

# Construction's Health and Safety Plan: the leading role of the main preventive management document on construction sites

M.N. González García<sup>a</sup>, M. Segarra Cañamares<sup>b,\*</sup>, B.M. Villena Escribano<sup>c</sup>, A. Romero Barriuso<sup>d</sup>

<sup>a</sup> *Universidad Politécnica de Madrid, Madrid, Spain*

<sup>b</sup> *Department of Civil Engineering & Edification, University of Castilla-La Mancha, Cuenca, Spain*

<sup>c</sup> *Universidad Isabel I, Burgos, Spain*

<sup>d</sup> *Universidad Internacional de la Rioja, Logroño, Spain*

## ABSTRACT

The European Union's strategic framework seeks to better protect its millions of workers from work-related accidents and illnesses. One of the main challenges, included in the European Strategy 2014-2020, is to improve the application of existing health and safety regulations, one of the strategic objectives being to help small and medium-sized companies to better comply with safety regulations and health. This study focuses on the Construction Sector, considered one of the economic activities with the highest accident rate, hardship and danger. Its objective, based on the regulatory framework that regulates health and safety in the Sector, is to know the effectiveness of the main management tool that construction works have, the Health and Safety Plan. In this study, 3600 Health and Safety Plans were analyzed in the Autonomous Community of Castile-La Mancha, Spain. The results show that the Health and Safety Plans are documents that present great deficiencies and that do not comply with the regulatory requirements, putting at risk the management of prevention in the workplace and therefore the health and safety of its workers.

## Keywords:

Health and Safety Plan; Construction Sector; Occupational Risk-prevention;  
Preventive regulations; Case study

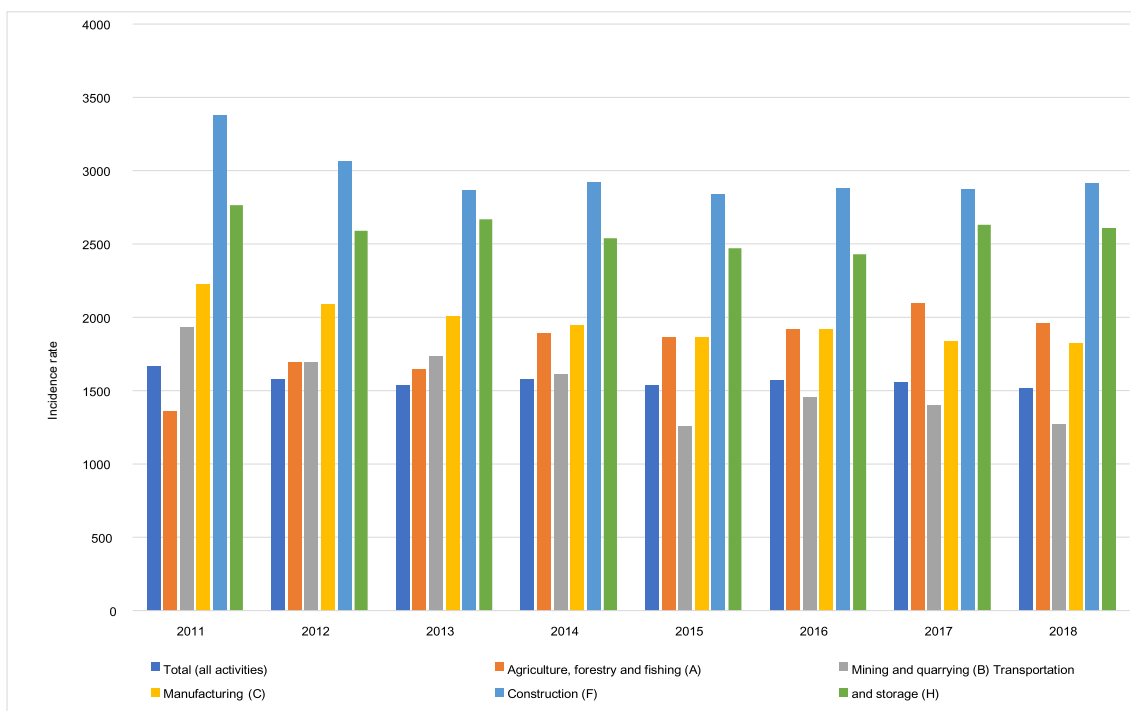
## 1. Introduction

The Construction Sector is one of the largest industrial sectors in Europe, with 14.8 million workers in 2018 (accounting for 6.4% of all workers) and 3.3 million companies representing 9, 0% of the gross domestic product of the European Union (hereinafter named EU) of the 28. It is estimated that 95% of these companies are small and medium-sized companies (hereinafter named SMEs) with less than 20 employees (FIEC, 2019). But it is also one of the productive sectors with the highest risk of work-related accidents and, highly punished by occupational accidents, due to its dynamics, complexity, and decentralized nature (Lozano et al., 2019). On construction sites, there are always normal activities and high-risk activities that can cause injuries and accidents, and potential fatalities (Shaawat et al., 2020). As such, construction is perceived globally as an accident-prone industry due to its dangerous and high-risk activities (Win et al., 2018) (Tayeh et al., 2020), resulting in this accident rate as an important problem (Misiurek & Misiurek, 2017). Of the total of the slightly more than 3 million non-fatal accidents per year that cause at least four calendar days of absences from work in the EU-28, construction accidents between 2011 and 2018 represent more than one-tenth of all accidents (Table 1).

**Table 1.** Number and% of Non-fatal accidents at work, by economic activity, EU-28,2011-2018. Source: Eurostat, 2020a.

NACE (Section)	Number (%)							
	2011	2012	2013	2014	2015	2016	2017	2108
Total (all activities)	3,414,735 (100.00)	3,165,414 (100.00)	3,180,506 (100.00)	3,276,596 (100.00)	3,267,085 (100.00)	3,339,900 (100.00)	3,342,349 (100.00)	3,345,812 (100.00)
Agriculture, forestry and fishing (A)	164,892 (4.83)	150,918 (4.77)	157,889 (4.96)	177,462 (5.42)	170,174 (5.21)	168,764 (5.05)	155,337 (4.65)	150,654 (4.50)
Mining and quarrying (B)	14,372 (0.42)	12,530 (0.40)	11,957 (0.38)	10,604 (0.32)	9,712 (0.30)	9,396 (0.28)	9,840 (0.29)	8,765 (0.26)
Manufacturing (C)	723,826 (21.20)	673,652 (21.28)	648,692 (20.40)	627,123 (19.14)	625,439 (19.14)	633,443 (18.97)	624,422 (18.68)	629,184 (18.81)
<b>Construction (F)</b>	479,869 <b>(14.05)</b>	418,414 <b>(13.22)</b>	378,018 <b>(11.89)</b>	376,551 <b>(11.49)</b>	372,284 <b>(11.39)</b>	371,737 <b>(11.13)</b>	376,088 <b>(11.25)</b>	385,249 <b>(11.51)</b>
Transportation and storage (H)	286,186 (8.38)	268,705 (8.49)	284,664 (8.95)	271,004 (8.27)	274,517 (8.40)	270,824 (8.11)	300,605 (8.99)	300,560 (8.98)

However, since the activity workforce is different in size, the incidence rate gives a clearer impression of where workers are most likely to encounter non-fatal accidents. The highest incidence of non-fatal occupational accidents in the EU-28 is observed in construction, where there are more than 2,500 accidents for every 100,000 people employed. Taking as a reference the five sectors of activity with the highest incidence rate, and their graphic representation, it can be seen how construction has remained above the rest of the sectors over the years (Figure 1).



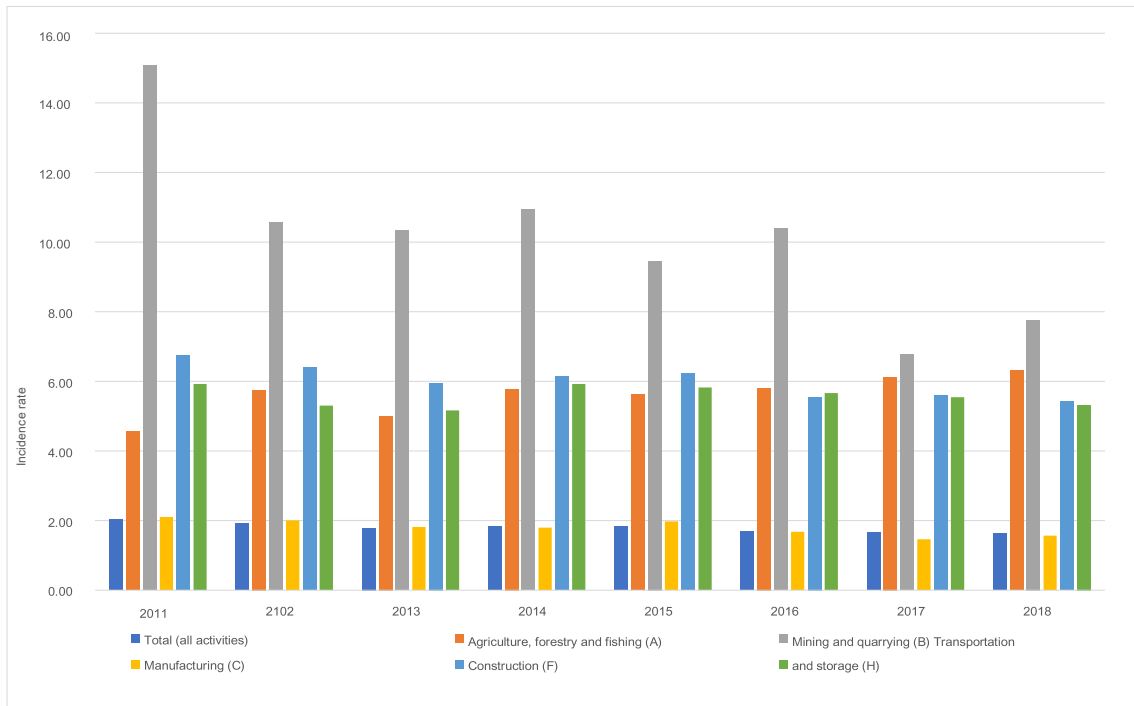
**Figure 1.** Incidence rate of Non-fatal accidents at work, by economic activity, EU-28,2011-2018. Source: Eurostat, 2020a.

Fatal accidents in absolute terms, between 2011 and 2018 were also more common in construction, with percentages that, even with rates falling from 23.23% to 17.29% between 2011 and 2018, are the highest in the EU-28 (Table 2).

**Table 2.** Number and% of Fatal accidents at work, by economic activity, EU-28,2011-2018. Source: Eurostat, 2020b.

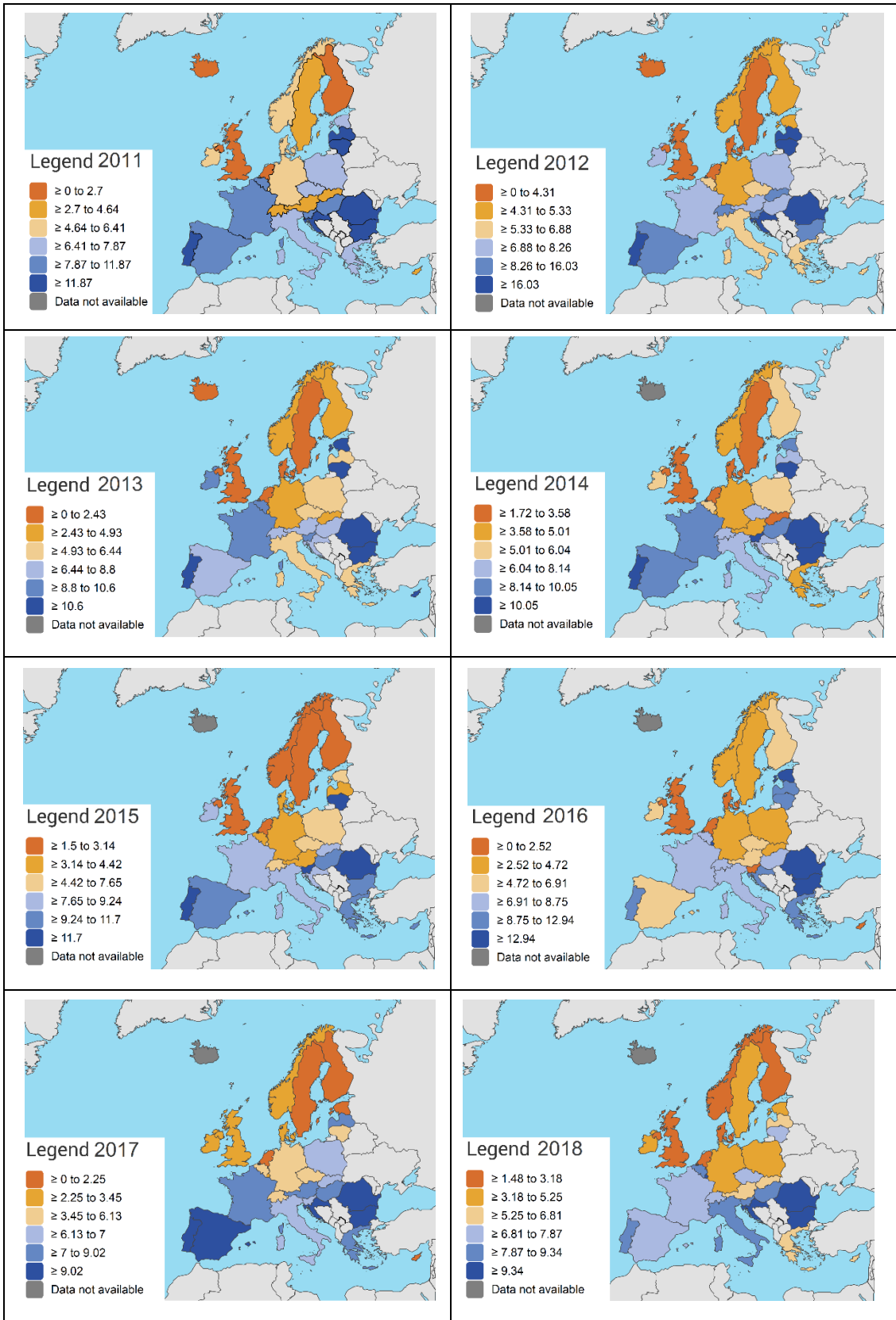
NACE (Section)	Number (%)							
	2011	2012	2013	2014	2015	2016	2017	2018
Total (all activities)	4,141 (100.00)	3,918 (100.00)	3,679 (100.00)	3,801 (100.00)	3,903 (100.00)	3,588 (100.00)	3,552 (100.00)	3,581 (100.00)
Agriculture, forestry and fishing (A)	552 (13.33)	527 (13.45)	480 (13.05)	542 (14.26)	513 (13.14)	511 (14.24)	453 (12.75)	485 (13.54)
Mining and quarrying (B)	112 (2.70)	78 (1.99)	71 (1.93)	72 (1.89)	73 (1.87)	67 (1.87)	48 (1.35)	53 (1.48)
Manufacturing (C)	684 (16.52)	651 (16.62)	585 (15.90)	578 (15.21)	659 (16.88)	549 (15.30)	496 (13.96)	537 (15.00)
<b>Construction (F)</b>	958 <b>(23.13)</b>	869 <b>(22.18)</b>	784.00 <b>(21.31)</b>	791.00 <b>(20.81)</b>	815.00 <b>(20.88)</b>	717.00 <b>(19.98)</b>	733.00 <b>(20.64)</b>	716.00 <b>(19.99)</b>
Transportation and storage (H)	613 (14.80)	562 (14.34)	551.00 (14.98)	631 (16.60)	646 (16.55)	631 (17.59)	633 (17.82)	625 (17.45)

Regarding the incidence of fatal accidents, also taking as a reference the five sectors of activity with the highest incidence rate, and their graphic representation, construction is positioned in second place after mining with an average incidence throughout these 8 years that exceeds 5 for every 100,000 accidents (Figure 2).



**Figure 2.** Incidence rate of fatal accidents at work, by economic activity, EU-28, 2011-2018. Source: Eurostat, 2020b.

In relation to the incidence of fatal accidents in the construction sector by country (Figure 3), the maps show the evolution followed between 2011-2018 by the EU-28 member countries. In these, it can be seen how countries such as Portugal, Romania or Bulgaria have values above 10 fatal accidents per 100,000 workers, while Spain, France and Italy are in a range above 6. On the contrary, with the lowest values, below 4 are countries such as the United Kingdom, the Netherlands or Sweden.



**Figure 3.** Incidence rate of fatal accidents at work, by countries, EU-28, 2011-2018. Source: Eurostat, 2020c.

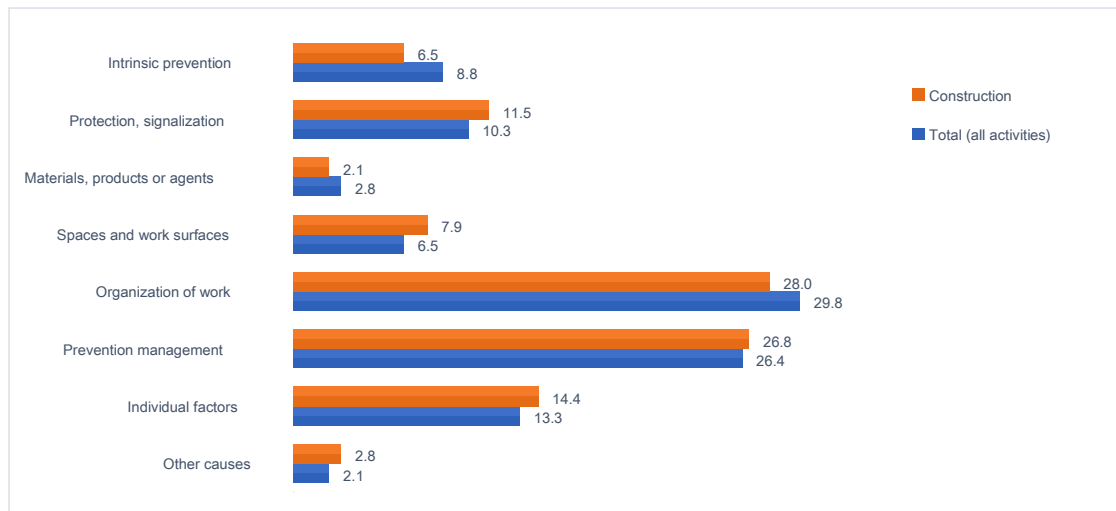
The relevance of these data undoubtedly shows a worrying situation, which has been and continues to be the subject of EU actions in the field of health and safety at work. These actions have been carried out over the years within a strategic policy framework that includes two key

components. On the one hand, there is a complete body of EU legislation that covers the most important occupational hazards and provides common definitions, structures, and standards that Member States adapt to their different national circumstances. And on the other, a series of multiannual action programs between 1978 and 2002, followed by European strategies (covering 2002-06, 2007-12 and 2014-20), to identify common priorities and objectives, provide a framework for the coordination of national policies and promote a comprehensive culture of prevention (European Commission, 2014) (Ivascu & Cioca, 2019) (Neag, 2019). These two areas of action materialize in the construction sector through regulatory development, which specifically addresses the characteristics and particularities of construction works and national strategies with their corresponding action plans.

Regarding the specific safety regulations for construction work, the reference is found in Directive 92/57 / EEC (The Council of the European Communities, 1992), which establishes the minimum health and safety requirements that must be applied to construction or civil engineering works on temporary or mobile construction sites (Martínez et al., 2020) (Martínez et al., 2010). This Directive aims to promote better working conditions on construction sites where workers may be exposed to particularly high risks. Health and safety must be integrated in the initial phases, and a chain of responsibilities that links all the people involved must be set to avoid any risks. For this, the regulation of prevention management tools in construction is configured through the Prior Notice, the Health and Safety Plan (hereinafter named H&S Plan) and the Adapted File, with the H&S Plan being the main management tool.

It is here, in the H&S Plan, where the interest is fixed, since it is in this document where the Directive establishes the need to indicate the specific measures related to the work whose performance implies special risks for workers, which must guarantee health and safety. It is therefore a document of utmost importance that must be prepared so that its contents are effective during the job execution phase.

In Spain, the latest study carried out on the causes of death due to work accidents (INSST, 2020), allows us to understand the importance of the H&S Plan, as it identifies organization of work and prevention management as the main causes of death and work accidents, representing 28% and 26.8% of the total (Figure 4).



**Figure 4.** Block of causes of fatal work accidents in the Spanish Construction Sector. Source: INSST, 2020.

Of both blocks, the report highlights the main cause as the non-identification of the risks that instigated the accident and the preventive measures proposed during the planning phase, derived from the assessment of insufficient or inappropriate risks in conjunction with inadequate work method and the absence of vigilance, control, and direction from a competent person.

By configuring the H&S Plan as a basic instrument for the management of identification activities and, where appropriate, risk assessment and preventive activity planning, its use is one of the practices that can reduce accidents in construction projects as well as improve worker productivity (Gurmu, 2019) (Feige-Munzig, 2008). Moreover, the injury rate decreases if a specific safety plan for the job is well planned (Enshassi et al., 2008). Therefore, we face an alarming reality that indicates that the lack of effectiveness of the H&S Plan may be decisive in the materialization of the risk in damage to workers' health.

## 2. Frame of reference

Directive 92 shows great heterogeneity in relation to the H&S Plan in the different national transpositions (IRSST, 2013). This heterogeneity occurs both in its name, by adopting different terms, and in its preparation, moving from a single document that is updated throughout the work to an ordered system around two differentiated documents in each phase, as exemplified by the following:

- Italy: Safety Plan and Coordination / Safety Operational Plans or Substitute Safety Plans.
- Portugal: H&S Plan in the Project / H&S Plan in the execution of the work.
- France: General Coordination Plan / Particular H&S Plan (prepared by each contractor and subcontractor company).
- Luxembourg: H&S Plan / Specific Safety Plan.
- Spain: Health and Safety Study (hereinafter named H&S Study), or basic H&S Study incorporated in the project / H&S Plan, prepared by each contractor.








Each member state has implemented Directive 92 differently in relation to obligated agents in its drafting (Table 3),

**Table 3.** Directive 92 implementation in 22 member states. Source: (Pérez Martín, I., 2016).

	<i><b>IMPLEMENTATION OF THE PLAN FOR HEALTH AND SAFETY AT WORK</b></i>
<b>Directive 92/57 / EEC</b>	Before construction begins, the property or construction manager will ensure that a H&S Plan is established. The coordinator or coordinators in matters of health and safety during the development of the project of the work will establish or cause a H&S Plan to be established in which the rules applicable to said work are specified.
PORTUGAL 	<p>The promoter must prepare or order elaboration during the project phase, the H&amp;S Plan in the work. It is the responsibility of the safety coordinator in the project phase to prepare the project H&amp;S Plan, but if it has been done by another person at the request of the promoter, it must be validated. It will later be developed and completed by the main contractor.</p> <p>The safety coordinator in the work phase must assess the progress and modifications of the H&amp;S Plan for the execution of the work and propose the appropriate modifications for technical validation to the executing entity.</p>
ROMANIA 	The Law expressly establishes that the Promoter or the project manager will be responsible for developing a general H&S Plan of the work through the Coordinator. The H&S Plan will be carried out in works in which several companies (contractors, subcontractors, or self-employed workers) are present on the worksite. The Law not only does not provide for the possibility of adhesion, but it establishes that contractors and subcontractors have a period of 30 days to make available a Plan of its own that is harmonized with the General Plan to the main contractor or health and safety coordinator.
BULGARIA 	The health and safety coordinator in the project phase, appointed by the promoter, will be responsible for establishing the H&S Plan on site. The contractor must make the H&S Plan available to subcontractors and others with access to the work.
SPAIN 	<p>In the project phase, the promoter is obliged to prepare H&amp;S Study or basic H&amp;S Study, in accordance with requirements related to the budget and execution period, as well as the presence of workers on site. The main contractor will prepare a H&amp;S Plan in which the forecasts contained in the study or basic study are analyzed, studied, developed, and complemented, depending on its own work execution system.</p> <p>The H&amp;S Plan must be approved before the start of the work by the coordinator or expert where appropriate, always be available in the work and updated.</p>



<p>FRANCE</p> 	<p>The promoter will prepare the General Coordination Plan, review the H&amp;S Plan prepared by the contractors and carry out the joint inspection visit in the project conception phase, as well as the prior Common Inspection with each of the contractor companies and before the start of work. They will carry out the Intervention Dossier during the work and until the end of it.</p>
<p>ITALY</p> 	<p>It is called a Safety and Coordination Plan and it must be developed by the developer through the safety coordinator when there is more than one company working on the work, even if not at the same time. Each contractor must prepare it for the work. But it is indicated that you will be able to communicate to the coordinator any changes that you consider appropriate as the work develops.</p>
<p>UNITED KINGDOM</p> 	<p>The promoter is obliged to produce and distribute the information before construction, which is carried out for all projects where more than one contractor is involved. It is prepared by the PD Principal Designer, subject to modifications whenever the project requires it. Required to be physically on-site. The H&amp;S Plan is only required in projects where it is mandatory to appoint the Principal Designer and Principal Contractor. It is made by the Principal Designer, with the collaboration of the Principal Contractor, who sends the necessary documents for preparation. During the work, and until the end of it, you must prepare the Health and Safety File containing all the indications on risk prevention transmitted during the work.</p>
<p>HOLLAND</p> 	<p>The promoter must guarantee the preparation of the H&amp;S Plan when the work is included in Annex II of Directive 92/57 / CEE or it is a work that must be notified.</p> <p>The document will be available for the work (of all established work centres) and will be delivered to all the companies involved in the work.</p>
<p>SWEDEN</p> 	<p>The planning and design coordinator will prepare the H&amp;S Plan with information on the construction works that is relevant for the subsequent activity of execution, repair, maintenance, and demolition inclusion. He is also responsible for ensuring that the Plan is in place and must make any necessary adjustments to it as the work progresses.</p>
<p>DENMARK</p> 	<p>The promoter must ensure that the coordinator prepares the H&amp;S Plan, as well as makes adaptations in the journal and keeps the plan available throughout the period of the work for all parties involved in the work.</p>
<p>POLAND</p> 	<p>The H&amp;S Plan is the obligation of the promoter or main contractor upon acceptance of the promoter.</p>
<p>FINLAND</p> 	<p>The promoter reviews the H&amp;S Plan of the contractor companies, as well as develops the prevention rules and transmits them to the construction companies through the client safety document.</p>
<p>IRELAND</p> 	<p>The promoter designates the safety coordinator who is responsible for preparing the preliminary H&amp;S Plan.</p> <p>During the work, and until the end of it, a Safety File must be prepared and must include all guidelines on risk prevention transmitted during the work and the existing risks and preventive measures to be considered for the subsequent phases of maintenance.</p>

<p>LUXEMBOURG</p> 	<p>The promoter prepares the General Coordination Plan and reviews contractor companies' Safety Plan, carrying it out the subsequent Intervention Dossier during the work and until the end of it.</p>
<p>NORWAY</p> 	<p>The promoter will ensure that an H&amp;S Plan is carried out, prepared by the Coordinator or by the promoter, before the start of the construction works (it is not specified from a certain number of companies, when there is more than one).</p> <p>The Plan will be easily accessible for workers and companies and will be promoted in the work between contractors and subcontractors.</p>
<p>SWITZERLAND</p> 	<p>Each company must have business regulations, which establish the necessary provisions regarding the protection of health at work and the prevention of occupational risks. Regulations are delivered to the cantonal authority and must be approved by it. Once approved, subcontractors must adhere to said regulations, as well as their workers.</p> <p>The H&amp;S Plan is prepared and written by the main contractor and handed over to the cantonal authority and reports to the subcontractors (they adhere to it). The figure of the promoter has practically no obligations in terms of risk prevention, it must only ensure coordination between companies when there is more than one contractor on the job.</p>
<p>CROATIA</p> 	<p>The H&amp;S Plan is the responsibility of the promoter, being prepared before the start of work by Coordinator I. Said plan will be part of the documentation of the project/design phase. The Promoter must deliver it at the time of notification of the start of work.</p>
<p>BELGIUM</p> 	<p>The site manager or site design manager will designate a project-coordinator in charge of establishing a H&amp;S Plan before the site opening. The coordinator-project or coordinator-implementation will establish the H&amp;S Plan if the workers are exposed to specific risks (biological or chemical agents, radiation, electricity, explosives, prefabricated elements, work at dangerous heights ...). A simplified H&amp;S Plan will be carried out when there are no specific risks.</p>
<p>GERMANY</p> 	<p>The promoter must ensure that an H&amp;S Plan is established for each job. The H&amp;S Plan is carried out by the promoter; it is not up to the contractor.</p>
<p>AUSTRIA</p> 	<p>The promoter must ensure that before the start of a job there is a H&amp;S Plan. This plan should be prepared in the preparation phase. The promoter will inform the entrepreneur about the existence of significant risks. The H&amp;S Plan must adapt to the progress of the job in case it is necessary for the safety of the workers. To carry out this plan, the safety managers of the different employers should be consulted.</p> <p>The promoter must guarantee that the employers involved, whose employees are workers or prevention personnel on-site, are informed about the H&amp;S Plan.</p>
<p>GREECE</p> 	<p>Before work begins, the developer or prime contractor will ensure that a H&amp;S Plan is established. Each contractor who joins the job site with jobs of 5 days or more, must prepare their own H&amp;S Plan or adhere to the General Plan if it covers the necessary aspects regarding the risks and work of the contractor.</p>

Regarding the obligation to ensure the preparation of the H&S Plan before starting the job, the solutions range from sharing this duty between the property and its technical

representative/project management (which occurs both in the Directive and in the transpositions of Luxembourg, United Kingdom and Belgium), until it is limited either to the technical representative/project management (in Finland, Ireland) or to the property (which is the case in the rest of the countries).

In Spain, this obligation that corresponds to the promoter, delegating this work, is configured in the project phase through the Study or Basic Health and Safety Study. The H&S Plan is configured from these studies (Orviz et al., 2019), but it is up to the contractor to prepare it (Martínez et al., 2015), being binding for all subcontractors that depend on the contract (Enshassi et al., 2008), which means that they can be prepared without knowing the forecasts established in the project phase with the consequent mismatch in the necessary preventive planning.

Therefore, the ways in which the different member states introduce the H&S Plan into their regulations are different, but in all of them, it is configured as the tool with which prevention must be integrated into the scope of each one of the actions to be carried out in the context of a construction site. It is introduced during the development phase of the project to prevent risks at the source, and in later phases, considering that in the construction process the work is constantly changing and that different companies participate in it, with different means and resources.

In 2008, and in order to assess the application of the regulatory framework to improve it, the Commission of the European Communities prepared a communication on the practical application of Directive 92 (Commission of the European Communities, 2008) considering that its application is a complex technical and administrative issue. The communication identifies as one of the possible reasons for the high accident rates in this sector, in comparison with others, the fact that the prevention of occupational hazards is not considered before the end of the project conception, so the lack of prevention planning in the implementation phase must be remedied. It also shows that in practice the fact that the Directive does not clearly describe the duties and responsibilities of all the agents involved in the process causes each actor to interpret their responsibilities subjectively and, consequently, the tasks and responsibilities. Responsibilities can be delegated from one actor to another. Designers delegate their responsibilities to companies, which, in turn, delegate them to subcontractors; the preparation phase coordinator leaves as soon as the plans and specifications have been finalized, even if the detailed conception has not yet been prepared.

Therefore, it is indicated that many accidents in this sector are due to poor planning and lack of foresight. Malekitabar states that 46.8% of accidents are related to the concept of design for safety (Malekitabar et al., 2016) (Ning et al., 2018) indicates that poor project planning at the stage Preparation of the project has caused more than half of the workplace accidents that occur in construction sites in the European Union (Martínez et al., 2018). Most health and safety-related

problems occurring during the construction phase can be eliminated through a stronger emphasis on the effort put into the pre-construction phase of the project (Tayeh et al., 2020) (Saifullah & Ismail, 2012). This is due to the fact that health and safety requirements in the pre-construction phase have been identified as an effective and successful technique in the management of health and safety on site because it reduces risks from their origin (Tayeh et al., 2020) (Saifullah & Ismail, 2012). This shows that the H&S Plan is not only a bureaucratic requirement but is of paramount importance to improve working conditions when the plan evolves in accordance with changes in the situation of the job.

Construction projects begin with project planning as decisions related to design and/or resource management are made at the beginning of the project as they are more efficient than those made in later stages (Ning et al., 2018). Thus, forecasting and planning are two basic pillars for guaranteeing the health and safety of the workers supported by the H&S Plan. This is configured as the main management tool as it is the document that must guarantee the correct integration of preventive management in construction sites. Additionally, hazardous situations vary over project life and schedule should be considered for safety planning (Choe & Leite, 2017). It will therefore be in it where the set of preventive actions to be carried out in the work by the participating companies (contractor, subcontractor, and self-employed worker) is established and in which the actions to be carried out by the agents involved in ORP matters (coordinator, preventive resource, site manager, etc.).

In relation to the jobs on the construction site, the H&S Plan constitutes the basic instrument for organizing identification activities and, where appropriate, risk assessment and planning of the preventive activity of each one of the activities they are going to carry out, being the basis for an effective health and safety program (López et al., 2015).

It is, therefore, as has already been pointed out, a document of major importance since the work must be executed in accordance with the measures provided for. The H&S Plan is the means with which the health and safety of workers in construction jobs must be guaranteed, being crucial to providing safety in the construction sector (Martínez et al., 2020). It is thus a critical safety factor that requires adequate attention to improve its effectiveness and efficiency (Bavafa et al., 2018).

The purpose of this research is to know if the H&S Plans, as they are conceived, comply with the regulatory requirements established, or if, on the contrary, they present significant deficiencies, which can jeopardize the management of prevention in the workplace.

### **3. Methodology**

This research seeks to understand the existing reality through the analysis of the contents of the H&S Plan. For this, a prospective analysis is carried out by consulting 3600 H&S Plan belonging to the five headquarters of the Labour Authority of the Autonomous Community of Castile-La Mancha in Spain, in charge of its registration, which allows for the obtaining of a large volume of data. The H&S Plan belong to works of both public and private nature, ensuring variables of randomness and impartiality, being H&S Plans made by various Prevention Services, companies, etc.

All the H&S Plans consulted were randomly selected and non-consecutively at a rate of 100 documents per year and per provincial headquarters. In one of the sites, only in the first two years of consultation, as the Labour Authority did not have so many documents, the size of the sample consulted had to be reduced to 50 PSSs, in order to guarantee the criteria of randomness and non-achievement. Likewise, it should also be noted that for two of the sites consulted, information regarding to the first years was not available, so the sample was configured with a total of 3,600 H&S Plans (Table 4).

Due to the fact that H&S Plans consulted date until 2016, prior to the entry into force in 2018 (DOCM 125, 2018) of the digitalization of the public administration (with the requirement of telematic submission of the communication of the opening of the work center), they were only available in physical paper format. As a result, data extraction was carried out manually. This handicap meant that the workflow schedule had to be reorganized, adapting it to the fact that it was not possible to use computerized means to analyze the content of the H&S Plans, making it impossible to use automatic content analysis tools, such as the KoNstanz Information MinEr software (Martinez et al. 2020), an open-source free tool also known as KNIME. For this purpose, checklists were adapted to the relevant questions or items to be assessed.

**Table 4.** Number of H&S Plan consulted by year and provincial headquarters in Castile-La Mancha.

Year	Provincial Delegation Labour Authority of Castile-La Mancha				
	Albacete	Ciudad Real	Cuenca	Guadalajara	Toledo
2008	100	100	-	50	-
2009	100	100	-	50	-
2010	100	100	100	100	-
2011	100	100	100	100	-
2012	100	100	100	100	-
2013	100	100	100	100	-
2014	100	100	100	100	100
2015	100	100	100	100	100
2016	100	100	100	100	100
Parcial	900	900	700	800	300
<b>Total</b>	<b>3600</b>				

The data obtained during the investigation are included in the category of observational data, according to the definition established by the National Science Foundation for them. At the same time, a subdivision to this categorization of data that fits the scientific discipline has to be made (Working Group on "Deposit and Management of Data in Open Access" of the RECOLECTA project, 2012).

This is the first investigation of its kind, which is unprecedented in Spain, in part due to the inaccessibility of the data, which must be consulted in situ at the different offices of the Labour Authority, after signing an agreement that allows the extraction of the data (due to the sensitive nature of the data to be consulted). This was the only methodology that was adapted to the requirements of impartiality and data variance necessary to carry out the study so that the results obtained could be extrapolated to other Autonomous Communities or provinces of the Spanish territory. There are studies of the quality of H&S Plan in Portugal, but with significantly smaller samples than this study, since they are based on 36 and 60 H&S Plan respectively (Reis et al., 2014) (Reis et al., 2015). Eleven as well as the Guide of Recommended Contents of a H&S Plan elaborated by the Technical Bureau of Occupational Safety in Construction (MTSC, 2012). In this way, the questionnaire was configured and structured in three sections:

1. Legal figures involved in construction works.
2. The formal aspect of the document (H&S Plan).
3. Risk assessment of the work.

The total number of questions that make up the questionnaire is 27. As the objective of this study is to obtain completely unbiased statistical data, the type of question that best suits this objective

is the dichotomous type, which only allows obtaining a yes (1, in a binary system, used in the data collection) or a no (0, in a binary system).

The consultation includes a period of 8 years, but when analyzing the data obtained, two periods have been differentiated, from 2008 to 2012 before the publication of the INSHT Technical Guide of RD 1627 and from 2013-2016 after it. The purpose is to be able to determine if the publication of the Guide has meant a greater degree of compliance with the regulations, as it serves as a reference for its interpretation and applicability.

- 1st period: from 2008 to 2012 (both years included), with a sample of 1,700 Plans analyzed.
- 2nd period: from 2013 to 2016 (both years included), with a sample size comprising 1,900 Plans studied.

The process used in the management of the data obtained has included, schematically and chronologically:

1. Study of the current regulations concerning the preventive document object of the analysis, as well as its context on site.
2. Prior analysis of the content of a H&S Plan, detection of existing strengths and weaknesses.
3. Preparation of a checklist that delves into the issues that are intended to be analyzed.
4. Ethical and legal issues regarding sensitive personal data are considered. This type of data is left aside, it is only decided to obtain statistical data.
5. Dump of the points of the Plan on which to reflect on in the team meeting.
6. Reworking of the checklist based on what was stated in the meeting and the objectives to be achieved with the investigation, reorganization process of the items.
7. After another subsequent meeting, they decide to discard all those questions that are not dichotomous in nature, to avoid interpretations that establish delay times in case of not reaching the objectives in any of the venues due to force majeure.
8. Documentation and restructuring of recorded data.
9. The headquarters of the Labour Authority are visited. The meetings with the Heads of Service and technicians of the Board reinforce the points on which the documentation phase and subsequent analysis of the volume of data obtained must focus.
10. In team meetings, the data obtained is shared and the strategy to deal with the large volume of data and how it must be approached is decided.
11. We proceed to scrutinize the data and analyze the results obtained that can be extracted.

## 4. Results and discussion

### 4.1 Legal figures involved in a construction site

The accident rate in the sector is closely associated with the management model (Segarra et al., 2017) and at the level of training and information of those responsible and of all the agents involved in the constructive-preventive processes (Romero et al., 2019). The deficient organizational structure of the companies in the Sector, made up for most SMEs (Ministry of Industry, Commerce and Tourism, 2020), together with the scarce, and in many cases non-existent, integration of prevention in the very structure of the companies (Segarra et al., 2017), explain the limited success in risk management in these types of companies (Lyons & Skitmore, 2004). Translated to the construction site environment, in which the work centre is the site itself, this integration of preventive management is carried out through the common work document that is the H&S Plan.

The Directive foresees that all the people active in a construction site have key functions in the prevention with responsibility in the matter. The fact that each one of the participating agents specifically appears in the H&S Plan is considered key to be able to foresee and plan all the performances. This allows the organization chart under which the work will be managed from the safety field to be defined. When developing safety plans and programs, priority should be given to the influence of safety officers and the underlying relationships between safety officers and workers, in relation to worker safety procedures (Newaz et al., 2019), which on the other hand should be included in the H&S Plan.

The data obtained in Table 5 shows how only those agents are included in a high percentage, above 80%, of which there is an obligation to have proof since they have to be communicated to the Labour Authority through the opening of the workplace. Such is the case of the promoter, contractor, faculty management and health and safety coordinator in the execution phase. However, it is also very significant that in this item and for the indicated reason the percentage is not 100%.

**Table 5.** Questions related to all the agents involved on construction sites (10) and its average and difference.

ITEMS	% Degree of compliance			
	2008-2012	2013-2016	Average	Difference
1.- ARE THE FIGURES OF THE PROMOTER, CONTRACTOR AND PROJECT DESIGN REFLECTED IN THE H&S PLAN?	91.00	99.00	95.22	8.00
2.- IS THE APPOINTMENT OF THE FIGURE OF PREVENTIVE	9.76%	40.79%	26.14	31.03



<b>RESOURCE COLLECTED?</b>				
<b>3.- IS THE PREVENTIVE RESOURCE THE ENTREPRENEUR?</b>	1.46	1.74	1.61	0.28
<b>4.- ARE THE SUBCONTRACTORS PRESENT ON THE SITE?</b>	36.24	58.05	47.75	21.28
<b>5.- ARE SELF-EMPLOYED WORKERS COLLECTED?</b>	0.12	0.11	0.11	- 0.01
<b>6.- ARE THE EMPLOYEES PRESENT AT THE JOB COLLECTED?</b>	0.18	0.53	0.36	0.35
<b>7.- IS THE OPTIONAL DIRECTION OF THE WORK INCLUDED?</b>	79.82	88.74	84.53	8.92
<b>8.- IS THE FIGURE OF THE HEALTH AND SAFETY COORDINATOR IN THE DRAFTING PHASE OF THE PROJECT / COMPETENT TECHNICIAN EDITOR OF THE H&amp;S STUDY OR BASIC H&amp;S STUDY?</b>	2.65	6.37	4.61	3.72
<b>9.- IS THE FIGURE OF THE HEALTH AND SAFETY COORDINATOR IN THE EXECUTION PHASE OF THE WORK?</b>	77.71	85.42	81.78	7.71
<b>10.- THE WORK HEALTH AND SAFETY COORDINATOR, IN CHARGE OF APPROVING THE H&amp;S PLAN? IS THE SAME ONE WHO DRAWS THE H&amp;S PLAN?</b>	3.41	3.74	3.58	0.33

As for subcontractors, the average percentage is below 50%, which shows the absolute lack of preventive planning of the work, since it is well known that this practice, subcontracting, favours work accidents since it implies a reduction in costs by neglecting occupational safety precautions (Yilmaz & Tosun, 2018). In any case, it cannot be ignored how, as of 2013, the previous period is 21.28% higher, a considerable percentage, although insufficient. At this point, it is worth highlighting the fact that in the RD 1627/97 Guide there is a specific appendix on subcontracting and the greater inspection action on the subcontracting law.

With negligible percentages, less than 1%, are the self-employed and employed workers, which means that the object of interest, the worker, is left out of preventive action in this initial phase, which entails a serious breach.

It should also be noted in relation to the H&S Study that only 4.61% of the H&S Plan mention the

technician who has prepared it or the coordinator if necessary. As already indicated, this will prevent first-hand knowledge of the preventive forecasts that have been studied in the project phase, something basic if what you want is to act from the prevention field and not from the protection.

Finally, the most significant aspect of the data obtained is the passage from 9.76% to 40.79% in the appointment of the Preventive Resource. As with outsourcing, the Guide contains a specific appendix in relation to this figure and recent years the labour inspection has paid a great deal of attention. Even so, it is still a% that is very far from what it should have been, as the presence of this resource is necessary mainly at times of special risks and when risks may be aggravated or modified and this makes it necessary to control the correct application of work methods, situations that occur in almost all jobs, so the percentage should be much higher.

## *2.- Formal aspect of the document*

In this section, as shown in Table 6, all the deficiencies that the H&S Plan presents and that should be part of it are detected in order to achieve real usefulness of the document, which reflects the preventive reality of the work and serves as a guide for consultation during the execution of the jobs.

**Table 6.** Questions related to the preventive reality on site (5) and its average and difference.

ITEMS	% Degree of compliance			
	2008-2012	2013-2016	Average	Difference
11.- ARE THE UNITS OR WORK PHASES (WORK SCHEDULE) INTEGRATED into THE DOCUMENT?	6.41	14.42	10.64	8.01
12.- DOES THE H&S PLAN? CONTAINS GRAPHIC MATERIAL?	32.06	63.53	48.67	31.47
13.- DOES THE H&S PLAN? INCLUDE GRAPHIC MATERIAL RELATED TO THE WORK OR THE MACHINERY TO BE USED ON THE WORK?	2.71	2.25	2.72	- 0.46
14.- DOES THE H&S PLAN HAVE GUIDELINES FOR ACTION IN THE EVENT OF EMERGENCIES?	26.82	38.47	32.97	11.65
15.- DOES THE H&S PLAN	2.94	15.53	9.58	12.59

INCLUDE ACTION GUIDELINES IN CASE OF SERIOUS AND IMMINENT RISK ON SITE?				
---	--	--	--	--

Taking the highest values as a reference, only 14.42% of the H&S Plans contain a schedule that reflects the phases of work and overlaps that occur between the different activities. These data are a true reflection of the fact that the previous preventive planning work is not carried out for the great majority of the H&S Plans.

Regarding the graphic material, although 48.67% of the H&S Plan contains it, only 2.72% corresponds to the specific performance of the work, therefore presenting generic graphic material without any value for identification of the risks. Comment on the% increase in relation to graphic material from 32.06% to 63.53%, the impact that the 1627/97 Guide could have on the same in relation to the content of the H&S Plan.

In relation to items 14 and 15, related to the actions to be carried out before the accident, the% obtained show the lack of awareness of an unquestionable reality and that is that this is a risk sector where accidents occur with a higher incidence than in the rest of the sectors and of which consequences are serious.

### 3.- Risk assessment of the work

The basis of all preventive action is the evaluation of the risks to which the worker is exposed insufficient time to be able to adopt the measures that prevent it.

This evaluation, in relation to the H&S Plan, cannot and should not be limited to a generic evaluation such as the one that may initially appear in the Occupational Risk Prevention Plans, but must be specific to the conditions that have been defined for the work in the project (Table 7).

**Table 7.** Questions related to the evaluation of risks (12) and its average and difference.

ITEMS	% Degree of compliance			
	2008-2012	2013-2016	Average	Difference
16.- IS EACH EVALUATED PHASE / JOB / POSITION / ACTIVITY OF THE WORK IN THE H&S PLAN?	80.69	80.42	80.53	- 0.27
17.- IS EACH PHASE / JOB / POSITION / ACTIVITY OF THE JOB EVALUATED IN THE PLAN IN A SPECIFIC WAY?	12.59	14.89	13.81	2.30

<b>18.- IS IDENTIFIED IN THE H&amp;S PLAN MACHINERY / EQUIPMENT PLANNED TO BE USED ON THE SITE?</b>	13.65	18.42	16.71	4.77
<b>19.- IS THE MACHINERY / EQUIPMENT PLANNED TO BE USED ON THE SITE IDENTIFIED AND EVALUATED?</b>	1.12	0.84	0.97	0.28
<b>20.- ARE THE AUXILIARY MEANS THAT ARE PLANNED TO BE USED ON THE SITE IDENTIFIED IN THE H&amp;S PLAN?</b>	13.12	18.47	15.94	- 5.35
<b>21.- ARE THE AUXILIARY MEANS THAT ARE PLANNED TO BE USED ON THE SITE IDENTIFIED AND EVALUATED?</b>	11.35	16.35	14.08	5.00
<b>22.- IS THE MANUAL OF INSTRUCTIONS AND / OR PROCEDURES FOR ASSEMBLY / DISASSEMBLY / USE OF THE AUXILIARY MEANS THAT ARE PLANNED TO BE USED ON THE SITE?</b>	7.29	7.95	7.64	0.66
<b>23.- ARE THE CHEMICAL PRODUCTS TO BE USED ON THE JOB INCLUDED IN THE H&amp;S PLAN?</b>	20.06	25.16	22.75	3.10
<b>24.- ARE THE SAFETY DATA SHEETS OF THE CHEMICAL PRODUCTS TO BE USED IN THE H&amp;S PLAN?</b>	0.00	0.00	0.00	0.0
<b>25.- IS THE RISK ASSESSMENT INTEGRATED INTO THE H&amp;S PLAN ADJUSTING TO WHAT IS DETERMINED IN ARTICLE 7 OF ROYAL DECREE 39/1997?</b>	0.18	0.00	0.36	- 0.18
<b>26.- IS THERE PREVENTIVE PLANNING IN THE H&amp;S PLAN AS A RESULT OF THE RISKS EVALUATION?</b>	0.06	0.37	0.22	0.31

<b>27.- THE PREVENTIVE PLANNING COLLECTED IN THE H&amp;S PLAN, IS IT ACCORDING TO THE PROVISIONS OF ARTICLE 9 OF ROYAL DECREE 39/1997?</b>	0.00	0.00	0.00	0.00
--	------	------	------	------

As already indicated, some of the main causes of fatal accidents in the sector are the failure to identify the risks that have led to the accident and the preventive measures proposed in the planning derived from the risk assessment insufficient or inadequate in conjunction with the inadequate method of work and the absence of vigilance, control, and direction of a competent person. The data that has been obtained show an extremely worrying reality.

Values of 80.53% in relation to the performance of risk assessments, which become 13.81% when what is requested are specific assessments, are a sign that it is being limited to merely formal compliance which points to false prevention that aims to avoid a sanction, but in no case guarantee the health and safety of workers.

Regarding the identification of machinery with 16.71% that becomes 0.97% at the time of its evaluation, or the inclusion of chemical products in 22.75% that later does not carry a knowledge of the Safety data sheets in order to adopt the appropriate measures, can only continue to confirm their ineffectiveness at a preventive level.

Regarding auxiliary means, their identification and evaluation with values of 15.94% and 14.08%, which are closer to each other, point to more appropriate actions, but such a low percentage shows how far they are from the H&S Plan to achieve their goal.

Finally, and what ends up confirming this reality, is that planning is not being carried out, with values of less than 0.5%, being 0.0% of the H&S Plan that adjust said planning to regulations. The European Union found through its research on the causes of fatal accidents on construction sites that more than a third originated in the planning phase (Seeling, 2001). This is concerning as it is known that effective risk identification and development of alternative solutions during project planning can reduce the likelihood of potential risks occurring and, in turn, facilitate successful project implementation (Yang et al., 2020) (Zwikael et al., 2014). It should be noted that the inadequate or incomplete organization and planning of preventive activity also occur in a significant number of occupational health and safety studies (Zapata et al., 2018). The health and safety study prior to the H&S Plan detects that the deficiency is already flawed in origin.

In this way, it coincides with the statement of Martínez-Rojas, who stated that this document

is not as useful as it should be for the required purposes since among the main drawbacks identified is the generalization of risk assessment and preventive measures and the absence of information relevant (Martínez-Rojas et al., 2020). Undoubtedly, this must lead to the belief that the H&S Plan, as it is approved and registered, cannot be an effective tool. And if it turns out to be an ineffective tool, it will not be fulfilled as it should, since the lower the compliance, the more risk on-site (Forteza et al., 2017).

## **5. Conclusions**

The European directive in relation to health and safety in construction works considers the H&S Plan as the main management tool with which the health and safety of workers must be guaranteed.

The transposition of the directive in the different member countries is carried out by adapting it to the rules of the law of each country, thus each member state has established different ways to make the H&S Plan effective. In any case, in all countries, this document is constituted as a fundamental element and therefore it is legislated under the obligation of its preparation and provision in construction works.

However, the data on the accident rate for the sector in Europe shows that not enough is being done, and the specific data on mortality in Spain point to the lack of effectiveness of the H&S Plan as a possible cause.

The study carried out shows that the H&S Plans that are prepared, which are approved by competent technicians and made available to the Labour Authority, are documents that present great deficiencies that do not comply with the regulatory requirements, both in the most formal aspects (but not for that reason less important) and in the development of risk assessments with which all preventive action must be initiated. The plans, in turn, must contain the preventive planning of the works, an aspect that is currently not included in this document. These deficiencies in the risk assessments in the project phase were also detected by Reis et al. in their studies (Reis et al., 2014) (Reis et al., 2015), where they verified the use of a base model for all projects, regardless of the type of work. Given this situation, it is not surprising that the experts' perception of the effectiveness of the different elements of the construction safety program gives the written document of the H&S Plan one of the lowest values (López et al., 2015). The specific risk assessment within the H&S

Plan, including in detail the special risks of that specific work, becomes an essential point to be considered within said document. More if it is known that risk assessment saves money since the less is known about the existing risks, the higher the level of safety measures to be used and the higher the costs of health and safety protection (Feige-Munzig, 2008).

Therefore, it is alarming to know that these documents are approved without questioning their suitability (Romero et al., 2019) and made available to the works as if the simple fact of having them was enough. Thus, this document tends to be a mere requirement that must be prepared in the event of a labour inspection (Martínez et al., 2020). This, without a doubt, generates fictitious safety that supposes a "serious and imminent risk" because, without adequate measures and their control, this is what workers are exposed to on the construction site.

This situation must make it necessary to review the current control systems, starting with the need for the decisions made in the project by competent technicians (H&S Coordinator in the design phase) in the area of health and safety to be transferred to the H&S Plan. Not only through the H&S Study, but with the necessary involvement of these technicians when transferring the decisions made to the contractors and the H&S Coordinator in the execution phase.

The approval of the plans by the H&S Coordinator in the execution phase or Facultative Direction must be motivated and justified based on the health and safety procedures that have been established in the execution of the works, in relation to the evaluation of the risks of the centre of work, and the monitoring and control of the plan during its execution.

The results obtained show, on the one hand, the misuse of the said preventive instrument and, on the other hand, its limited validity at a preventive level, being a document, of which its usefulness is very limited and due to variations during the work of the construction process, in most cases it does not cover the entire work. It is emphasized that it is a dynamic and flexible document, which must be modified if necessary (Martínez et al., 2020) (BOE, 1997).

To date, it is a preventive document with little value in terms of health and safety at the worksite, and a change in the model must take place so that it can adapt to the reality of the work, even from the modification of the regulations that regulate it.

Finally, it should be noted that all the above must be complemented with prevention strategies through design, to prevent possible construction hazards, avoiding exposing construction workers to unknown tasks and dangerous work environments due in part to the incorporation of new materials, technologies and innovative strategies, as they are not familiar with the required methods and procedures (Karakhan & Gambatese, 2017).

The H&S Plan must therefore be a document that develops as fundamental points on which to base preventive activity:

- The identification of all the agents that participate, specifically in the reference work, with an indication of the safety functions that each of them performs in the execution phase of the work. Setting up an organization chart of functions and responsibilities.
- The identification of specific risks of the work activities based on which, and in the case of requiring the adoption of measures, to establish specific work procedures to be signed by the contractors and subcontractors. Paying special attention to those activities that require the presence of preventive resources.
- The planning of all preventive activity with identification of the measures to be adopted and the specific monitoring and control thereof.

Points that cannot be ignored and without whose development the H&S Plan should not be approved, thus requiring their supervision by the Labour Inspection.

## REFERENCES

Bavafa, A., Mahdiyari, A., & Marsono, A. K. (2018). Identifying and assessing the critical factors for effective implementation of safety programs in construction projects. *Safety Science*, *106*, 47-56. <https://doi.org/10.1016/j.ssci.2018.02.025>

BOE, n.º Real Decreto 1627/1997, de 24 de octubre, por el que se establecen disposiciones mínimas de seguridad y salud en las obras de construcción. Boletín Oficial del Estado, núm. 256, 25 October 1997; 30875-30886, 20 (1997). <https://www.boe.es/buscar/pdf/1997/BOE-A-1997-22614-consolidado.pdf>

Choe, S., & Leite, F. (2017). Construction safety planning: Site-specific temporal and spatial information integration. *Automation in Construction*, *84*, 335-344. <https://doi.org/10.1016/j.autcon.2017.09.007>



Commission of the European Communities. (2008). *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the regions on the practical implementation of Health and Safety at Work Directives 92/57/EEC (temporary and mobile sites) and 92/58/EEC (safety signs at work)*. COM/2008/698 final.

DOCM, Decreto 41/2018, de 19 de junio, para la tramitación electrónica de la comunicación de apertura de centro de trabajo o de reanudación de actividad. Diario Oficial de Castilla-La Mancha, nº 125, 27/06/2018; 17844-17845.

[https://docm.castillalamancha.es/portaldocm/descargarArchivo.do?ruta=2018/06/27/pdf/2018\\_7574.pdf&tipo=rutaDocm](https://docm.castillalamancha.es/portaldocm/descargarArchivo.do?ruta=2018/06/27/pdf/2018_7574.pdf&tipo=rutaDocm)

Enshassi, A., Choudhry, R. M., Mayer, P. E., & Shoman, Y. (2008). Safety Performance of Subcontractors in the Palestinian Construction Industry. *Journal of Construction in Developing Countries*, 13(1), 51-62.

European Commission. (2014). Communication from the Commission to the European Parliament, the Council, European Economic and Social Committee and Committee of the Regions on an EU Strategic Framework on Health and Safety at Work 2014–2020. Brussels, COM/2014/0332 final.

Eurostat. (2020a). European Statistical System. Database-Health-Eurostat. Recuperado el 20 de noviembre de 2020. [https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hsw\\_n2\\_01&lang=en](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hsw_n2_01&lang=en)

Eurostat. (2020b). European Statistical System. Database-Health-Eurostat. Recuperado el 20 de noviembre de 2020. [https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hsw\\_n2\\_02&lang=en](https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=hsw_n2_02&lang=en)

Eurostat. (2020c). European Statistical System. Database-Health-Eurostat. Recuperado el 20 de noviembre de 2020. [https://ec.europa.eu/eurostat/databrowser/view/hsw\\_n2\\_02/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/hsw_n2_02/default/table?lang=en)

Feige-Munzig, A. P. (2008). Risk assessment and occupational safety and health protection in construction work on brownfields. *Brownfields IV, I*, 209-219. <https://doi.org/10.2495/BF080211>

FIEC. (2019). *Key figures activity 2019. Construction in Europe edition 2020. European Construction Industry Federation*.

[http://www.fiec.eu/application/files/9016/0190/8790/FIEC\\_Key\\_Figures\\_Edition\\_2020.pdf](http://www.fiec.eu/application/files/9016/0190/8790/FIEC_Key_Figures_Edition_2020.pdf)

*FIEC (2019)*. (s. f.). Recuperado 8 de noviembre de 2020, de

[http://www.fiec.eu/application/files/9016/0190/8790/FIEC\\_Key\\_Figures\\_Edition\\_2020.pdf](http://www.fiec.eu/application/files/9016/0190/8790/FIEC_Key_Figures_Edition_2020.pdf)

Forteza, F. J., Carretero-Gómez, J. M., & Sesé, A. (2017). Occupational risks, accidents on sites and economic performance of construction firms. *Safety Science*, 94, 61-76.

<https://doi.org/10.1016/j.ssci.2017.01.003>

- Grupo de Trabajo de «Depósito y Gestión de datos en Acceso Abierto» del proyecto RECOLECTA. (2012). *La conservación y reutilización de los datos científicos en España. Informe del grupo de trabajo de buenas prácticas*. Fundación Española para la Ciencia y la Tecnología, FECYT.
- Gurmu, A. T. (2019). Identifying and prioritizing safety practices affecting construction labour productivity: An empirical study. *International Journal of Productivity and Performance Management*, 68(8), 1457-1474. <https://doi.org/10.1108/IJPPM-10-2018-0349>
- INSST. (2019). *Guía Técnica para la evaluación y prevención de los riesgos relativos a las obras de construcción*. Instituto Nacional de Seguridad y Salud en el Trabajo (INSST).
- INSST. (2020). *Análisis de la mortalidad por accidente de trabajo en España 2014 -2015 – 2016*. Instituto Nacional de Seguridad y Salud en el Trabajo (INSST).
- IRSST. (2013). *Estudio de los requisitos de internacionalización de empresas de la construcción*. Fundación Agustín de Betancourt. Instituto Regional de Seguridad y Salud en el Trabajo. Comunidad de Madrid.
- Ivascu, L., & Cioca, L.-I. (2019). Occupational Accidents Assessment by Field of Activity and Investigation Model for Prevention and Control. *Safety*, 5(1), 12. <https://doi.org/10.3390/safety5010012>
- Karakhan, A. A., & Gambatese, J. A. (2017). Integrating Worker Health and Safety into Sustainable Design and Construction: Designer and Constructor Perspectives. *Journal of Construction Engineering and Management*, 143(9), 04017069. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0001379](https://doi.org/10.1061/(ASCE)CO.1943-7862.0001379)
- López-Arquillos, A., Rubio-Romero, J. C., Carrillo-Castrillo, J., & Suarez-Cebador, M. (2015). Effectiveness of Construction Safety Programme Elements. En P. Cortés, E. Maeso-González, & A. Escudero-Santana (Eds.), *Enhancing Synergies in a Collaborative Environment* (pp. 285-289). Springer International Publishing. [https://doi.org/10.1007/978-3-319-14078-0\\_32](https://doi.org/10.1007/978-3-319-14078-0_32)
- Lozano-Díez, R. V., López-Zaldívar, O., Herrero del Cura, S., & Verdú-Vázquez, A. (2019). Analysis of the impact of health and safety coordinator on construction site accidents: The case of Spain. *Journal of Safety Research*, 68, 149-156. <https://doi.org/10.1016/j.jsr.2018.12.012>
- Lyons, T., & Skitmore, M. (2004). Project risk management in the Queensland engineering construction industry: A survey. *International Journal of Project Management*, 22(1), 51-61. [https://doi.org/10.1016/S0263-7863\(03\)00005-X](https://doi.org/10.1016/S0263-7863(03)00005-X)
- Malekitabar, H., Ardeshir, A., Sebt, M. H., & Stouffs, R. (2016). Construction safety risk drivers: A BIM approach. *Safety Science*, 82, 445-455. <https://doi.org/10.1016/j.ssci.2015.11.002>
- Martínez-Aires, M. D., Rubio-Gámez, M. C., & Gibb, A. (2010). Prevention through design: The effect of European Directives on construction workplace accidents. *Safety Science*, 48(2), 248-258. <https://doi.org/10.1016/j.ssci.2009.09.004>

- Martínez-Aires, M. D., López-Alonso, M., & Martínez-Rojas, M. (2018). Building information modeling and safety management: A systematic review. *Safety Science*, *101*, 11-18.  
<https://doi.org/10.1016/j.ssci.2017.08.015>
- Martínez-Aires, M. D., Rubio-Gámez, M. C., & Gibb, A. (2015). The impact of occupational health and safety regulations on prevention through design in construction projects: Perspectives from Spain and the United Kingdom. *Work*, *53*(1), 181-191. <https://doi.org/10.3233/WOR-152148>
- Martínez-Rojas, M., Martín-Antolín, R., Salguero-Caparrós, F., & Rubio-Romero, J. C. (2020). Management of construction Health and Safety Plans based on automated content analysis. *Automation in Construction*, *120*, 103362. <https://doi.org/10.1016/j.autcon.2020.103362>
- Ministerio de Industria, Comercio y Turismo. (2020). *Cifras PYME. Datos octubre 2020*. 4.
- Misiurek, K., & Misiurek, B. (2017). Methodology of improving occupational safety in the construction industry on the basis of the TWI program. *Safety Science*, *92*, 225-231.  
<https://doi.org/10.1016/j.ssci.2016.10.017>
- MTSC. (2012). *Guía de Contenidos Recomendables de un Plan de Seguridad y Salud elaborada por la Mesa Técnica de Seguridad Laboral en la Construcción*. MTSC.  
[http://www.coamu.es/wcoamuficheros/noticias/noticias\\_doc/962\\_guiaplandeseguridad.pdf](http://www.coamu.es/wcoamuficheros/noticias/noticias_doc/962_guiaplandeseguridad.pdf)
- Neag, N. P. (2019). A comparison study of the Romanian occupational safety and health strategy with other European countries' strategy. *MATEC Web of Conferences*, *290*, 12021.  
<https://doi.org/10.1051/matecconf/201929012021>
- Newaz, M. T., Davis, P. R., Jefferies, M., & Pillay, M. (2019). Validation of an agent-specific safety climate model for construction. *Engineering, Construction and Architectural Management*, *26*(3), 462-478. <https://doi.org/10.1108/ECAM-01-2018-0003>
- Ning, X., Qi, J., & Wu, C. (2018). A quantitative safety risk assessment model for construction site layout planning. *Safety Science*, *104*, 246-259. <https://doi.org/10.1016/j.ssci.2018.01.016>
- Orviz, N., Arce, S., & Cuervo, T. (2019). EVALUACIÓN DE LA ORIGINALIDAD DE LOS ESTUDIOS DE SEGURIDAD Y SALUD. *DYNA MANAGEMENT*, *7*(1), [12 p.]-[12 p.].  
<https://doi.org/10.6036/MN9330>
- Pérez Martín, I. (2016). *Estudio internacional sobre la figura del promotor como integrador de prevención de riesgos laborales en la materialización de proyectos: Modelo de gestión preventiva desarrollado*. [Doctoral Thesis]. Universidad Europea de Madrid.
- Reis, C., Oliveira, C., Mieiro, M., & Freitas, P. (2014). Assessment of the health and safety plan on Vila Nova de Gaia county. En P. Arezes, J. Baptista, M. Barroso, P. Carneiro, P. Cordeiro, N. Costa,

R. Melo, A. Miguel, & G. Perestrelo (Eds.), *Occupational Safety and Hygiene II* (pp. 543-546). CRC Press. <https://doi.org/10.1201/b16490-96>

Reis, C., Oliveira, C., Pinto, D., Ferreira, J., Mieiro, M., & Silva, P. (2015). Health and safety plans analysis. En P. Arezes, J. Baptista, M. Barroso, P. Carneiro, P. Cordeiro, N. Costa, R. Melo, A. Miguel, & G. Perestrelo (Eds.), *Occupational Safety and Hygiene III* (pp. 447-451). CRC Press. <https://doi.org/10.1201/b18042-90>

Romero, Á., González, M. N., Segarra, M., Villena, B. M., & Rodríguez, Á. (2019). Mind the Gap: Professionalization is the Key to Strengthening Safety and Leadership in the Construction Sector. *International Journal of Environmental Research and Public Health*, *16*(11), 2045. <https://doi.org/10.3390/ijerph16112045>

Saifullah, N. M., & Ismail, F. (2012). Integration of Occupational Safety and Health during Pre-construction Stage in Malaysia. *Procedia - Social and Behavioral Sciences*, *35*, 603-610. <https://doi.org/10.1016/j.sbspro.2012.02.127>

Seeling, R. (2001). POSSIBILITIES OF IMPLEMENTING THE RESOLUTION No 92/57 ES OF THE COUNCIL OF THE EU MINISTRIES IN GERMANY. *Statyba*, *7*(4), 286-293. <https://doi.org/10.1080/13921525.2001.10531738>

Segarra, M., Villena, B. M., González, M. N., Romero, A., & Rodríguez, A. (2017). Occupational risk-prevention diagnosis: A study of construction SMEs in Spain. *Safety Science*, *92*, 104-115. <https://doi.org/10.1016/j.ssci.2016.09.016>

Shaawat, M. E., Almohassen, A. S., & Al-Hamd, A. A. A. (2020). A Practical Framework for Improving Profitability for High-Rise Buildings Projects in Saudi Arabia. *Industrial Engineering & Management Systems*, *19*(3), 484-497. <https://doi.org/10.7232/iems.2020.19.3.484>

*Statistics / Eurostat*. (s. f.). Recuperado 20 de noviembre de 2020, de [https://ec.europa.eu/eurostat/databrowser/view/HSW\\_N2\\_02\\_\\_custom\\_231547/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/HSW_N2_02__custom_231547/default/table?lang=en)

Tayeh, B. A., Yaghi, R. O., & Abu Aisheh, Y. I. (2020). Project Manager Interventions in Occupational Health and Safety During the Pre-construction Phase in the Gaza Strip. *The Open Civil Engineering Journal*, *14*(1), 20-30. <https://doi.org/10.2174/1874149502014010020>

The Council of the European Communities, Council Directive 92/57/EEC of 24 June 1992 on the implementation of minimum safety and health requirements at temporary or mobile construction sites (1992). <https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=celex:31992L0057>

Win, K. N., Trivedi, A., & Lai, A. S. (2018). Workplace fatalities in Brunei Darussalam. *Industrial Health*, *56*(6), 566-571. <https://doi.org/10.2486/indhealth.2018-0053>

Yang, X., Yu, M., & Zhu, F. (2020). Impact of Project Planning on Knowledge Integration in Construction Projects. *Journal of Construction Engineering and Management*, 146(7), 04020066. [https://doi.org/10.1061/\(ASCE\)CO.1943-7862.0001852](https://doi.org/10.1061/(ASCE)CO.1943-7862.0001852)

Yilmaz, F., & Tosun, S. B. (2018). Evaluation of safety trends in construction, mining and transportation sectors in Turkey. *Sigurnost*, 60(1), 13-23. <https://doi.org/10.31306/s.60.1.2>

Zapata, M. A., Ros, A., & Izquierdo, P. (2018). Incumplimientos más habituales que comparten los estudios y estudios básicos de seguridad y salud en las obras de construcción de la Armada, respecto a las exigencias del Real Decreto 1627/1997 (1). *Informes de la Construcción*, 70(551), 263. <https://doi.org/10.3989/ic.58255>

Zwikael, O., Pathak, R. D., Singh, G., & Ahmed, S. (2014). The moderating effect of risk on the relationship between planning and success. *International Journal of Project Management*, 32(3), 435-441. <https://doi.org/10.1016/j.ijproman.2013.07.002>