ALIGNING EXTERNAL AND INTERNAL OCCUPATIONAL SAFETY AND HEALTH SERVICES IN PORTUGAL (CASE PT5)

1. Introduction

Promoting effective occupational safety and health (OSH) practices is key to safer and healthier workplaces. Improving arrangements and practices for managing OSH across a whole range of industry sectors and firm sizes — large, medium and small — is stimulated, supported and sustained by a range of institutional actors and internal and external processes to firms. Scientific research highlights, among other things, the critical role that state regulators for OSH, such as Labour Inspectorates and prevention services, can play (EU-OSHA, 2021). This case study is part of a research project conducted in Portugal to provide further insight into this topic.

In Portugal, the organisation of OSH services can be divided into four types (Law No 102/2009,[1] of 10 September, which defines the Legal Regime for the Promotion of Safety and Health at Work and is a transposition of OSH Framework Directive 89/391/CEE, from 12 June): internal services, external services, common services and designated employer/employee. Nonetheless, there is a significant prevalence of external services in the country — 92,2% of the total services (GEP, 2023).

The selection of the type of OSH services depends on two main factors: the number of workers in the company and the level of risk of the activity which is carried out. Companies with a significant number of workers (i.e. 400 or more) are legally obliged to organise internal OSH services. This involves creating a structure within the company to deal with occupational risk prevention issues and monitor workers' health. The activity carried out by the company also impacts this selection, as companies involved in high-risk activities (e.g. construction, the chemical industry or metallurgy) must also organise internal services, as they allow for a more personalised approach to dealing with the specific risks of these activities. In contrast, smaller companies, or those with low-risk activities, can opt for external services,[2] or designate and train an employer or an employee to carry out OSH functions. Research has shown 'compliance with legal obligations' and 'avoiding sanctions and fines by ACT' are the main reasons companies report when resorting to external services, accounting for around 97% and 96% of Portuguese organisations, respectively (EU-OSHA, 2022, p. 64).

Concerning safety representatives and safety committees in SMEs, the third European Survey of Enterprises on New and Emerging Risks (ESENER 2019) findings suggest that Portugal shows a low presence of 'health and safety representatives' (reported by 24% of surveyed companies, compared to 56% in the EU-27), 'works councils' (4%, compared to 24% in the EU-27), 'health and safety committees' (13%, compared to 22% in the EU-27), and 'trade union representation' (7%, compared to 18% in the EU-27) (ESENER, 2022).

According to the Office for Strategy and Planning (Gabinete de Estratégia e Planeamento – GEP) of the Ministry of Labour, Solidarity, and Social Security (Ministério do Trabalho, Solidariedade e Segurança Social – MTSSS), by 2022, micro-enterprises and SMEs represented 99.6% of Portugal's enterprises — of which 81% were micro-enterprises — employing 68.8% of the labour force (GEP, 2023). According to Law No 102/2009, of 10 September, Article 21, companies with fewer than 61 workers can only have one workers' representative for OSH, although they are not legally obliged to do so. These rules vary according to the size of the companies and are different among the EU Member States (EU-OSHA, 2022). Among the EU-27, Portugal is the second country with the lowest results in terms of employee participation tradition

[1] More information is available at: https://files.dre.pt/1s/2009/09/17600/0616706192.pdf

[2] The authorisation of an external service depends on the verification of the requirements specified in Article 85 of Law 102/2009, of 10 September. Namely, to cite a few examples: the existence of a senior safety expert, a safety expert and an occupational doctor who carry out the respective safety or health activities; adequate and equipped facilities for conducting the activity; and equipment and tools to assess OSH conditions. The list of authorised entities to provide external OSH services is provided by ACT: https://portal.act.gov.pt/Pages/Entidades_autorizadas_servicos_externos.aspx

reported in ESENER 2019. In addition, only 24% of the Portuguese companies surveyed in ESENER 2019 declared to have these representatives, revealing their scarce presence in the country.

While some companies may establish internal OSH services, they commonly seek external preventive services when specialised skills or equipment are necessary — particularly safety preventive services, for tasks such as risk assessments (Cabral, 2001). Thus, this case study explores the relationship between internal and external services, while highlighting some strategies developed by different OSH actors to address shortcomings of the Portuguese OSH services model.

2. Description of the case

While external services have advantages in Portugal due to the country's predominance of micro, small and medium-sized enterprises, with often more limited economic resources (Leitão et al., 2023), they do not always indicate an integrated safety and health approach. As mentioned by one of the interviewed safety experts, external services involve the provision of ad hoc services, and the selection of the companies providing prevention services is according to the interviewee often based on the lowest price offered, due to the marketisation of prevention services. This leads to a lack of knowledge of the actual risks workers are exposed to, as reported by a safety expert:

> *'There are more and more companies offering these [external] services. But what is done in practice is not very important, is it? … We send out theoretical documents, but no one assesses whether, in practice, things are really done this way or not. I think it's already clear to everyone, whether for us, for the ACT, or the National Health Service, that a lot of things are not working properly in our country [regarding the OSH system] …. Everyone [in the OSH field] can see that aptitude records don't show us anything, that we don't even know who did the [medical] consultations… Just as there are risk assessments, which we often look at and they do not give us any information about the work activity of that specific worker and the risks to which he is exposed.' (Safety expert, Female, 24 years of seniority)*

Furthermore, in the field of OSH, in Portugal, it remains possible for a worker — due to a lack of legal obligation and often due to the limited conditions of the service provider safety experts themselves (i.e. service contracts) — to not have had contact with an occupational doctor throughout their professional career. Such limitations can contribute to the under-reporting of occupational diseases. As reported by a family doctor from the National Health System (Sistema Nacional de Saúde – SNS), who works in a territory that contains several companies with high-risk activities from the extraction sector, the responsibility falls upon the general practitioners/family doctors to address such shortcomings:

> *'We have more [cases of] silicosis [in the area] … I can tell you that, as strange as it may seem, reports [of occupational disease] — if not 99%, it will be close to this percentage — are made by family doctors … it is strange that extraction companies do not have their own tests for this type of element, or that they do not care about respiratory screening. In fact, the last thing we [the doctors at the medical unit] achieved was because we pressured the Public Health to intervene in tuberculosis cases, as we are in the areas that have the highest incidence — and we have the highest incidence because of silicosis and the lack of intervention by occupational medicine colleagues, not because they don't want to intervene, but because they are not part of the company's staff, they are not part of the Insurance… … but regarding [the intervention done by the Public Health department] it was temporary.' (SNS general practitioner/family doctor, Male, 40 years of seniority)*

Aims

Various Portuguese OSH professionals who participated in the study presented strategies implemented to promote greater integration between health and safety services and thus minimise the boundaries between these two areas of preventive services. These strategies aim, ultimately, to facilitate OSH compliance in the country and address the system's current limitations. Notably, in November 2024, Portugal presented the Green Book on the Future of Safety and Health at Work (MTSSS, 2024), which includes a recommendation aimed at formally establishing 'a regulatory framework that promotes the integration of Occupational Safety and Hygiene services with Occupational Health services, so that, whenever feasible, both aspects function within the same structure' (p. 204, free translation).

Target group

There are two possible target groups: the safety experts, and the workers in the companies to which safety experts provide services.

What was done, and how?

To promote greater compliance with legal requirements, safety experts have initiated a series of activities designed to facilitate interaction between key stakeholders in OSH prevention, including occupational doctors, nurses, occupational therapists and other relevant professionals. Most of these practices come from safety experts working within internal services in the context of large-size companies. This observation reinforces the widespread notion that this modality seems to contribute to higher-quality OSH activities.

The results of the individual interviews and focus group sessions revealed four key strategies:

- holding daily or weekly meetings of multi-professional teams to discuss the specific cases of workers (e.g. work accidents, specific complaints);
- carrying out preventive visits and technical assessments in the 'field', that is, at the workplace, with the participation of an occupational doctor;
- engaging in active listening and dialogue with workers to identify and address their concerns regarding their working conditions; and
- using a digital platform to integrate and connect workers' and companies' health and safety data.

As mentioned previously, it is common in Portugal that when a company has internal OSH services, it also relies on external services to provide specific services. In this case, some internal services might be either more oriented to workers' health aspects or others than to safety matters. Such circumstances can increase the difficulty for OSH professionals in ensuring an interface between health and safety at work (and OSH compliance, in general). Yet, these challenges were reported by the experts interviewed for our study as more prevalent in external services, often related to the availability of other professionals (such as occupational doctors) to participate in such discussions, visits and/or meetings. Some safety experts have carried out technical visits to workplaces accompanied by an occupational doctor whenever possible. During these visits, the safety experts provide information to the occupational health doctors on specific aspects of the activities carried out there, on the company, on the workers who work there and other relevant information. This makes it easier to discuss solutions in a timely manner.

'Two months ago, I finally got the occupational doctor to come to one of our companies, where we go every month for about three days at a time. This way we were able to get him to assess all the workstations and verify, on the spot, many of the things we had reported in the risk assessment. I can give you an example: we have a paint handling room classified as ATX, where the workers don't wear any kind of individual protection equipment, and we don't have any kind of gas or vapour extraction. That's when the occupational doctor realised that the higher level in the risk assessment was not due to excessive pickiness, but it was necessary. That's it, but I have this advantage: it's not another company; it's the same company so that we can act in a better way.' (Safety expert, Female, nine years of seniority)

'I think it's fundamental for a doctor to come to the workplace … in the construction industry, it's a bit difficult for this measure to be implemented. It would be ideal if it were because we have very tight documentary control; the workers only go to the site if they are fit to work or if there is a conditioned aptitude. The aptitude form has to say which one, but here we have the executing entity and we have a lot of subcontractors, which means that each one has its own medical examinations and consultations at various clinics; it's a bit difficult to manage to get a doctor to come to a worksite, but it would be the ideal measure because we have a lot of risks here.' (Safety expert, Female, 13 years of seniority)

Regarding collective discussion meetings, their organisation and frequency depend on various factors, including the context in which prevention services are carried out and the team's availability. Two internal safety experts from large-sized companies[3] have highlighted a favourable context for implementing this practice. While, on the one hand, one safety expert highlights how these meetings lead to more informed and multi-professional decision-making, another one provides examples regarding how this practice reveals a preventive approach (e.g. changes to workstations stemming from the slightest suspicion that there is a risk for the workers' wellbeing before this is translated into a health problem):

'In my particular case, I work in an activity in which the occupational doctor and the occupational nurse also play a fundamental role in prevention. So, this work here, these meetings, this work that's being carried out doesn't make sense without this working team … because the health of the worker in the first instance also involves knowing all the risks, but also of the physical conditions of the worker. So, working as a team with the occupational doctor and nurse is fundamental in the hospital environment.' (Safety expert, Male, 23 years of seniority)

'I have an advantage because my employer is [a company of] occupational doctors, or are doctors, so it's much easier to involve health and safety in activities. In terms of external services, as I was saying earlier, we have some industries that are already concerned about safety and have much better contracts, no longer those typical annual or six-monthly visits. I can tell you that I have companies where I'm there every week or every fortnight, so we're already able to carry out various activities here. So, we manage, at the slightest suspicion, at the slightest complaint from the workers, to quickly talk to the medical department and understand what needs to be done. I don't know about my colleagues, but what I come across most are occupational illnesses in terms of ergonomics, musculoskeletal disorders… So, it's always [necessary to do] ergonomic analyses, then working out with the medical team what that worker can and can't do, what the constraints are, and finding workstations where that worker can carry out their duties without aggravating the illness or developing others… Because we know that workers then tend to compensate with other muscle groups.' (Safety expert, Female, nine years of seniority)

These meetings, mostly organised by internal safety experts of larger companies, are particularly important in Portugal due to the rarity of health and safety committees, which also, when existent, often take on advisory roles on more transversal issues (e.g. risk assessments). Meetings such as the ones described are more frequent, taking place daily or weekly, and they are intended for the discussion of workers' specific cases (i.e. work accident), with data that is not necessarily shared with other company stakeholders (i.e. health data). Nevertheless, health and safety committees are rare in the country (EU-OSHA, 2022).

In general, the integration of the following two practices is reported: **holding collective discussions on OSH cases**, and **visiting the workplace accompanied by an occupational doctor**. The safety experts reported this integration as a good practice in reducing the boundaries between occupational health and safety services.

[3] In these companies, safety representatives do not exist.

'We have an interaction that works very well and is very positive, because whenever there's a report in a consultation about a complaint or a need … to adapt the workstation, a need for a conditioned aptitude, … normally this always involves an individual assessment. … One thing is what the worker reports in the consultation; another is to then observe the working conditions: under what conditions they work, how they work and what their tasks are. And then there's always a meeting where the cases end up being discussed and give rise to the limitation, and we get feedback on the limitation assigned to the worker …. We can't separate health from safety, that's for sure.' (Safety expert, Female, 18 years of seniority)

'So, we do consultations every week, the occupational doctor goes there every week, and these consultations are not just to say whether the worker is fit or not, but also for the doctor to make regular visits to the workplaces. In particular, we monitor the collection circuits; the doctor and I do this together so that she also understands what the workers actually do and so that her job as a doctor is facilitated. In addition, we had to choose new individual protective equipment, in which we involved the occupational doctor — particularly regarding safety footwear. She also visited all the workstations and even recommended some exercises that the colleagues can do … so I think, yes, in that sense, it's been a good experience.' (Safety expert, Female, six years of seniority)

Another type of practice that illustrates this interface is the **involvement of workers in discussions about their working conditions**. In some cases, meetings are held monthly to provide a more concrete perspective on workers' activities and, thus, privileged access to suggestions for change that might otherwise go unnoticed.

'Every month, we hold a meeting with team leaders …. Basically, what we ask them is if there's anything to improve on the site, anything in terms of their working conditions. I'll give you a specific example: we're now putting showers on the sites. It wasn't a normal thing to implement on the sites; normally, it was always toilets, but not showers. But we're only noticing this need because they're all saying the same thing. It's often very hot, and they also arrive at the end of the day. They're all sweaty, they're in no condition to leave, so to speak, and they want to have a shower. We hold these meetings every month. Sometimes, what we say is that it may not immediately be applied …. There's a lot of dialogue with the workers. … we get them together.' (Safety expert , Female, five years of seniority)

'In my case, I hold quarterly meetings with different groups of workers. I have a group of heavy and special vehicle drivers, as well as cleaners. We always hold a quarterly meeting. Of course, it's not always easy to deal with, because it's a lot of people together, sometimes in the same room with different opinions, but the interesting thing is that we get to dissect a few things they say, which for them may not be very interesting, but for us it's very important in terms of measures to improve their day-to-day life.' (Safety expert, Focus Group, Female, six years of seniority)

Some safety experts also commonly rely on digital platforms to integrate and link **information about workers' and companies' health and safety**. In the interviews, they mentioned that platforms of this type allow OSH data from different companies to be cross-referenced. Specifically, this tool allows, for example, the sharing and updating of information in the system, which integrates it and makes it available according to each professional's practice. Through this platform, they can monitor occupational health check-ups and track health-related activities (such as nursing visits and workers' vaccination status); ensure that risk assessments are kept up to date; document accidents and psychosocial risks; and incorporate technical functions, such as keeping track of meeting minutes and monitoring the implementation of OSH measures within a specified timeframe. As an example of this practice, a safety expert reported:

'Imagine that I open this [demonstrating what the platform does] and … [I see the] "worker has been deconditioned on the 31st of July", I have those deconditioned [workers], and I know the recommendations. Now, if I'm going to visit this school [the workplace] tomorrow, I print out this map or take it on the tablet — we have a tablet. If I'm busy, I'll print it out. … And I'll go and see this worker [and ask] "How are you doing? Is your health better? Is it not? Have these recommendations been sufficient?" If there's a doctor, I'll talk to the doctor right away. If not, I'll make an appointment to see the occupational doctor later, or I'll book an examination so that he can go and see the doctor, and have new tests done …. Some have already [been to the doctor again] or have been on sick leave, so when I get to the human resources [department], I'll ask for the test, and the person will be called in.' (Safety expert , Female, five years of seniority)

In addition, the same safety expert mentioned that more than just data integration, the use of this platform has also allowed OSH professionals to improve their activities via app functionalities made specifically for them. Safety experts, nurses and doctors have access to different data on the platform, but with their inputs into the system, the platform combines risk assessment, occupational aptitude and occupational health impact on workers, for example. For this reason, it is a tool for developing OSH multi-professional preventive actions, with an interface between health and safety aspects.

'I think the greatest benefit of having a platform like this is actually being able to combine medical and work data with safety data. I think that's the biggest benefit. In other words, you can have risk assessments, as well as health impacts and workers' complaints.' (Safety expert, Female, five years of seniority)

Degree of innovation

Based on the interviews and focus groups conducted, the practices described proved effective in integrating prevention and health promotion measures beyond safety aspects This included e.g. involving the occupational doctor in the visits to the workstations to check risks, and in the decisions on protective equipment; development of a digital platform for all the different OSH actors of the company to access what is being done and which enables them to verify needs for action; and meetings to discuss needs, including preventive actions — such as an adaptation to a workstation through complaints, before the existence of any diagnosis. This strategy is considered innovative in terms of OSH compliance.

Although these are examples of isolated practices, prevalent in large companies, they are consistent with a recommendation proposed by the recent Green Book on the Future of Safety and Health at Work (MTSSS, 2024): 'to define a process of communication and permanent coordination between Occupational Safety and Hygiene services and Occupational Health Services, especially when they are still organised separately, which enables the sharing of mutually relevant information to organise prevention measures' (p. 204, free translation).

Approach

While safety experts take both a reactive and preventive approach to OSH, the initiatives described are mostly framed within a preventive approach. They aim to integrate health and safety into their practices in teams to improve OSH compliance and better identify situations in need of intervention.

What was achieved?

In most cases, the health and safety interface — noticeable in all the strategies described throughout this case study — has enabled some OSH professionals to develop healthier and safer work practices (e.g. workstation adaptations in advance to target specific complaints or needs, target protective equipment necessities) through a preventive approach, while also reducing occupational injury and illness sub-notification.

Success factors and challenges

The availability of multidisciplinary teams in both external and internal services, with OSH actors from different backgrounds, was represented as a common success factor for implementing the aforementioned OSH practices, allowing for the exchange of information and the development of tailored action.

> *'[the doctors] ask us what that worker does on a daily basis, what risks I think they're exposed to, so they listen to us, in other words, they let us guide them, let us describe the work the workers do, how often they do it… Once we've given them that guidance, they talk to the worker — or to the foreman or the person in charge, depending on the job — and then they go to the place where the worker spends the most time. Or, if they do intermediate work, they go to the machines, so they can also see what the activity itself is like, from when it starts until it finishes, so they can cross-reference it with our risk assessment.' (Safety expert, Female, five years of seniority)*

However, throughout the qualitative data collection phases, several challenges to the development and efficiency of these practices were mentioned. Namely, the interviewees highlighted:

i. A lack of concrete practice guidelines for both regulating OHS compliance and providing these services, with the exception for specific high-risk cases (e.g. asbestos), including a clear OSH service plan that includes all phases of prevention and intervention:

> *'The law, and excluding some very specific areas — for example, the case of asbestos, in which there are complementary diagnostic tests that are mandatory by law — there are few areas in which this happens. Therefore, what we see is that, for example, medical consultations are sold "ad hoc". For example, when what the law tells us is that there must be a contract [for an OHS service plan] … A service plan which includes all phases and that must be thought out, taking into account the needs of the population it is serving. And that doesn't exist. … this leads to us having companies or entities that practice this in a way... it's the "selling of the aptitude record". And that is not the service that, at all, should be provided.' (Safety expert, 18 years of seniority)*

ii. The lack of safety experts available for the number of companies and/or workers they are providing services for.

iii. The precarious nature of OSH employment conditions, as OSH professionals often work as service providers without long-term contracts, coupled with the absence of occupational doctors and the failure to update the lists of available professionals (e.g. Occupational doctors who are deceased or retired still appear on the lists):

> *'We have had a huge deficit of occupational doctors for several years …. Most occupational doctors [on the lists of doctors currently active and authorised to work as so4] do not work in occupational medicine full-time. … Many of them don't even work in occupational medicine at all. Some doctors have been retired for several years and continue to appear on the lists. There are even doctors who have passed away and continue to appear on the lists. … We had super good doctors working with us for many years, and from one day to the next, they could no*

[4] More information is available at: https://www.dgs.pt/saude-ocupacional/autorizacao-de-profissionais-de-saude-do-trabalho-/medicina-do-trabalho/lista-dos-medicos-autorizados-transitoriamente-.aspx

longer do this because they stopped seeing these [working contract] extensions.' (Safety expert, 18 years of seniority)

iv. Situations in which companies are not able or willing to pay for extended and more complete OHS prevention plans, and do not activate the insurance in cases of non-life-threatening occupational accidents due to the increase in insurance prices. Workers' cases are then forwarded by the employers to the local health centres, leading to the under-reporting of work-related accidents, injuries and disabilities, but also to workers being left unsupported financially when such unreported accidents lead to disabilities.[5]

'There was some progress, with some insistence from our part [from family doctors at the Family Health Units], because normally we end up making this note to companies: first, that they must have prevention, hygiene and safety services working, they must have the insurance signed and working... And insurance companies have their own guidelines, [to] not [send the workers] to us. Now, I notice that companies normally continue to apply this type of pressure. … It is a way to reduce the [insurance] premium because when the insurance company activates the work accident, the monthly payment increases. So, an indirect way to reduce the premium is not to declare it [the accident] and send [the worker] to the National Health Services to try to get them to solve it somehow.6 But this has some inconveniences for workers, which is what worries me most … when insurance is not activated, the issue that arises is not just about that accident, but rather the consequences and limitations that they can have as a result of that accident. And obviously, when it is not declared, there is an activation time in insurance companies …, what happens is that often when there are consequences and chronic injuries, in which [workers] are left with a disability, as it is not being declared, and by not having the insurance activated, they are left without [financial] support.' (SNS general practitioner/family doctor, 40 years of seniority)

Transferability to other EU Member States

Practices endorsing the interface between different OSH actors and services are transferable and recommended for other EU Member States to promote a greater degree of integration between health and safety matters and, thus, greater compliance with OSH requirements.

References

Cabral, F. (2001). *Livro branco dos serviços de prevenção nas empresas*. IDICT.

EU-OSHA – European Agency for Safety and Health at Work, *Improving compliance with occupational safety and health regulations: an overarching review*, 2021. Available at: https://osha.europa.eu/sites/default/files/Improving_compliance_OSH_regulatons_lit%20review.pdf

EU-OSHA – European Agency for Safety & Health at Work, *Third European Survey of Enterprises on New and Emerging Risks (ESENER 2019): Overview Report. How European workplaces*

[5] When companies only comply with the minimal OSH legal requirements, and workers don't have access to an occupational doctor or when occupational doctors are working as service providers for multiple companies at the same time, without a continued presence in the field, they have further difficulties in having their occupational accidents and diseases recognised as such. The workers do not, in this context, have easy access to these actors — often, even resulting in resorting to the family doctor for doing so. However, in the cases of work accidents, the family doctors can only report this as a 'direct disease' and a suspected work accident, but the company is still responsible for reporting it (or not) to the insurance company. Furthermore, the number of such reports done to the insurance company increases the premium. For this reason, the companies often under-report work accidents.

[6] Considering the work accidents are the employers' responsibility.

manage safety and health, 2022. Publications Office of the European Union. Available at: https://osha.europa.eu/sites/default/files/esener-2019-overview-report.pdf

GEP - Gabinete de Estratégia e Planeamento. (20**23**). *Quadros de Pessoal*. Ministério do Trabalho, Solidariedade e Segurança Social. https://www.gep.mtsss.gov.pt/documents/10182/10928/qp2022pub.pdf/9907641c-9c42-4a19-a14d-8decc807a207

Leitão, M., Mesquita, S., Gomes, B., Ferreira, S., & Pestana, H. (2023). Quais os Benefícios que existem na implementação de um serviço de Saúde Ocupacional interno numa pequena/média empresa. *Revista Portuguesa de Saúde Ocupacional online, 16*. https://www.rpso.pt/quais-os-beneficios-que-existem-na-implementacao-de-um-servico-de-saude-ocupacional-interno-numa-pequena-media-empresa/

MTSSS - Ministério do Trabalho, Solidariedade e Segurança Social. (2024). *Livro Verde do Futuro da Segurança e Saúde no Trabalho*. Versão de trabalho para consulta pública (novembro de 2024). https://www.dgert.gov.pt/wp-content/uploads/2024/11/LivroVerde-SST_17.06.2024.pdf

Authors: Liliana Cunha and Sarah Maggioli, Center for Psychology at University of Porto (CPUP); Faculty of Psychology and Education Sciences at University of Porto (FPCEUP), Portugal

Sara Ramos, Centre for the Study of Socioeconomic Change and the Territory (DINÂMIA'CET); University Institute of Lisbon (ISCTE), Portugal

Joana Guedes, Joana Duarte and João Santos Baptista, Laboratory for the Prevention of Occupational and Environmental Risks (PROA)/Associate Laboratory of Energy, Transports and Aerospace (LAETA); Faculty of Engineering of the University of Porto (FEUP), Portugal

Project management: Dietmar Elsler, Ioannis Anyfantis, European Agency for Safety and Health at Work (EU-OSHA).

This case study was commissioned by the European Agency for Safety and Health at Work (EU-OSHA). Its contents, including any opinions and conclusions expressed, are those of the authors alone and do not necessarily reflect the views of EU-OSHA.