



Dyna

ISSN: 0012-7353

dyna@unalmed.edu.co

Universidad Nacional de Colombia

Colombia

Rodrigues, Matilde A.; Rubio-Romero, Juan C.; Arezes, Pedro; Soriano-Serrano, Manuel

Occupational risk assessment at Olive Oil Mills: Limitations and new perspectives

Dyna, vol. 83, núm. 196, abril, 2016, pp. 21-26

Universidad Nacional de Colombia

Medellín, Colombia

Available in: <http://www.redalyc.org/articulo.oa?id=49645153003>

- How to cite
- Complete issue
- More information about this article
- Journal's homepage in redalyc.org

redalyc.org

Scientific Information System

Network of Scientific Journals from Latin America, the Caribbean, Spain and Portugal

Non-profit academic project, developed under the open access initiative

Occupational risk assessment at Olive Oil Mills: Limitations and new perspectives

Matilde A. Rodrigues ^{a,b}, Juan C. Rubio-Romero ^c, Pedro Arezes ^b & Manuel Soriano-Serrano ^d

^a Department of Environmental Health, Sciences School of the Polytechnic Institute of Porto, Porto, Portugal. mar@estsp.ipp.pt

^b Centre Algoritmi, Department of Production and Systems, Engineering School, University of Minho, Guimarães, Portugal. pazezes@dps.uminho.pt

^c School of Industrial Engineering, University of Málaga, Málaga, Spain. juro@uma.es

^d The Centre of Occupational Risk Prevention of Jaén, Government of Andalucía, Jaén, Spain. msoriano@ujaen.es

Received: December 09th, 2015. Received in revised form: February 29th, 2016. Accepted: March 02nd, 2016.

Abstract

Risk assessment is an essential tool to support risk decisions. However, this process may not always be applied effectively, and this can limit the quality of the preventative action. This is particularly critical in sectors that have a lot of micro and small companies, such as Olive Oil Mills (OOMs). To better understand how to improve the quality of the risk assessment at OOMs, this study aims to analyze the views of Occupational Safety and Health (OSH) practitioners on the key difficulties/limitations in this process and identify some improvements to current practices. This analysis was based on a questionnaire that was developed and given to 13 OSH practitioners working for OOMs. The results showed that the time available to perform the risk assessment is the major limitation. The need for a specific tool for risk assessment in the OOM sector was identified, and the use of accident reports from the entire sector was indicated as an alternative to the absence of data at company level.

Keywords: occupational accidents; Olive Oil Mills; prevention; risk assessment quality; risk assessment.

Evaluación de riesgos laborales en Almazaras: Limitaciones y nuevas perspectivas

Resumen

La evaluación de riesgos es una herramienta esencial para apoyar las decisiones acerca del riesgo. No obstante, este proceso puede no siempre aplicarse con eficacia, y esto puede limitar la calidad de la acción preventiva. Esto es particularmente crítico en sectores que incluyen una gran cantidad de micro y pequeñas empresas, como las Almazaras. Para comprender cómo mejorar la calidad de la evaluación de riesgos en las Almazaras, este estudio tiene como objetivo analizar los puntos de vista de los profesionales de la Prevención de Riesgos Laborales (PRL) acerca de las principales dificultades/limitaciones en este proceso e identificar algunas mejoras en las prácticas actuales. Para este análisis fue desarrollado un cuestionario que fue aplicado a 13 profesionales de la PRL con experiencia en las Almazaras. Los resultados mostraron que el tiempo disponible para el desarrollo de la evaluación de riesgos es la principal limitación. Esta investigación identificó la necesidad de una herramienta específica para la evaluación de riesgos en las Almazaras, siendo identificado el uso de informes de accidentes de todo el sector como una alternativa a la falta de datos a nivel de la empresa.

Palabras clave: accidentes del trabajo; almazaras; calidad de la evaluación de riesgos; evaluación de riesgos; prevención.

1. Introduction

Risk assessment is an essential and systematic process to assess the impact, occurrence and consequences of specific activities in safety and health [1,2]. Quite understandably, it is a critical phase in the overall process of risk management in any organization as it is important to help decision-makers make informed choices and prioritize actions [3].

Despite the importance of risk assessment, it must be understood that it is not a simple process. The obvious problem is that there is no simple, unique method and strategy to undertake the process. There are many ways to perform a risk assessment as different strategies and tools can be selected. Each OSH practitioner can do this differently by selecting and applying different approaches. The degree of depth with which some of the steps of risk assessment are analyzed can change depending

on the practitioner who is carrying out the process [4]. Moreover, it is important to bear in mind that each sector of activity has particular features that need to be considered when making decisions about how risk should be assessed. This will provide reliable results to support decision-making when risk reduction measures are being undertaken. In fact, selecting which approach will be used is a critical issue in the risk assessment process, since the results will vary significantly as a result of this decision [4]. In view of this, it is essential to use adequate risk assessment strategies and tools that, on the one hand, make it possible to consider limitations in the situation being analyzed and, on the other hand, are capable of providing risk judgment based on complete and transparent risk evaluation [1].

To select a strategy that makes it possible to achieve quality risk assessment, it is essential to be aware of the limitations/problems in the process. Over the years, several problems related to the reliability of the risk assessment process have been identified. Cox [5] indicated five: inaccuracy; incompleteness; difficulty of checking final results; inadequate criteria to evaluate the results; and complexity and laboriousness of the method. Backlund & Hannu [4] pointed out three key problems in the risk assessment process: a vague requirement specification; lack of systematic preliminary hazard analysis; and incomplete documentation of the analysis performed. Specifically, for occupational risks, the lack of reliable data [6-8], time available, quality of the applied methods [9] and the criteria used to support decisions about risk acceptance [10,11] are some of the key problems that determine the reliability of this process. In fact, a lack of sufficient data to apply objective approaches in these settings and the limited time available to spend on this process limit the methodologies that can be applied; this may affect the quality of the results. For example, Carvalho e Melo [12] found that when the risk assessment methodologies usually used to assess occupational risks are applied, different OSH practitioners make different decisions. Furthermore, the use of inappropriate acceptance criteria may result in poor and divergent decisions about risk control and mitigation [11]. Due to these limitations/problems, Pinto et al. [13] suggested that many companies only undertake a superficial analysis of their hazards, just to comply with legal requirements.

Based on this context, it is necessary to understand how the quality of the risk assessment process can be improved in order to provide a reliable basis for decision-making according to the specific characteristics of the sector. This understanding is maybe more important for sectors composed of micro and small companies, as in the case of Olive Oil Mills (OOMs). These types of companies mostly have less resources, and accident prevention management is not a priority. Furthermore, they lack sufficient accident data to support more objective approaches to risk assessment.

The OOM industry is one of the most important sectors in Spain, particularly in the region of Andalusia, which is responsible for 74% of the overall national production [14]. In fact, Spain remains the world's leading producer of olive oil. Close to 23% of olive groves are located in Spain, which is responsible for about 47% of the global olive oil production [15].

The risk management process at OOMs is not

straightforward. These industries have particularities that make this process more difficult to carry out. Most of the companies are small and micro companies and the number of workers varies throughout the year [16]. In addition, at most of the companies, the health and safety management system is undertaken by an external prevention service, which does not always cover all the critical areas, such as ergonomics [16]. This can be a critical issue in a sector where most occupational accidents are related to excessive physical effort [17].

Although most of the accidents that occur in this sector are considered to be "basic" risks, such as excessive physical effort and fall-related injuries [17], correct risk assessment needs to be made in order to provide supporting information for the companies' managers and to better define intervention priorities that promote an effective use of resources. In view of this, this study aims to analyze the views of Occupational Safety & Health (OSH) practitioners regarding the risk assessment process in OOMs. The key difficulties/limitations inherent to the risk assessment process at these companies will be identified, as well as some improvements to current practices.

2. Materials and Method

2.1. Sample

A total of 13 OSH practitioners working in the Andalusia region who engaged with OOMs were surveyed. They had, on average, 12.4 years' (SD=5.3) experience undertaking OSH duties and had worked with OOMs for an average of 9.9 years (SD=5.5).

2.2. Analysis of OSH practitioners' views about the risk assessment process at OOMs

An analysis was undertaken of OSH practitioners' views that dealt with OOMs about the current limitations to the risk assessment process; improvements that could be made to this process were also identified. This process was important in order to better understand the most important features to bear in mind during the risk assessment process and, additionally, when developing new risk assessment methodologies. Thus, a questionnaire was developed and applied.

The questionnaire was divided into two parts. The first part referred to professional characterization, and the OSH practitioners were asked about their qualifications, academic background, years of experience and number of years working with OOMs. The second part was comprised of three questions. In the first question, the OSH practitioners surveyed were asked to classify whether the four factors presented were seen as a limitation to the risk assessment process at OOMs: (1) Accident data available at the companies; (2) Risk acceptance criteria included in the risk assessment methodologies; (3) Risk assessment methods available; (4) Time available for the risk assessment process. Finally, they were asked to comment on their choices. The issues included in this question have been frequently mentioned in previous studies as important limitations to the risk assessment of occupational accidents at SMEs [6, 9].

Despite the fact that the limitations identified may be linked to the risk assessment process, the quality of the process must be guaranteed and some factors need to be considered in order to do so. Pinto et al. [13], for example, have identified some important factors for the quality of the risk assessment process in the construction sector. Some of the factors identified were included in this study, according to their applicability to OOM risk assessment. Therefore, in the second question, OSH practitioners were asked about the importance of several factors to ensure the quality of the risk assessment process: (1) Accident reports; (2) Risk assessment methods adjusted to the needs of the OOM; (3) Risk assessment tools based on a quantitative approach; (4) Structured processes for hazard identification; (5) Identification of the relationship between cause and effect; (6) Identification of safety barriers; and (7) Support for risk decisions based on acceptance criteria that is defined specifically for OOMs. The last question in the survey enquired as to OSH practitioners' perspectives on the applicability of different ways to carry out the risk assessment process at OOMs in order to gain important insights into the development of a new methodology: (1) The use of accident reports from the sector; (2) Severity being assessed as number of days missed as a result of injury; (3) Severity assessed as a qualitative scale; (4) Probability derived from accident frequency; (5) Probability assessed as a qualitative scale; (6) The use of diagrams to establish the relationship between hazard, event, and consequence.

The preliminary version of the questionnaire was given to four OSH practitioners, who examined the questionnaire in terms of the clarity of the meaning of the questions and the linguistic terms, the applicability of the questions, and the scales used to check that the order of the survey questions did not affect the answers. Some improvements related to the language used were suggested and taken into consideration in the final version.

2.3. Data analysis

All statistical analyses were conducted using the IBM SPSS Statistics version 20. statistical software package. To determine differences between the ways of carrying out the risk assessment process at OOMs, the Kruskal-Wallis test was utilized. A $p < 0.05$ significance level was used.

3. Results

Table 1 presents the views of OSH practitioners about the limitations to the risk assessment process at OOMs due to several different factors. The results showed that the main limitation identified was the time available to perform the risk assessment (92.3%), followed by the criteria included in the risk assessment methodologies (30.8%) and then the data of the companies available to support objective risk assessment (30.8%). The risk assessment methods available were not seen as a problematic issue in the risk assessment process in the OOM sector, as only 15.4% of the respondents identified it as a limitation.

The importance of some specific factors in terms of the quality of the risk assessment process was also analyzed and

Table 1.

Limitations to the risk assessment process at OOMs (%)

Factor	Not a limitation	Limitation
Accident data available from the companies	69.2	30.8
Risk acceptance criteria included in the risk assessment methodologies	69.2	30.8
Risk assessment methods available	84.6	15.4
Time available for the risk assessment process	7.7	92.3

Source: The authors

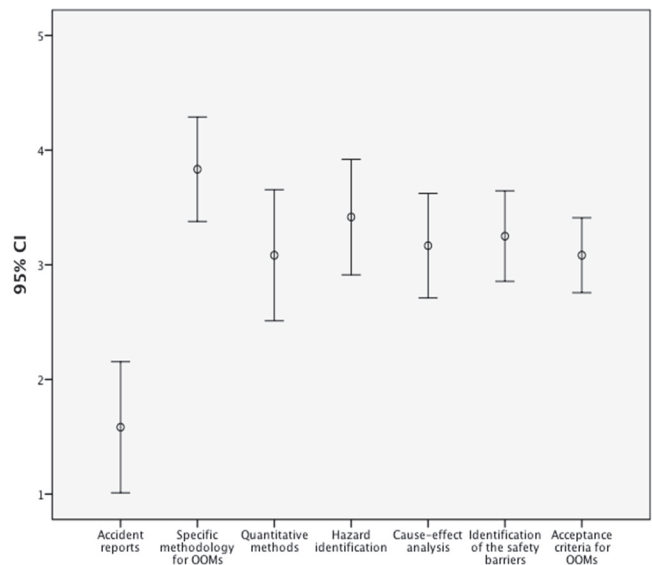


Figure 1. 95% confidence interval for the importance of some factors in the quality of the risk assessment process (5-point Likert scale, "1=Unimportant" to "5=Extremely important").

Source: The authors

the results are presented in Fig. 1. This information is relevant to be able to better understand how the quality of the risk assessment methodology in this specific sector can be improved in order to provide reliable results.

According to the results obtained, most of OSH practitioners consider that the use of statistical accident reports to support a more objective risk assessment process is not an important issue (61.5% of respondents indicate this information as "unimportant"). However, greater importance was attributed to a specific risk assessment methodology for the OOM sector (79.9% of respondents consider this factor to be "highly important"). Respondents assessed the other factors analyzed as "important".

The applicability of different ways of carrying out the risk assessment was also analyzed in order to obtain insights into a new possible strategy to be applied in the sector. Respondents were asked about the use of workdays lost as a measure for severity or whether the use of a qualitative classification was more appropriate. Although no significant differences were found ($p > 0.05$), most respondents assessed the use of qualitative measures as being either "applicable" (23.1%) or "highly applicable" (69.2%). The possibility of using accident frequency as a measure for probability was also compared with a qualitative assessment. Significant differences were not found

($p>0.05$); however, most respondents considered the use of accident frequency to be either “applicable” (30.8%) or “highly applicable” (69.2%). Results also show that sector data could be a good solution for supporting risk decisions as most of the OSH practitioners surveyed assessed this possibility to be highly applicable (30.8% “applicable” and 69.2% “highly applicable”). The use of diagrams to establish the relationship between hazard, event, and consequence was also seen as applicable to the risk assessment process at OOMs (38.5% “applicable” and 53.8% “highly applicable”).

4. Discussion

According to the results obtained, the time available to carry out the risk assessment at OOM companies is the main limitation for OSH practitioners. The organization of health and safety management at these companies may explain this result. Most OOM companies outsource OSH services to external consultants and only sign comprehensive contracts covering limited prevention actions [16]. Obviously, faced with this scenario, and bearing in mind that all the OSH practitioners surveyed are external consultants in the OOM sector, they do not have much time to spend on the risk assessment process. This can be a major limitation to the quality of risk assessment in this sector. Without sufficient time, a superficial analysis of hazards and risk assessments based on insufficient information may be performed, the only goal being the provision of prevention services to ensure that the companies comply with legal requirements [13,16]. Furthermore, as there is not very much time, it is expected that the approaches used and the results obtained are not presented in the most effective way to the companies’ managers. Without due care, the approaches employed and results obtained from risk assessments cannot be easily understood, and, as such, important risk reduction measures may not be implemented [4].

Moreover, most of the OSH practitioners surveyed did not identify the risk assessment methods available as a limitation. To better understand this point of view, we should emphasize several issues. In Spain, the National Institute for Safety and Health at Work (INSHT) (www.insht.es) recommends that a qualitative method be used in small and medium-sized enterprises (SMEs). This method is based on a risk matrix, in which the likelihood of accidents and their expected severity are presented as categorical variables. Based on this idea, and considering the small amount of time available and the lack of statistical accident data, it is expected that most OSH practitioners will apply this method and perform the assessment of occupational risks qualitatively [8]. In fact, qualitative methods have the advantage of requiring less information, time and effort [17]. Therefore, they can be seen as a good approach for companies with little information about past accidents and when the time for performing the risk assessment is limited.

As qualitative methodologies may be used in this sector, it is understandable that OSH practitioners do not see companies’ accident reports as a critical limitation to the risk assessment process. However, it is important to bear in mind that, in these conditions, decisions about risk will be based on the knowledge, perception and experience of the decision-makers [18]. This can be a limitation to the quality of risk assessment in the sector. This

is particularly critical when only one person performs most of the process. In other industrial sectors, a team of 3 to 5 people is recommended in order to cover all areas of expertise [13]. However, it is important to highlight that some respondents considered the absence of accident data from the companies as a limitation to the risk assessment process. In fact, by using this information, the subjectivity inherent to this process can be reduced and additional important information can be provided [8].

The results also showed that the criteria included in the risk assessment methodologies were seen as a limitation by some respondents. Although most consider the methodologies used to be adequate in the OOM sector, the criteria included may not be the most appropriate in all circumstances. Rodrigues et al. [11] discussed this issue, emphasizing the need to adjust the acceptance criteria included in the risk assessment methodologies to the companies’ circumstances. In these cases, when acceptance criteria are not properly adapted, the OSH practitioners may take the initiative to adjust them, and, without guidelines, this process may be based on their own judgment about risk acceptance. In fact, this is a regular practice in several countries such as Portugal. Rodrigues et al. [10], in a study of Portuguese OSH practitioners, found that a significant number adjust the acceptance criteria included in the methodologies, particularly when risk matrices are used.

It is interesting to note that all the respondents agreed that a specific risk assessment methodology in the OOM sector is important. In fact, the features specific to this sector in terms of organization, the particularities of the activities performed at these companies, differences at the worksite, the varying number of workers throughout the year (as most are seasonal), operations in more than one shift, and external staff [16] are all a significant constraint to the risk assessment process. It may be difficult for the OSH practitioner to identify all the hazards and to analyze all the accident mechanisms when they are faced with this type of work organization. This situation is exacerbated by the limited time available to perform the risk assessment and the lack of data about accidents.

The results also indicated that the OSH practitioners surveyed believe that it is important to perform hazard identification in a structured manner, following a systematic process. This process makes it possible to ensure that all the sources of risks have been identified. Furthermore, the analysis of cause and effect, i.e., the analysis of the relationship between hazard, event, and consequence, and the analysis of the safety barriers to prevent or provide protection from risks are also seen as important. These results are in accordance with other studies in other sectors [13].

This study also analyzed how OSH practitioners view the applicability of different ways of carrying out the risk assessment process at OOMs. The results show that respondents see the use of accident reports from the sector as a good alternative to support the risk assessment process. This kind of approach is not new in Spain; Carrillo-Castrillo et al. [8] had already proposed this a method based on the use of sectorial accident reports to support an initial risk assessment of maintenance activities. Furthermore, the OSH practitioners surveyed believe that the use of quantitative measures for probability, such as accident frequency, would

also be useful, although they seemed to prefer assessing severity in a qualitatively. The use of diagrams to establish the relationship between hazard, event, and consequence is also considered to be useful in this sector. In fact, they indicated the importance of the cause and effect analysis to improve the quality of risk assessment. Diagrams can enable the relevant accident's causal pathways and their consequences to be identified, while at the same time identifying the existing or necessary safety barriers [6].

Despite this study's results, it is important to bear in mind that if the questionnaire was applied in other sectors, the results could be different, e.g. in other sectors the lack of accident data on a company level may not be deemed to be an important limitation.

5. Conclusions

The results of the current study provided evidence about the key difficulties/limitations inherent to the risk assessment process at OOMs, and identify some improvements that could be made to current practices. This research is an extension of a previous paper [19], in which a more in-depth analysis of the issue was undertaken.

In general, throughout the study, a need for a new strategy for risk assessment at OOMs was emphasized. This strategy needs to be directed towards the quality of the risk assessment process in order to provide useful and beneficial information for the companies. When the results of the risk assessment are effective, risk reduction measures can be implemented more easily, achieving a suitable level of accomplishment to improve work conditions and, more importantly, to allow the companies go beyond legal requirements. Furthermore, this type of approach can make the companies' managers more risk-conscious and committed to OSH, promoting new models for risk management such as a culture based on people [20]. In this way, companies can change their prevention policy, providing better conditions for OSH practitioners to perform a more quality risk assessment. The companies' managers can hire other types of services that allow for a deeper analysis of hazardous situations, thereby giving more time to OSH practitioners to perform their actions.

The study highlighted the need for a specific tool for risk assessment in the OOM sector. That tool needs to include acceptance criteria adjusted to the OOMs' circumstances and to use risk metrics based on the frequency of accidents as measures to assess accident probability. The use of accident reports from the entire sector was deemed to be a good approach to reduce the subjectivity of the risk assessment process and to help OSH practitioners to focus on the most important circumstances of accidents. Furthermore, a structured process for hazard identification, the identification of the relationship between cause and effect, and the identification of the safety barriers were also considered to be important issues in order to improve the quality of risk assessment in OOMs.

References

[1] van Duijne, F.H., van Aken, D. and van Schouten, E.G., Considerations in developing complete and quantified methods for risk assessment. *Safety Science*, 46(2), pp. 245-254, 2008.

[2] Hajakbari, M.S. and Minaei-Bidgoli, B., A new scoring system for assessing the risk of occupational accidents: A case study using data mining techniques with Iran's Ministry of Labor data. *Journal of Loss Prevention in the Process Industries*, 32, pp. 443-453, 2014.

[3] ISO 31000: 2009., Risk management- Principles and guidelines. International Organization for Standardization, 2009.

[4] Backlund, F. and Hannu, J., Can we make maintenance decisions on risk analysis results? *Journal of Quality in Maintenance Engineering*, 8(1), pp. 77-91, 2002.

[5] Cox, R.A., Improving risk assessment methods for process plant. *Journal Of Hazardous Materials*, 6, pp. 249-260, 1982.

[6] Jacinto, C. and Silva, C., A semi-quantitative assessment of occupational risks using bow-tie representation. *Safety Science*, 48(8), pp. 973-979, 2010.

[7] Pinto, A., Ribeiro, R.A. and Nunes, I.L., Fuzzy approach for reducing subjectivity in estimating occupational accident severity. *Accident Analysis & Prevention*, 45, pp. 281-290, 2012.

[8] Carrillo-Castrillo, J.A., Rubio-Romero, J.C., Guadix, J. and Onievac, L., Risk assessment of maintenance operations: The analysis of performing task and accident mechanism. *International Journal of Injury Control and Safety Promotion*, 22(3), pp. 267-77, 2015.

[9] Khanzode, V.V., Maiti, J. and Ray, P.K., Occupational injury and accident research: A comprehensive review. *Safety Science*, 50(5), pp. 1355-1367, 2012.

[10] Rodrigues, M.A., Arezes, P.M. and Leão, C.P., Risk decision in occupational environments: The Portuguese reality, *Proceedings of 11th International Probabilistic Safety Assessment and Management Conference and the Annual European Safety and Reliability Conference 2012, PSAM11 ESREL 2012*, 2, pp. 1366-1375, 2012.

[11] Rodrigues, M.A., Arezes, P. and Leão, C.P., Defining risk acceptance criteria in occupational settings: A case study in the furniture industrial sector. *Safety Science*, 80, pp. 288-295, 2015.

[12] Carvalho, F. and Melo, R., Stability and reproducibility of semi-quantitative risk assessment methods within the occupational health and safety scope. *Work*, 51(3), pp. 591-600, 2015.

[13] Pinto, A., Ribeiro, R.A. and Nunes, I.L., Ensuring the quality of occupational safety risk assessment. *Risk Analysis*, 33(3), pp. 409-419, 2013.

[14] Agencia de Información y Control Alimentarios., Informe de gestión de la campaña 2012-2013 del aceite de oliva y de la aceituna de mesa, Madrid, Ministerio de Agricultura, Alimentación y Medio Ambiente, 2014.

[15] Consejería de Agricultura, Pesca y Medio Ambiente., Estrategia Andaluza para la investigación de la calidad del aceite de oliva, Andaluza, Junta de Andaluza, 2013.

[16] Parejo-Moscoso, J.M., Rubio-Romero, J.C., Pérez-Canto, S. and Soriano-Serrano, M., Health and safety management in olive oil mills in Spain. *Safety Science*, 51, pp. 101-108, 2013.

[17] Lee, H.-S., Kim, H., Park, M., Teo, E.A.L. and Lee, K.-P., Construction risk assessment using site influence factors. *Journal of Computing in Civil Engineering*, 26, pp. 319-330, 2012.

[18] Parejo-Moscoso, J.M., Rubio-Romero, J.C. and Pérez-Canto, S., Occupational accident rate in olive oil mills. *Safety Science*, 50, pp. 285-293, 2012.

[19] Hughes, P. and Ferrett, E., Introduction to health and safety at work. 1st ed. UK: Elsevier, 2007.

[20] Rodrigues, M., Romero, J., Arezes, P., and Soriano-Serrano, M., Limitations and improvements to the risk assessment process in olive oil mills: The views of OSH practitioners, *Proceedings of Occupational Safety Hygiene SHO2015*, pp. 309-311, 2015.

[21] Formoso, J.A.F., Couce, L.C., Rodriguez, G.I. and Carricoba, M.S., The path to excellence: A management strategy based on people. *DYNA*, 80(182), pp. 7-14, 2013.

M.A. Rodrigues, is a lecturer in the Department of Environmental Health at the Allied Health Sciences School at the Polytechnic Institute of Porto; Portugal. She received her BSc. in Environmental Health in 2007 from the Polytechnic Institute of Porto; Portugal. She received her MSc. from the University of Minho; Portugal in Human Engineering in 2009 and her PhD in Industrial Engineering and Systems in 2014. Her research interests focus on occupational, safety and health in different domains, particularly risk management, industrial hygiene, risk perception, safety culture and

ergonomics. She is particularly interested in the decision-making process behind occupational accidents.
ORCID: 0000-0001-6175-6934

J.C. Rubio-Romero, is PhD, MSc. and Industrial Engineer and an associate professor of “Safety at Work” in the School of Industrial Engineering of the University of Malaga, Spain. He obtained his PhD in 2000 in occupational health and safety in the industry, and is currently the Chair of Prevention and Social Corporate Responsibility at the University of Malaga as well as the director of the research group, “Operations and Sustainability: Quality, ICT and Risk Prevention at Work”. Dr. Rubio has spent over 18 years researching workplace health and safety and has published a wide range of textbooks, reports, and papers, especially on management of workplace health and safety in the manufacturing industry and at construction sites.
ORCID: 0000-0002-5122-7526

P.M. Arezes, received his PhD. in Industrial and Systems Engineering from UMinho, in Portugal. He is a full professor of ergonomics and human factors at the School of Engineering - University of Minho. He is also a visiting fellow at MIT’s AgeLab in the USA. He leads the human engineering research group and he is also the UMinho coordinator of the Engineering Design and Advanced Manufacturing (EDAM) area of the MIT Portugal Program, and he is the chair of the steering board on the “Leaders for Technical Industries (LTI)” PhD program at UMinho. He is the (co)author of more than 60 papers published in peer-reviewed international journals, as well as a member of the editorial board of more than 15 international scientific journals.
ORCID: 0000-0001-9421-9123

M. Soriano-Serrano, is a Lawyer, the Director of the Centre of Occupational Risk Prevention in the Government of Andalucía, and a lecturer at the University of Jaén, Spain.



UNIVERSIDAD NACIONAL DE COLOMBIA

SEDE MEDELLÍN
FACULTAD DE MINAS

Área Curricular de Ingeniería Administrativa e
Ingeniería Industrial

Oferta de Posgrados

Especialización en Gestión Empresarial
Especialización en Ingeniería Financiera
Maestría en Ingeniería Administrativa
Maestría en Ingeniería Industrial
Doctorado en Ingeniería - Industria y Organizaciones

Mayor información:

E-mail: acia_med@unal.edu.co
Teléfono: (57-4) 425 52 02