors for technical knowledge, for "toolboxes". In their perspective, it is needed to be confident, but this might not be the way to help them to be more confident. Nowadays, safety professionals in organizations also need to master the financial aspects of their job and need to have critical analysis skills. Transversal human factor competences like negotiation, argumentation, human resource management; all those skills are expected from a modern safety professional. To satisfy mastering technical knowledge, they can appeal to their professional network where they can also share their

own knowledge. Identifying your own skills and knowing where you can find the knowledge you lack, is an important competency in a fast-changing world.

The IRM program had some impacts on the students' vision of their future roles in organizations. When trying to estimate the maturity of the student by their view on theory and practice, *"Have you ever been exposed to a situation (during your internships for example) which involved making adaptations in relation to what you have been taught?"*, the "yes" responses increased after the IRM program. We can assume that real life necessarily requires an adaptation of the theory and being aware of this is proof of professional maturity. When asked what are the most important risks for a company, students mention industrial risks and OSH. Unsurprisingly, these two areas are at the core of IRM training. It may be necessary to, during academic training, ensure putting into perspective other very important risks for the company and perhaps in the first place the commercial and financial risks. This echoes with the need for management and business competencies of a safety professional.

There was a significant change in language after IRM training: more structured concepts are mentioned after the training (OHS, industrial risks) than the simpler words used before. and more links between keywords (rather conceptual) and contextual words were present. We can therefore deduce that the training brings a focus on occupational health and safety risks and industrial risks and that the program helps to structure the concepts related to these two areas, which seems quite logical after having followed a safety program. In line with the need for confidence we saw above, students consider before training technical skills as the most important, followed by human and relational skills. After the training, synthesis and analytical skills improved, probably because of multiple case studies in group work (analysis of a problem and synthetic restitution).

One of the last interesting things that came out of this case study was the observation of the importance of a substantive dialogue on the profession between professional and students/young professionals in the making. It is a first confrontation between theory and practice, a substantive exchange on safety paradigms and on the mental models of professionals and young professionals. Those discussions are appreciated by the young professionals and probably improves the process of professional socialization (Foussard et al. 2021; Madigan et al. 2019). Those discussions are also appreciated by the experienced professionals, it is experienced as refreshing and challenging. Madigan et al also found that students with a good relationship with their workplace supervisor, who carried out meaningful and relevant work, and who received payment from the host organisation foster the OHS professional identity, with graduates reporting a greater understanding of the OHS role and

professional practice skill development (Madigan et al. 2019).

Finally, there are tensions between expectations regarding assignments and professional content on the part of the organization and on the part of the safety professional. It may not be surprising, a company is made up of conflicting constraints and priorities between production and safety, for example. It is more curious if it is about the way to perform the safety function, which missions of the safety professional to stress, or even deeper, which safety paradigm to rely on. In perspective, these factors which influence the role and missions of the safety professional must be studied. Future safety professionals must be made aware of the real conditions of their future profession. Risk control techniques are certainly important to teach, but their implementation in organizations depends on several factors that should also be understood while training to become a safety professional.

## 6. Conclusion

So, in what degree can we generalize the results of the IRM alumni to safety professionals? This case study brings some new insights on how an IRM student becomes a safety professional and how to adapt future safety education programs to achieve that goal.

A general idea gradually emerged from this study. It is the duality between theory and practice as well as the integration of (new) (scientific) theories into industrial practices. The importance of the academic curriculum regarding this aspect should not be overlooked. The academic curriculum must encourage the students' scientific curiosity, as well as the ability to take a critical look at professional practices. A managerial position in the field of safety cannot be conceived without knowledge of the general culture of industrial companies and a general culture of the "safety studies". These are essential elements for taking a step back from practices and suggesting "innovations". The presence of "enlightened and cultured" professionals in the course is essential to bear witness to the application of general (and new) theories in professional practices. Internships are very important in this regard by the interactions they offer. Madigan et al demonstrated also the importance of internships. They build capacity for OHS students and foster OHS professional identity (Madigan et al. 2019). A post-master level training in safety must be based on the technical safety knowledge of students and tackle substantive questions. The students must improve more by themselves on the techniques and methods of the profession. This implies passing a very important threshold for students with no specific safety training. However, practice, being in an organization and if possible, on the work floor, allows the student to acquire experience in action and to transform their theoretical learning into skills that can

be used. Work-study training allows students to implement this technical and operational improvement in a professional context. Theoretical lessons allow you to take a step back from these practices. This back-and-forth motion is essential in the learning process. For the professionalization of safety, it is important to teach a "general culture" of risks and the ability to have a critical insight on (their) professional practices. The (future) professionals thus have the capacity to work in different sectors or fields. Managerial skills must be strengthened, project management, business management process but also team and people management. The profession has a very important relational component; this is a constant element in all the studies of this paper.

The safety profession is a fascinating, but complex field, thanks to the multiple interactions available within an organisation, the versatility of the application domains, without speaking of the complex object safety itself is. Knowing and understanding the professional realities of the safety profession is necessary to create good safety education programs. The present case study helps program directors to appropriate safety education programs and to ensure that future safety professionals acquire the necessary competencies and skills. Research is actually done on the evolution of a global, professional capability framework covering the role, contribution and status of Occupational Health and Safety (OHS) professionals (Hale et al. 2020). The issue of fundamental knowledge for the safety profession is important for program directors but also for students as the field can go beyond OHS. Safety professionals also deal with process safety or industrial safety, and they can be faced with security or cyber security issues. A clear vision from the student on their knowledge and their competences and on the global field of safety profession is important. Presenting a global body of knowledge to the students and testing them on fundamental knowledge is one way to improve their vision and to enhance professional socialization.

In conclusion, the results of this case study enable us to re-engineer academic safety professional education programs. We can consider that IRM alumni's situations are somehow representing the global safety professionals' situations, but a broader (international) study would be appropriate for validation. Further research will continue to investigate the role of safety professionals in their organisations.

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