

Barriers to OHS interventions in Small and Medium-sized Enterprises

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ABSTRACT

Barriers to OHS interventions are factors that hinder proper design, implementation and evaluation. An analysis of the barriers is crucial for understanding intervention effectiveness and improving the way in which design, implementation and evaluation of interventions are carried out. However, there is little consensus on how barriers should be understood, how important they are in different contexts, and how they can hinder OHS interventions. This exploratory study based on interviews with 58 safety officers of Small and Medium-sized Enterprises (SMEs) gave an overview of the most frequent barriers to OHS interventions, as well as of the effect of the intervention process phase, of the firm's size and of the sector. The most frequent barriers underline three main issues: regulation, resources, and information. The barriers are mainly concentrated in the design and implementation phases, and the frequency of barriers grows with the size from micro enterprises to small enterprises, and then it decreases from Small to Medium-large enterprises. The industry sector of companies does not imply meaningful differences among frequencies.

1. Introduction

Occupational Health and Safety (OHS) issues continue to be one of the major work environment challenges facing legislators, companies and workers worldwide. It is estimated that 2.34 million people died from work-related accidents or diseases in 2008, of which 2.02 million were caused by various types of diseases and 321,000 from work-related accidents (ILO, 2011). This equates to an average of more than 6300 work-related deaths every day. The direct and indirect consequences of work-related accidents and diseases have been well documented and involve loss of life, lost working years, compensation costs, lost productivity, medical and rehabilitation treatment. The OHS issue is even more significant for Small and Medium-sized Enterprises (SMEs). In most countries SMEs constitute the large majority of all enterprises and account for a considerable share of all employees. At the same time it has become clear that smaller enterprises have a higher injury risk than larger enterprises (Fabiano et al., 2004; Mendeloff and Kagey, 1990; Stevens, 1999; Suruda and Wallace, 1996), and it is difficult and expensive for preventive efforts to reach all smaller enterprises (Walters, 2001).

As a consequence, a multitude of safety related interventions aimed at reducing occupational injuries and illnesses have been proposed and tested. These interventions focus on developing engineering strategies that decrease the probability of an employee engaging in at-risk behaviours (see, e.g., Hollnagel, 2004; Hasan et al., 2003; Pohjola, 2003), on educating and training employees regarding equipment, environmental hazards, policies and procedures (see, e.g., Robson et al., 2012; Paul and Maiti, 2007; Whysall et al., 2006a), and on enforcing the safety related policies and procedures (see, e.g., Robson et al., 2007; Laurence, 2005). The proposed intervention strategies are more difficult to apply in SMEs for different reasons. Firstly, SMEs can devote less human, economic and technological resources to OHS than larger enterprises (Micheli and Cagno, 2010; Beaver, 2003); secondly, SMEs have a lower capacity of effectively assessing and controlling risks than larger enterprises (Hasle and Limborg, 2006; Champoux and Brun, 2003).

In light of these challenges, calls have been made for more and better research on OHS interventions (Goldenhar et al., 2001). In particular, evaluating the effects of OHS interventions has become a growing concern in both the scientific and public policy arenas (Baril-Gingras et al., 2006) and has given rise to several reviews (see, e.g., Robson et al., 2007, 2012) and methodological proposals (Murta et al., 2007; Sanson-Fisher et al., 2007). However, reviews seldom provide information about the reasons why the intervention worked or not, nor under what circumstances. As a consequence, reviews focusing on measuring and reporting program

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effectiveness not including context and personal characteristics, often find that evidence is mixed or conflicting (Pedersen et al., 2012). Contextual factors are crucial in understanding intervention effectiveness, and it might be a moot point to isolate intervention and outcome from external influences, when it comes to organizational research (Julnes et al., 1998; Olsen et al., 2008; Pawson, 2002). A new stream of research is so growing, in which several models have been proposed to characterize the intervention process, its context, and factors fostering or inhibiting the process of intervention (Pedersen et al., 2012).

Factors fostering or inhibiting the process of intervention are called drivers and barriers (Whysall et al., 2006b). Barriers and drivers identify all those factors of context not directly involved in workplace safety intervention, but significantly affecting, respectively hindering and fostering, the outcome of interventions. Several studies (EASHW, 2010; Whysall et al., 2006b) analysed specific barriers and drivers and their impact on workplace safety interventions and demonstrated that the relevant factors hindering or fostering interventions operate both at the strategic and operational level. Although relevant, the studies on drivers are outside the scope of this paper, which will focus mainly on barriers, since the ability to learn from failures has been heralded as essential for organizational innovation, adaptation, and success in a changing environment (Sitkin, 1992; Nonaka and Takeuchi, 1995).

An overview of the most relevant studies on barriers (see, e.g., Champoux and Brun, 2003; Whysall et al., 2006b) shows that the approaches used for the analysis of barriers have three main limitations. Firstly, existing studies are usually specific, while a comprehensive overview of barriers to the intervention process is still missing. Secondly, the relative importance of barriers perceived by practitioners has not been adequately investigated. Third, the existing studies neglected the analysis of the differences existing, for instance, between a micro enterprise and a medium-large enterprise. In other words, very little attention is paid to the difference between the Micro- (MiEs, employees ≤ 10), the Small- (SEs, $10 < \text{employees} \leq 50$), and the Medium-sized Enterprises (MEs, $50 < \text{employees} \leq 250$), as defined in the 2003/361/EC recommendation. In the majority of cases, SMEs are bundled together and considered as a unique group of enterprises with similar features and different from LEs (Micheli and Cagno, 2010). The effect on the perceived importance of barriers of factors, such as the phase of the intervention process or the firm's industrial sector, is neglected.

In light of these gaps, this study presents the results of an exploratory study and identifies barriers to OHS interventions in SMEs. More specifically, the study describes the barriers to OHS interventions in SMEs and explores their relevance in different contexts. The paper is structured as follows. Section 2 provides an overview of the literature on barriers for OHS interventions in SMEs, and it reclassifies these into a structured and comprehensive scheme. Section 3 presents the research objectives and the research methodology. Section 4 presents an analysis of the frequency of barriers in SMEs. Finally, Section 5 provides conclusions.

2. Barriers to OHS interventions in SMEs: an overview of the literature

A literature review of likely barriers to OHS interventions in SMEs was undertaken. It covered essentially scientific work of the past two decades (year 1995+). The main reason driving to this time-line was that it became rapidly evident that the most important contemporary approaches were developed from the early 1990's and were formally published in the following years. The search was carried out in abstract databases and other bibliographic sources, and also through the scrutiny of references cited

by previous authors. Searches were made in international bibliographic databases (i.e. SCOPUS and Web of Knowledge), and Science Search Engines (i.e. IEEE Xplore and Google Scholar), and also by browsing directly the web sites of journal Editors and Publishers (e.g., Elsevier). The key-words employed for the systematic searches were "interventions" and "workplace safety" combined with "barriers" and other synonyms; in total these made out 12 search combinations. References provided by other authors were searched directly at the source/publisher. Based solely on the Title, Abstract and Key-words, and after excluding repetitions, 142 publications (year 1995+) have emerged from the several searches; naturally, a number of publications have surfaced repeatedly under multiple combinations, providing an indication of their potential relevance. By examining the Title and the Abstract, the search was substantially narrowed to articles that seemed to address, or explicitly mentioned, barriers to OHS interventions. In some cases, papers dealing with relevant factors for OHS performance were considered, since a negative performance of the company respect to some of these factors could be seen as a barrier. The set of references were downloaded to archive (or collected through inter-library loans) and were afterwards examined more carefully to decide whether to discard them (for low relevance) or to include in the review. The final reading led to fifteen papers focusing on barriers and strictly related topics were identified for inclusion in the review. All of them identified in this way, were articles from scientific journals (peer-reviewed) and were written in English. After identifying the most relevant studies, the proposed barriers were compared in a cross-cut analysis with the objective of creating a list of barriers suited for the empirical investigation in SMEs. Some of the barriers identified in the reviewed studies were split into slightly different categories for the present study. Some of the barriers were considered to be overly broad and had to be described through more narrowly defined sets of barriers. Based on the review, definitions were developed. This analysis was conducted in parallel with extensive discussions with five safety officers from SMEs. At the end of this process, twenty-seven likely barriers were identified and defined. A summary of the 15 key papers identified in the review is given below, and the results of the cross-cut analysis are presented.

Based on our review, this paragraph provides our definitions of an OHS intervention and of barriers. An OHS intervention is defined as an attempt to improve safety and health conditions in workplaces by means of targeted activities and initiatives. Such activities include changes in work organization and working conditions, engineering activities for the modification or installation of plant and equipment, training and behavioural changes (Robson et al., 2001; Rychetnik et al., 2002). The factors of the external and internal context are decisive for the outcome of an intervention, and therefore they must be considered during design, implementation and evaluation of intervention (Pawson, 2002). The contextual factors hindering the implementation of implementation can be defined by means of the barriers. Barriers are defined as the set of internal and external factors influencing the process of intervention, inhibiting or interrupting it (EASHW, 2010). The selected studies are presented in the following paragraph.

Rubenowitz (1997) reported the most common obstacles to obtaining positive results to interventions to resolve physical workspace design problems. These were lack of commitment from the line managers' point of view, neglecting to engage technicians and employees concerned, ignoring to take psychosocial conditions into consideration, and ignoring the impacts of the proposed changes on the wage system and the organizational system. Lamm (1999) identified a number of factors influencing the level of small business understanding and compliance with OHS requirements. She listed the following influential factors: difficulty accessing resources (such as lack of resources, inability to spread

costs and wider market environment), limited training or industry experience; pressure from large businesses to reduce costs, influence of large businesses requiring safe work systems from suppliers, influence of quality management systems (such as qualified integration of OHS with quality management systems), and relationship with OHS regulatory agencies (often perceived as distant and lacking an understanding of small business). Quinlan and Mayhew (2000) summarised several Australian studies of small business highlighting the significance of economic pressures overriding health and safety concerns. Theberge and Neumann (2010) provided examples of strategies that ergonomists pursue in the course of making the case for ergonomics in workplaces. They noticed how in some workplaces there may be resistance, or apathy, to putting in place organizational arrangements that enhance the profile of ergonomics, and they suggested that, in these cases, a strategy of cultivating supportive relationships may be more effective. Gallagher et al. (2003) analysed whether the performance of such occupational safety and health management systems lived up to expectations. By combining a literature review and extensive interviews about OHS management systems they identified several barriers to successful implementation which included lack of senior management commitment, effective workforce involvement, and programme integration, inappropriate application of audit tools to ensure compliance, the problematic application of these in certain sectors such as small business, contractors, and the part-time and temporary workforce. They concluded that OHS management systems can live up to their promise, but often fail because of inadequate implementation or application in hostile environments. Champoux and Brun (2003) invited the owner-managers of 223 SMEs to identify the factors they felt were obstacles to OHS improvement in their firms. Six out of ten respondents said there were no obstacles to OHS improvement in their firms. A variety of obstacles were identified: costs (37%), paperwork (36%), lack of training (31%), priority to production (29%), lack of time (28%), lack of staff (17.5%), employee attitudes (16%), employee demands (16%), planning difficulties (14%), and profitability of investments in prevention (13%). Walker and Tait (2004), while analysing a simple OHS management system for small enterprises, identified several barriers to OHS improvements in these enterprises, namely the presence and adequacy of the OHS policy statement and of the risk assessment process, the presence and adequacy of documentation for training, processes for first aid treatments and dealing with accidents, the presence and adequacy of training standards, maintenance standards, the general standard of premises and welfare facilities, and finally other information such as manager attitudes or particular problems encountered. Barbeau et al. (2004) administered a survey in 25 small worksites. In response to the question about barriers to OHS, responses included employee defensiveness, language differences, low literacy, and most frequently "the reality of production" and other time and budget constraints. With regard to language barriers, companies described hiring translators, providing OHS materials in several languages, holding English as a Second Language classes, relying on family members to translate materials or enlisting bilingual employees to help in training. Hasle and Limborg (2006) reviewed the literature on preventive occupational health and safety activities in small enterprises. Among other topics, they focused on the difficulty of SMEs in complying with legal requirements and the lack of resources allocated to OHS interventions. Whysall et al. (2006b) explored the process of implementing interventions to tackle occupational ill-health, in particular the facilitators and barriers involved in implementing such interventions. The factors cited by interviewees as key barriers to the effective implementation of interventions are inability to generate behaviour change among workers, gaining managerial authorization and/or commitment, managerial attitudes towards health and safety,

insufficient resources, prioritization of production over safety, finding appropriate equipment and space, and industrial relations issues. Smith and Carayon (2009) analysed the various components of the workplace that interact to increase and decrease workplace safety and health risk. Their work system model encompassed psychosocial, cognitive and physical aspects of work that could have various impacts on the individual's ability to respond appropriately to risk. Even though barriers were not explicitly mentioned, their integrated and holistic approach to identifying the elements of the work system provides useful suggestions for the identification of possible barriers. Moreover, it provides useful insights for the classification of the barriers themselves. The main components of the workplace mentioned in their study, impacting on the individual's ability to respond appropriately to risk, are summarised as follows: organizational factors (commitment to reducing workplace risks, policy statement in support of OSH promotion, communication between the workforce and management, human relations, structured activities for assessing and controlling hazards), human factors (opportunities for employees to be active in managing the risks of their own work tasks, training for employees in hazard awareness and recognition, employees are motivated to respond properly to the risks), task factors (demands of a work activity, way in which work is conducted, pace or rate of work, the amount of repetition in task activities, work pressure due to production demands), technology and materials factors (relationship between the controls of a machine and its subsequent action, hazard characteristics of materials), and work environment factors (hazard exposures in the work environment, formalized approach to hazard control). The European Agency for Safety and Health at Work (EASHW, 2010) investigated the difficulties in dealing with health and safety in establishments through a survey involving a sample of approximately 36,000 European companies of every size and sector. The greatest difficulties experienced by companies, together with their overall prevalence, are lack of resources such as time, staff or money (36%), lack of awareness (26%), lack of expertise (24%), culture within the establishment (24%), sensitivity of the issue (23%), and lack of technical support or guidance (21%). Cherniack and Lahiri (2010) identified insurance related, structural, and workplace cultural barriers to the implementation of effective preventive and upstream clinical interventions in the working age adult population. They identified three types of barriers to more effective and sustainable workplace interventions: misplaced allocations and incentives, organizational and cultural barriers to implementing efficient interventions, and discordance between improved health and reduced health care costs. Hale et al. (2010) described the patterns of interventions distinguishing between successful and unsuccessful projects and discussed their underlying mechanisms. They concluded that interventions bringing about constructive dialogue between shop-floor and line management, providing motivation to line managers and strengthening the monitoring and learning loops in the safety management system appeared more successful. The amount of energy and creativity injected/provided by top managers and, above all, by the coordinator appeared also to be a distinguishing factor. Mellor et al. (2011) focused on the barriers to progress in the implementation of the management standards for preventing and reducing work-related stress. The critical barriers across many public sector organizations were major restructuring/mergers, replacement of senior management, on-going organizational changes, target driven cultures, weak support from senior management support, belief that stress issues cannot be solved, lack of trade unions involvement leading to lower employee participation, perceived lack of management competency in conducting risk assessment, insufficient resources, managers unavailability which slows down action plan delivery, HSE indicator tool not suited for some work environments, risk assessment seen as resource intensive, external consultancies' help

needed for focus group facilitation, and gap in HSE guidance on how to conduct an evaluation of interventions.

In order to classify the barriers identified in the above review, we have introduced a model of the socio-technical system involved in the control of safety. Among different possible classification schemes, we looked for a scheme structuring the socio-technical system in different hierarchical levels; indeed, the use of different levels underlines the causal relationship that could exist among the different levels, namely among the different categories of barriers. Many levels of politicians, managers, safety officers, and work planners are involved in the control of safety by means of laws, rules, and instructions that are established to control some hazardous, physical process. Rasmussen (1997) represented the socio-technical system actually involved in the control of safety by means of six different levels: (1) the government level, (2) the regulators and associations level, (3) the company level, (4) the management level, (5) the staff level, and (6) the work and technological system. In order to classify the barriers identified in the literature, we have introduced two modifications to Rasmussen's six levels. First, we have introduced the level of intermediaries between the regulators and associations level and the company level, since intermediaries play an essential role in SMEs (Hasle, 2000; Olsen et al., 2012). Especially smaller firms with fewer than 20 employees often lack the necessary resources for effective occupational safety and health activities, and many require external assistance with safety and health programming (Cunningham and Sinclair, 2014). The intermediaries can play such a role, and their contribution can consist, for instance, in introducing new mechanisms enabling the desired change (Olsen and Hasle, 2014). Second, we have divided the "work and technological system" level into two different levels: organization and technology, in accordance with the very well-known man, technology, and organization (MTO) triad which is often used (see e.g. Hollnagel, 1998) for the description of the internal context in which actions take place. As for the role of regulators and associations, it has to be underlined how regulators and associations – and in particular unions – generally have an interest and a supportive role for OHS (Hasle, 2000; Olsen and Hasle, 2014). However, Whysall et al. (2006b) cite industrial relations issues as an important barrier to implementing changes aimed at tackling musculoskeletal disorders, and they cite one occupational health advisor who suggested that the implementation of changes had been prevented because "there are some industrial relation issues that they [the trade union] want resolving first, before they go forward". As a consequence, we introduced the behaviour of trade unions among barriers, with the purpose of investigating the relative importance of the cases in which the behaviour of trade unions implies negative consequences for OHS, but being aware that their role is generally supportive.

On the basis of the classification scheme described above, the barriers identified in the literature have been rescreened out and structured in a seven-layer hierarchy, containing 27 barriers. The classification scheme, the barriers, the related definitions, and the references are shown in Table 1. In Table A1, the relationship between the 27 barriers and the studies in the literature is presented.

3. Research objectives and methodology

Very few empirical investigations (see e.g., Champoux and Brun, 2003; EASHW, 2010) were found that clarified the importance of barriers in enterprises and that clarified whether other features such as the phase of the intervention process, or the firm's size, or firm's industrial sector can affect barriers. In addition, the context of SMEs is almost completely overlooked. Thus the present study is one of the first to examine barriers to OHS interventions in manufacturing SMEs. In this way, the paper addresses the

afore-mentioned gaps in the scientific literature. Manufacturing SMEs were selected for this exploratory study because of the relevance of SMEs in the EU zone. SMEs account for 99.8% of non-financial enterprises in 2012, which equates to 20.7 million businesses. In employment terms, SMEs provided an estimated 67.4% of job positions in the non-financial business economy in 2012 (European Commission, 2012). They are characterized by a high average risk level, especially in the manufacturing sector: more than one in four (26.1%) fatal accidents at work in the EU-27 in 2009 took place within the construction sector, while the manufacturing sector had the next highest share (16.1%) (Eurostat, 2013).

Between April and July 2012, the authors contacted by phone the owners of 151 SMEs and asked their availability to participate in the study. Fifty-eight owners agreed to participate. A questionnaire was sent to their companies by e-mail and an appointment for a further telephone interview was fixed with the 58 owners which agree to participate. The questionnaire was addressed to the safety officers (which in some limited cases corresponded with the owner-manager), and they had one or two days to understand the questions and to think about their answers. The questionnaire was divided into two sections: (1) enterprise characteristics (sector, number of employees, turnover, interviewees' role, etc.), (2) perceived intensity for each barrier included in the proposed overview, considering separately the three phases of the interventions process: design, implementation, and evaluation. A three point Likert scale was used, with 0 indicating the absence of the barrier, 1 the perception of the barrier with a low (*L*) intensity, and 2 the perception of the barrier with a high (*H*) intensity; on the basis of the experience of the authors. This choice seemed the best compromise for the discriminative power of safety officers using qualitative measures. During the succeeding telephone interviews, any doubts about the questions were clarified and the answers were registered by the authors. Each interview lasted an average of forty minutes.

The analysis of the questionnaires/interviews was performed firstly for the total sample (see Section 4.1), and then considering how the phase of the intervention process (see Section 4.2), the firm's size (see Section 4.3), and the firm's industrial sector (see Section 4.4) could affect barriers. The results of these analyses are presented in the following sub-sections below.

4. Results and discussion

The distribution of sample firms by industry sectors is summarised in Table 2. The distribution of sample firms by turnover and number of workers is summarised in Table 3. The SMEs – as defined in the 2003/361/EC recommendation (European Commission, 2003) – belong to the most important manufacturing sectors of the Lombardy region in Italy in terms of employees and turnover and they have been classified according to the International Standard Industrial Classification of All Economic Activities "ISIC rev.4". The sectors considered by the sample and the corresponding ISIC codes are reported in Table 2. Table 3 shows that the SMEs have been divided into four classes: Micro (MiEs, employees ≤ 10), the Small (SEs, $10 < \text{employees} \leq 49$), Medium (MEs, $50 < \text{employees} \leq 99$), and Medium-Large Enterprises (MLEs; $100 < \text{employees} \leq 250$). This classification differs from the one proposed by the European Commission as it introduces an additional class, i.e. the medium-sized enterprises class has been divided into two sub classes (MEs and MLEs). Indeed, considering the organizational processes within SMEs, there might be a difference in their behaviour, as observed in other issues, e.g. energy efficiency (Trianni and Cagno, 2012).

Table 1

Classification scheme, barriers, related definitions, and references.

Kind	Level	Barrier	Definition	References	
External	Government	G1 – stringent legal requirements	Indicate that the legal requirements are excessive or not effective with respect to the real OHS needs of the company. They can represent a barrier altering the proper allocation of resources or driving the commitment of the company on the wrong objectives	Hasle and Limborg (2006)	
		G2 – bureaucracy	Indicates an excessive amount of paperwork necessary to be compliant with legal requirements which is not tailored with respect to the capabilities of the company, thus subtracting time and resources to main effective OHS related activities	Champoux and Brun (2003)	
	Regulators, Associations	R1 – lack of technical support by control authorities	Indicates that control authorities are not able to provide a preliminary guidance for the accomplishment of their requirements	Champoux and Brun (2003) Mellor et al. (2011) Lamm (1999)	
		R2 – behaviour of trade unions	It is a barrier when the implementation of changes is prevented because of the resistance of trade unions	Whysall et al. (2006a,b)	
		R3 – difficulties in the interaction with external agencies	Indicates that interaction with external agencies, such as associations of SMEs, is not satisfactory with respect to the OHS challenges of SMEs	EASHW (2010)	
		R4 – lack of guidelines	Indicates that guidelines that should address OHS interventions, such as voluntary norms, are not satisfactory with respect to the needs of SMEs	EASHW (2010) Mellor et al. (2011)	
	Intermediaries	I1 – lack of technical support by consultants	Indicates that consultants are not able to provide an adequate guidance to SMEs with respect to technical issues	Champoux and Brun (2003) Mellor et al. (2011)	
	Internal	Management	M1 – systematically wrong behaviour of management	Indicates the adoption of wrong safety related behaviours by the management Wrong behaviours are related both to the primary activities of management, such as decision making, both to secondary activities, such as actively participating to the safety activities	Rubenowitz (1997) Walker and Tait (2004) Whysall et al. (2006a,b) Smith and Carayon (2009) Hale et al. (2010) Mellor et al. (2011)
			M2 – management not adequately skilled	Indicates the lack of adequate skills of the management with respect to OHS themes	Rubenowitz (1997) Champoux and Brun (2003) Walker and Tait (2004) Whysall et al. (2006a,b) EASHW (2010) Mellor et al. (2011) Smith and Carayon (2009)
			M3 – lack of knowledge of the criticalities of the company by management	Indicates that the management ignores which are the criticalities of the firm with respect to the OHS issue. This can mainly hinder the proper need assessment or the proper scheduling of interventions	Champoux and Brun (2003)
M4 – lack of knowledge of the effect of the interventions			Indicates that the management ignores the advantages of carrying out OHS interventions. This not only impacts the commitment of the management, but it also affects the scheduling of interventions and the allocation of resources	Mellor et al. (2011)	
Staff		S1 – systematically wrong behaviour of personnel	S1 – systematically wrong behaviour of personnel	Indicates the adoption of wrong safety related behaviours by the personnel. Wrong behaviours are mainly related to the working activities of personnel, which should be performed accordingly to safety rules. Wrong behaviours could hinder the implementation of OHS interventions in case in case in which the considered intervention requires an active participation of the personnel	Champoux and Brun (2003) Barbeau et al. (2004) Whysall et al. (2006a,b) Smith and Carayon (2009) Theberge and Neumann (2010) Champoux and Brun (2003)
			S2 – personnel not adequately skilled	Indicates the lack of adequate skills of the personnel with respect to OHS topics. It can hinder the implementation of intervention in the cases in which the implementation of the intervention requires an active involvement of the personnel	Barbeau et al. (2004) Smith and Carayon (2009) EASHW (2010) Lamm (1999) Smith and Carayon (2009) Lamm (1999)
		S3 – lack of knowledge of the criticalities of the company by workers	S3 – lack of knowledge of the criticalities of the company by workers	Indicates that the workers ignore which are the criticalities of the firm with respect to the OHS issue. This lack of knowledge can mainly hinder the proper need assessment or the proper scheduling of interventions	Rubenowitz (1997) Smith and Carayon (2009)
			S4 – lack of awareness of OHS relevance by workers	Indicates that the workers neglect OHS relevance. It can hinder the implementation of interventions requiring a high degree of workers' commitment in order to be properly implemented	EASHW (2010) Hale et al. (2010)

Table 1 (continued)

Kind	Level	Barrier	Definition	References
	Organization	O1 – inadequate OHS policy	Indicates the lack of an adequate policy statement in support of occupational safety and health promotion that comes from the top of the company. It can hinder interventions since the OHS policy affects both the choices made for the interventions themselves both the environment in which the interventions take place	Walker and Tait (2004) Smith and Carayon (2009)
		O2 – personnel inadequately involved in OHS activities	Indicates the lack or the inadequacy of involvement of personnel during the design, implementation, and evaluation of OHS interventions. It can hinder interventions in all the cases in which the involvement of personnel plays an essential role	Rubenowitz (1997) Smith and Carayon (2009) Hale et al. (2010) Mellor et al. (2011)
		O3 – Inadequate dedication of time	Indicates the absence of time to be scheduled for the design, implementation, and evaluation of OHS interventions	Champoux and Brun (2003); Barbeau et al. (2004); EASHW (2010)
		O4 – Inadequate dedication of economic resources	Describes the absence or the inadequacy of funding for OHS interventions	Champoux and Brun (2003) Barbeau et al. (2004) Hasle and Limborg (2006) Whysall et al. (2006a,b) Smith and Carayon (2009) EASHW (2010) Cherniack and Lahiri (2010) Mellor et al. (2011) Lamm (1999)
		O5 – lack of organizational coherence and flexibility	Indicates the lack of an adequate organization within the company. Adequate indicates that the organization is coherent with occupational safety and health promotion and enough flexible for the implementations of the needed changes and interventions. The inadequacy of the organization can hinder interventions in all the cases in which interventions require an organizational flexibility or an adequate organizational environment in order to be properly implemented	Rubenowitz (1997) Walker and Tait (2004) Smith and Carayon (2009) Cherniack and Lahiri (2010) Hale et al. (2010) Mellor et al. (2011) Lamm (1999) Gallagher et al. (2003)
		O6 – absent or ineffective communication	Indicates the lack of communication or the inadequacy of the communication between management and workers or between the workers themselves	Barbeau et al. (2004) Smith and Carayon (2009) Hale et al. (2010) Mellor et al. (2011)
		O7 – absent or ineffective information	Indicates the lack of information or the inadequacy of the information owned by management and by workers. The lack of the right information hinders interventions affecting the behaviour of the workers and the choices of the management	Mellor et al. (2011) Walker and Tait (2004) Barbeau et al. (2004) EASHW (2010)
		O8 – prioritization of production over safety	Indicates the priority given to the production at the expense of OHS related activities	Cherniack and Lahiri (2010) Champoux and Brun (2003) Barbeau et al. (2004) Whysall et al. (2006a,b) Smith and Carayon (2009) Quinlan and Mayhew (2000)
		O9 – difficulty in planning the OHS activities	Indicates difficulties experienced by decision makers during the design of OHS interventions. These difficulties are related to the complexity of OHS interventions and to the lack of proper tools supporting decision makers in different tasks, such as the allocation of resources	Champoux and Brun (2003) Whysall et al. (2006a,b) Smith and Carayon (2009) Cherniack and Lahiri (2010) Mellor et al. (2011) Whysall et al. (2006a,b) Mellor et al. (2011)
		O10 – difficulty in obtaining authorizations by management	Indicates difficulties of practitioner in gaining the managerial authorization necessary for the implementation of OHS interventions. It hinders the implementation of interventions since the managerial authorization is an essential element in the implementation of OHS interventions.	
	Technology	T1 – lack of technical resources	Indicates the lack or the inadequacy of physical and technical elements necessary for the proper implementation of OHS interventions. Examples of physical elements are the premises of the company, while technical elements are for instance machinery and equipment necessary to the implementation of OHS interventions	Walker and Tait (2004) Barbeau et al. (2004)
		T2 – absent or ineffective information collection system	Indicates the lack or the inadequacy of the system used for the collection of safety related data such as past accidents, risk assessment	Walker and Tait (2004) Smith and Carayon (2009) EASHW (2010) Mellor et al. (2011)

Table 2
Industry sectors of companies in survey sample.

Sector	Code	Number of companies
Food	C 10	2
Textiles, wearing apparel	C 13; C 14	2
Leather (excluding apparel) and related products	C 15	1
Wood, and wood and cork products	C 16	2
Paper and paper products	C 17	1
Coke and refined petroleum products	C 19	1
Chemical products, Basic pharmaceutical products and pharmaceutical preparations	C 20; C 21	4
Rubber and plastic products	C 22	11
Other non-metallic mineral products	C 23	2
Metal products	C 24	1
Metal products, excluding machinery and equipment	C 25	15
Computer, electronic and optical products; electro-medical and measuring equipment, watches and clocks, Electrical equipment and non-electric domestic appliances	C 26; C 27	5
Machinery and equipment n.e.c.	C 28	6
Motor-vehicles, trailers, semi-trailers	C 29	1
Other manufacturing industry products	C 32	1
Other	-	3
Total		58

Table 3
Features of the companies by annual turnover and number of workers.

Turnover	Number of workers				Total
	<10	10–49	50–99	100–250	
<2 M€/year	4	6	0	0	10
2– 10 M€/ year	0	8	6	1	16
10–20 M€/ year	0	6	5	1	12
>20 M€/ year	0	1	7	12	20
Total	4	21	19	14	58

The data were compiled and analysed using Microsoft Excel software. Firstly, frequency distributions tables referred to the total sample were produced. These tables were then compared with a set of descriptive variables corresponding to other characteristics of the firms and of the interventions process. Three variables, i.e. phase of the intervention process, firm's size, and firm's industrial sector were selected to provide an overall description of the dynamics of barriers in SMEs.

4.1. The total sample

The frequency and the intensity (high and low) of the barriers detected for the whole sample are reported in Table 4. Thus, the second column of Table 4 reports the absolute frequency of the barriers with intensity both high and low (Abs Freq ($H + L$)), i.e. the number of "1" and "2" in the answers to the questionnaires. It has been used because of the relatively small size of the sample, so as to better clarify the number of answers taken into account for the analysis. Since there were 58 questionnaires, and each barrier could be detected during three phases (design, implementation, and evaluation), the highest possible absolute frequency for each barrier is 174 (i.e. $58 * 3$). The third column of Table 4 reports the relative frequency of barriers perceived with a high intensity normalised by the absolute frequency of barriers with intensity both high and low (Rel Freq ($H/H + L$) = Abs Freq (H)/Abs Freq ($H + L$)), i.e. the number of "2" in the answers to the questionnaires, divided by the number of "1" and "2" in the answers to the questionnaires.

The ten most frequent barriers – marked with a (+) in Table 4 – underline three main issues: regulation (G1 and G2), resources (O3 and O4), and information (O6, O7, S4, R1, and R4). The regulation issue is expressed both by stringent legal requirements (G1) and by bureaucracy (G2). Since these two barriers are perceived with the highest frequencies, it is easy to understand how regulations

play an essential role for OHS management in SMEs. Previous studies underlined how legal matters and regulations play an important role in OHS decisions and they can constitute a strong invitation to improve safety (Cagno et al., 2013); however, it has also been shown how legal pressures can have pernicious effects (Asche and Aven, 2004), especially when some requirements are perceived as costly and their real effectiveness seems vague and dubious. The high importance of regulations can be explained if we consider that in several SMEs the management of safety consists essentially in being compliant with regulations. The difficulties encountered in the management of safety are thus ascribed by the practitioners to the regulations, considered too stringent or bureaucratic.

The most frequently perceived barrier was related to stringent legal requirements (G1). However, before proposing a solution, it is necessary to underline that the perception of practitioners about legal requirements could be incorrect. If the perception of practitioners is correct, the results of the survey suggest that regulation is not adequate to the real needs of SMEs. There could be different causes of this inadequacy. A first cause could be the heterogeneity of SMEs: the characteristics of SMEs are so different that it is terribly difficult for general preventive efforts suggested by regulations to reach all SMEs and become effective (Walters, 2001; Cagno et al., 2011). A second cause could be related to the fact that many SMEs do not have the expertise or the time to propose a solution ensuring compliance with regulation (Hale and Swuste, 1997). Thus, instead of focusing on their lack of resources, they could consider legislation as too stringent. Summing up, if the perception of practitioners is correct, the results suggest that regulation should be modified tailoring it to the needs of SMEs. Otherwise, the risk is that SMEs waste resources in trying to show compliance to regulation, rather than in really ameliorating their OHS conditions. On the other hand, if the perception of practitioners is not correct, and the legislation is not so stringent and bureaucratic, it is necessary to intervene on the awareness of practitioners, since their decision-making depends on their perception. The perception of practitioners could be correct in some cases and distorted in others; as a consequence, the best strategy to solve the regulation issue should be chosen on the basis of the particular situation.

The second most frequently perceived barrier was related to bureaucracy (G2). The bureaucratic activities require an amount of paperwork that is considered excessive by SME practitioners. This barrier is in part linked to the lack of staff dedicated to OHS activities which must be performed by owner, who often has

Table 4

Absolute frequency of the barriers with intensity both high and low and relative frequency of barriers with a high intensity, detected on the whole sample. In each column the ten highest values are marked with a (+), while the two lowest values are marked with a (-).

Barrier	Abs Freq (H + L)	Rel Freq (H/H + L)
G1 – stringent legal requirements	81 ⁽⁺⁾	58% ⁽⁺⁾
G2 – bureaucracy	77 ⁽⁺⁾	58% ⁽⁺⁾
R1 – lack of technical support by control authorities	58 ⁽⁺⁾	43% ⁽⁺⁾
R2 – behaviour of trade unions	19 ⁽⁻⁾	53% ⁽⁺⁾
R3 – difficulties in the interaction with external agencies	46	26%
R4 – lack of guidelines	61 ⁽⁺⁾	46% ⁽⁺⁾
I1 – lack of technical support by consultants	43	51% ⁽⁺⁾
M1 – systematically wrong behaviour of management	37	46% ⁽⁺⁾
M2 – management not adequately skilled	49	41% ⁽⁺⁾
M3 – lack of knowledge of the criticalities of the company by management	31	29%
M4 – lack of knowledge of the profitability of the interventions by management	35	23%
S1 – systematically wrong behaviour of personnel	52	31%
S2 – personnel not adequately skilled	53	30%
S3 – lack of knowledge of the criticalities of the company by workers	45	13% ⁽⁻⁾
S4 – lack of awareness of OHS relevance by workers	54 ⁽⁺⁾	33%
O1 – inadequate OHS policy	20 ⁽⁻⁾	15% ⁽⁻⁾
O2 – scarce involvement of personnel in OHS activities	52	21%
O3 – lack of time	76 ⁽⁺⁾	46% ⁽⁺⁾
O4 – lack of economic resources	68 ⁽⁺⁾	59% ⁽⁺⁾
O5 – inadequacy of the organization	51	27%
O6 – absent or ineffective communication	61 ⁽⁺⁾	36%
O7 – absent or ineffective information	54 ⁽⁺⁾	41%
O8 – prioritization of production over safety	54 ⁽⁺⁾	26%
O9 – difficulty in planning the OHS activities	49	33%
O10 – difficulty in obtaining authorizations by management	36	31%
T1 – lack of technical resources	49	37%
T2 – absent or ineffective information collection system	50	30%

considerable difficulty in dealing adequately with all the paperwork (Walters, 2001; Hasle et al., 2009).

The second main issue was resources, expressed by lack of time (O3) and lack of economic resources (O4). The latter, especially in SMEs, has been widely discussed in the literature (see, e.g., Micheli and Cagno, 2010; Beaver, 2003). It is interesting to notice how lack of time occurs more frequently than lack of resources. In order to understand the causes of the lack of resources, it is firstly possible to observe that the lack of resources could be better expressed as lack of resources dedicated to OHS. Indeed OHS is often seen uniquely as a cost, while the economic advantage of investing in OHS is not perceived by SMEs' owners and managers (Tomba et al., 2010). So if on the one hand it is true that SMEs have in general less resources compared to large enterprises, it has to be considered that the resources are allocated on the basis of the priorities perceived by decision makers, and that their perceived priorities could be distorted because the benefits of investing, for instance, in the production are perceived in the short term, while the benefits of the investments in OHS are perceived in the long term. The solution for overcoming this barrier is thus complex. On the one hand, measures for a more effective use of resources could be introduced, for instance, by means of networks of enterprises (Wallner, 1999). On the other hand, it is necessary to increase the awareness of OHS practitioners of the incomes of the investments on safety, so that the allocation of resources can be done in a proper way.

The information issue was expressed by the absent or ineffective communication (O6), the absent or ineffective information (O7), the lack of awareness of OHS relevance by workers (S4), lack of technical support by control authorities (R1), and lack of guidelines (R4). The information issue can thus be related to different levels of the socio-technical system involved in the control of safety: the regulators and associations level (R4 and R1), the organization level (O6 and O7), and the staff level (S4).

The inadequacy of the information flow between the Regulators, Associations, and enterprises (R4, R1) could be due to different causes. First, regulators and associations could limit themselves to assess the incompliance of the OHS conditions of

the enterprises, without providing any suggestions for the improvement of these conditions. Second, the information channels could not be adequate: for instance, the enterprise may not be able to receive technical support provided on the internet, or they may not be aware of the existence of this kind of support. Third, SMEs may have excessive expectations in terms of support by control authorities, which in fact cannot operate as consultants. In order to overcome this barrier regulators, associations and enterprises need to assess their respective information channels, capabilities and relationships.

The inadequacy of the information flow among different actors within the enterprise (O6, O7, and S4) could originate from the behaviour of the actors involved in the communication or from the channels used in the communication. The actors could hinder an effective communication because of a lack of motivation to communicate. On the other hand, the channels used in the communication within the enterprise could be ineffective. Considering this situation, in order to overcome these barriers it is necessary to carefully consider the role of the actors and of the channels in the specific cases.

The less frequently perceived barriers – marked with a (-) in Table 4 – are related to the behaviour of trade unions (R2) and to the inadequate OHS policy (O1). The scarce importance given to behaviour of trade unions was predictable, since unions generally have a supportive role with respect to OHS issues (Hasle, 2000); so the analysis confirms the perceived low importance of this barrier. In contrast, although the literature gives a high importance to the inadequacy of OHS policy (Smith and Carayon, 2009), the results seem to contradict this assumption. This can be explained by considering that often in SMEs an OHS policy is absent or not adequately formalized (Hasle and Limborg, 2006). As a consequence, when practitioners experience difficulties in OHS management, they do not relate these difficulties to the absence of an OHS policy. In order to properly investigate this barrier it is necessary to make practitioners aware of the relationship between the absence of an OHS policy and the difficulties in OHS management.

As for the relative frequency of barriers perceived with a high intensity, it is possible to identify how these – marked with a (+)

– tend to coincide with the barriers perceived with a high frequency. It is therefore possible to hypothesise that among the causes of the high frequency of a barrier, it may be difficult to overcome the barrier itself. There are some exceptions as, for instance, the behaviour of trade unions (R2). Although it has a low frequency, this barrier is particularly relevant when perceived.

4.2. Effect of the phase of the intervention process

The effect of the phase of the intervention process on the frequency and intensity of the barriers is reported in Table 5. This analysis aims at understanding the perceived frequency and intensity of the barriers in the different phases of the intervention process. For each phase, two columns are presented. The first column reports the absolute frequency of the barriers (Abs Freq ($H + L$)), i.e. the number of “1” and “2” detected for the particular phase (since there are 58 questionnaires, the highest possible absolute frequency for the particular phase is 58); and an “*” indicates that the barrier is detected mainly (i.e. more than 50% of the times for the whole intervention process) in that particular phase. The second column reports the relative frequency of the barriers perceived with a high intensity normalised by the absolute frequency (Rel Freq ($H/H + L$)), i.e. the number of “2”, divided by the number of “1” and “2” in that particular phase; an “*” indicates that the difference between the relative frequency of barriers in the particular phase and in the total sample is higher than 20%.

The results of this analysis tend to reinforce the analysis reported above for the whole sample. Indeed, the most frequent barriers of the different phases – marked with a (+) – are generally the same.

A comparison of the answers provided for the design, implementation and evaluation phases (see Table 5, columns 4, 5, and 6) shows that the barriers are mainly concentrated in the design

and implementation phases. This finding can be due to different causes. First, the design and the implementation of interventions are the most time and resources consuming phases. As a consequence, practitioners are mainly focused on these phases and tend to perceive barriers in these phases. Second, mistakes that may happen during the design or the implementation of an intervention are perceived only during its evaluation, while there is rarely a critical analysis of the evaluation of the intervention and of the factors fostering or hindering it. Third, it is difficult to perceive barriers to the evaluation of interventions because, as shown in the literature, there is no consensus about what is the most appropriate way of evaluating OHS interventions. The investigation of barriers to the evaluation of interventions is very complex and requires both theoretical advancements and tailored analyses.

The most frequent barriers during the design of interventions – marked with a (+) – are related to management: these barriers are: difficulty in obtaining authorizations by management (O11), management not adequately skilled (M2), lack of knowledge of the criticalities of the company by management (M3), lack of knowledge of the profitability of the interventions by management (M4). The most frequent barriers during the implementation of interventions are connected to the personnel. These barriers are: Scarce involvement of personnel in OHS activities (O2), systematically wrong behaviour of personnel (S1), lack of knowledge of the criticalities of the company by workers (S3). This result can be explained on the basis of the classical approach that considers that ‘management’ is mainly responsible for the design and that ‘personnel’ is mainly responsible for the implementation of interventions. This classical approach however is not consistent with the recommendations of recent studies (see, e.g., Øystein et al., 2003; Loisel et al., 2001) which suggest the introduction of a participatory approach for the design and the implementation of OHS interventions. Among the most frequent

Table 5
Effect of the phase on the absolute and relative frequency of barriers. For each phase, the first column reports the absolute frequency of the barriers and an “*” indicates that the barrier is detected mainly (more than 50%) in that particular phase. The second column reports the relative frequency of the barriers perceived with a high intensity and an “*” indicates that the difference between the relative frequency of barriers in the particular phase and in the total sample is relevant (higher than 20%). In each column the ten highest values are marked with a (+), while the two lowest values are marked with a (–).

Barrier	Abs Freq ($H + L$)	Rel Freq ($H/H + L$)	Design		Implementation		Evaluation	
			Abs Freq ($H + L$)	Rel Freq ($H/H + L$)	Abs Freq ($H + L$)	Rel Freq ($H/H + L$)	Abs Freq ($H + L$)	Rel Freq ($H/H + L$)
G1 – stringent legal requirements	81 ⁽⁺⁾	58% ⁽⁺⁾	42 ^{(+)*}	62% ⁽⁺⁾	27 ⁽⁺⁾	52% ⁽⁺⁾	12 ⁽⁺⁾	58% ⁽⁺⁾
G2 – bureaucracy	77 ⁽⁺⁾	58% ⁽⁺⁾	32 ⁽⁺⁾	50% ⁽⁺⁾	28 ⁽⁺⁾	75% ⁽⁺⁾	17 ⁽⁺⁾	47% ⁽⁺⁾
R1 – lack of technical support by control authorities	58 ⁽⁺⁾	43% ⁽⁺⁾	32 ^{(+)*}	44% ⁽⁺⁾	18	44% ⁽⁺⁾	8	38%
R2 – behaviour of trade unions	19 ^(–)	53% ⁽⁺⁾	8 ^(–)	50% ⁽⁺⁾	8	50% ⁽⁺⁾	3 ^(–)	67% ⁽⁺⁾
R3 – difficulties in the interaction with external agencies	46	26%	18	33%	23	17%	5	40%
R4 – lack of guidelines	61 ⁽⁺⁾	46% ⁽⁺⁾	30 ⁽⁺⁾	43% ⁽⁺⁾	18	50% ⁽⁺⁾	13 ⁽⁺⁾	46% ⁽⁺⁾
I1 – lack of technical support by consultants	43	51% ⁽⁺⁾	20	45% ⁽⁺⁾	14	50% ⁽⁺⁾	9	67% ⁽⁺⁾
M1 – systematically wrong behaviour of management	37	46% ⁽⁺⁾	14	43% ⁽⁺⁾	17	47% ⁽⁺⁾	6	50% ⁽⁺⁾
M2 – management not adequately skilled	49	41% ⁽⁺⁾	32 ^{(+)*}	47% ⁽⁺⁾	12	33%	5	20%*
M3 – lack of knowledge of the criticalities of the company by mgmt.	31	29%	18*	39%	9	22%	4	0% ^{(–)*}
M4 – lack of knowledge of the profitability of the interv. by mgmt.	35	23%	19*	21%	7 ^(–)	14%	9	33%
S1 – systematically wrong behaviour of personnel	52	31%	5 ^(–)	40%	34 ^{(+)*}	29%	13 ⁽⁺⁾	31%
S2 – personnel not adequately skilled	53	30%	18	50% ⁽⁺⁾	23	22%	12 ⁽⁺⁾	17%
S3 – lack of knowledge of the criticalities of the company by workers	45	13% ^(–)	12	8% ^(–)	25 ^{(+)*}	20%	8	0% ^(–)
S4 – lack of awareness of OHS relevance by workers	54 ⁽⁺⁾	33%	20	25%	21	43%	13 ⁽⁺⁾	31%
O1 – inadequate OHS policy	20 ^(–)	15% ^(–)	9	22%	5 ^(–)	0% ^(–)	6	17%
O2 – scarce involvement of personnel in OHS activities	52	21%	12	42%*	33 ^{(+)*}	12%	7	29%
O3 – lack of time	76 ⁽⁺⁾	46% ⁽⁺⁾	25 ⁽⁺⁾	20% ^{(–)*}	35 ⁽⁺⁾	46% ⁽⁺⁾	16 ⁽⁺⁾	88% ^{(+)*}
O4 – lack of economic resources	68 ⁽⁺⁾	59% ⁽⁺⁾	28 ⁽⁺⁾	43% ⁽⁺⁾	30 ⁽⁺⁾	67% ⁽⁺⁾	10	80% ^{(+)*}
O5 – inadequacy of the organization	51	27%	22 ⁽⁺⁾	27%	20	30%	9	22%
O6 – absent or ineffective communication	61 ⁽⁺⁾	36%	21 ⁽⁺⁾	38%	29 ⁽⁺⁾	34%	11 ⁽⁺⁾	36%
O7 – absent or ineffective information	54 ⁽⁺⁾	41%	17	53% ⁽⁺⁾	24	33%	13 ⁽⁺⁾	38%
O8 – prioritization of production over safety	54 ⁽⁺⁾	26%	12	42%	35 ^{(+)*}	23%	7	14%
O9 – difficulty in planning the OHS activities	49	33%	18	33%	25 ^{(+)*}	28%	6	50% ⁽⁺⁾
O10 – difficulty in obtaining authorizations by management	36	31%	21 ^{(+)*}	33%	13	31%	2 ^(–)	0% ^{(–)*}
T1 – lack of technical resources	49	37%	19	32%	27 ^{(+)*}	44% ⁽⁺⁾	3 ^(–)	0% ^{(–)*}
T2 – absent or ineffective information collection system	50	30%	23 ⁽⁺⁾	30%	9	0% ^{(–)*}	18 ⁽⁺⁾	44% ⁽⁺⁾

Table 6

Effect of the size on the absolute (normalised) and relative frequency of barriers. For each company size, the first column reports the absolute frequency of the barriers, normalised by the number of enterprises in that dimensional class in the sample; an “*” indicates that the frequency of the barrier has a great variation (i.e. higher than 50%) with respect to the correspondent value detected for the total sample. The second column reports the relative frequency of the barriers perceived with a high intensity and an “*” indicates that the difference between the relative frequency of barriers in the particular dimensional class and in the total sample is particularly high (more than 20%). In each column the ten highest values are marked with a (+), while the two lowest values are marked with a (-).

Barrier	Abs Freq (H + L)	Norm Abs Freq (H + L)	Rel Freq (H/H + L)	Micro		Small		Small medium		Medium large	
				Norm Abs Freq (H + L)	Rel Freq (H/H + L)	Norm Abs Freq (H + L)	Rel Freq (H/H + L)	Norm Abs Freq (H + L)	Rel Freq (H/H + L)	Norm Abs Freq (H + L)	Rel Freq (H/H + L)
G1 – stringent legal requirements	81 ⁽⁺⁾	47% ⁽⁺⁾	58% ⁽⁺⁾	42% ⁽⁺⁾	20%	51% ⁽⁺⁾	72% ⁽⁺⁾	51% ⁽⁺⁾	62% ⁽⁺⁾	36% ⁽⁺⁾	33%
G2 – bureaucracy	77 ⁽⁺⁾	44% ⁽⁺⁾	58% ⁽⁺⁾	25% ⁽⁺⁾	33% ⁽⁺⁾	52% ⁽⁺⁾	70% ⁽⁺⁾	49% ⁽⁺⁾	57% ⁽⁺⁾	31%	38%
R1 – lack technical supp control a.	58 ⁽⁺⁾	33% ⁽⁺⁾	43% ⁽⁺⁾	25% ⁽⁺⁾	0% ⁽⁻⁾	32% ⁽⁺⁾	40%	46% ⁽⁺⁾	58% ⁽⁺⁾	21%	22%
R2 – behaviour of trade unions	19 ⁽⁻⁾	11% ⁽⁻⁾	53% ⁽⁺⁾	25% ⁽⁺⁾	0% ⁽⁻⁾	2% ⁽⁻⁾	0% ⁽⁻⁾	14% ⁽⁻⁾	38%	17% ⁽⁻⁾	100% ⁽⁺⁾
R3 – diff. interaction ext. agencies	46	26%	26%	25% ⁽⁺⁾	0% ⁽⁻⁾	30% ⁽⁺⁾	47% ⁽⁺⁾	26%	20%	21%	0% ⁽⁻⁾
R4 – lack of guidelines	61 ⁽⁺⁾	35% ⁽⁺⁾	46% ⁽⁺⁾	33% ⁽⁺⁾	0% ⁽⁻⁾	25%	75% ⁽⁺⁾	39% ⁽⁺⁾	36%	45% ⁽⁺⁾	42% ⁽⁺⁾
I1 – lack of tech. sup. by consultants	43	25%	51% ⁽⁺⁾	33% ⁽⁺⁾	0% ⁽⁻⁾	25%	75% ⁽⁺⁾	18%	20%	31%	62% ⁽⁺⁾
M1 – syst. wrong behaviour of mgmt.	37	21%	46% ⁽⁺⁾	8% ⁽⁻⁾	0% ⁽⁻⁾	17%	36%	23%	46% ⁽⁺⁾	29%	58% ⁽⁺⁾
M2 – mgmt not adequately skilled	49	28%	41% ⁽⁺⁾	17%	50% ⁽⁺⁾	29% ⁽⁺⁾	61% ⁽⁺⁾	26%	33%	33% ⁽⁺⁾	21%
M3 – lack of know. critical. by mgmt.	31	18%	29%	17%	0% ⁽⁻⁾	14%	33%	19%	27%	21%	33%
M4 – lack of knowl. profit. by mgmt.	35	20%	23%	33% ⁽⁺⁾	0% ⁽⁻⁾	16%	40%	23%	15%	19%	25%
S1 – syst. wrong behaviour of p.	52	30%	31%	25% ⁽⁺⁾	33% ⁽⁺⁾	29% ⁽⁺⁾	28%	30%	47% ⁽⁺⁾	33% ⁽⁺⁾	14%
S2 – personnel not adequately skilled	53	30%	30%	17%	50% ⁽⁺⁾	21%	38%	42% ⁽⁺⁾	33%	33% ⁽⁺⁾	14%
S3 – Lack of know. critical. by w.	45	26%	13% ⁽⁻⁾	17%	0% ⁽⁻⁾	21%	15%	30%	12%	31%	15%
S4 – lack of awar. of OHS relevance	54 ⁽⁺⁾	31% ⁽⁺⁾	33%	25% ⁽⁺⁾	0% ⁽⁻⁾	22%	29%	39% ⁽⁺⁾	32%	36% ⁽⁺⁾	47% ⁽⁺⁾
O1 – inadequate OHS policy	20 ⁽⁻⁾	11% ⁽⁻⁾	15% ⁽⁻⁾	25% ⁽⁺⁾	67% ⁽⁺⁾	10% ⁽⁻⁾	0% ⁽⁻⁾	12% ⁽⁻⁾	14%	10% ⁽⁻⁾	0% ⁽⁻⁾
O2 – scarce inv. of pers. in OHS act.	52	30%	21%	33% ⁽⁺⁾	75% ⁽⁺⁾	24%	27%	33%	11% ⁽⁻⁾	33% ⁽⁺⁾	14%
O3 – lack of time	76 ⁽⁺⁾	44% ⁽⁺⁾	46% ⁽⁺⁾	33% ⁽⁺⁾	0% ⁽⁻⁾	37% ⁽⁺⁾	43%	40% ⁽⁺⁾	52% ⁽⁺⁾	62% ⁽⁺⁾	50% ⁽⁺⁾
O4 – lack of economic resources	68 ⁽⁺⁾	39% ⁽⁺⁾	59% ⁽⁺⁾	25% ⁽⁺⁾	33% ⁽⁺⁾	35% ⁽⁺⁾	68% ⁽⁺⁾	42% ⁽⁺⁾	50% ⁽⁺⁾	45% ⁽⁺⁾	63% ⁽⁺⁾
O5 – inadequacy of the organization	51	29%	27%	67% ⁽⁺⁾	38% ⁽⁺⁾	21%	46% ⁽⁺⁾	32%	6% ⁽⁻⁾	29%	33%
O6 – absent or ineffective comm.	61 ⁽⁺⁾	35% ⁽⁺⁾	36%	17%*	50% ⁽⁺⁾	29% ⁽⁺⁾	17%	37% ⁽⁺⁾	43% ⁽⁺⁾	48% ⁽⁺⁾	45% ⁽⁺⁾
O7 – absent or ineffective information	54 ⁽⁺⁾	31% ⁽⁺⁾	41%	17%	50% ⁽⁺⁾	24%	47% ⁽⁺⁾	35%	45% ⁽⁺⁾	40% ⁽⁺⁾	29%
O8 – prioritization of production	54 ⁽⁺⁾	31% ⁽⁺⁾	26%	25% ⁽⁺⁾	0% ⁽⁻⁾	29% ⁽⁺⁾	17%	35%	40% ⁽⁺⁾	31%	23%
O9 – diff. in planning the OHS act.	49	28%	33%	8% ⁽⁻⁾	0% ⁽⁻⁾	24%	40%	26%	27%	43% ⁽⁺⁾	33%
O10 – diff. in obt. Auth. by mgmt.	36	21%	31%	8% ⁽⁻⁾	0% ⁽⁻⁾	16%	30%	25%	21%	26%	45% ⁽⁺⁾
T1 – lack of technical resources	49	28%	37%	17%	50% ⁽⁺⁾	27%	24%	26%	40% ⁽⁺⁾	36% ⁽⁺⁾	47% ⁽⁺⁾
T2 – absent or ineff. Inf. system	50	29%	30%	17%	50% ⁽⁺⁾	22%	50% ⁽⁺⁾	39% ⁽⁺⁾	23%	29%	17%

Table 7
Effect of the sector on the absolute (normalised) and relative frequency of barriers. For each sector (i.e., C22 – rubber and plastic products; C 25 – metal products excluding machinery and equipment; Other - Other sectors), the first column reports the absolute frequency of the barriers, normalised by the number of enterprises of a given sector in the sample; an “+” indicates that the frequency of the barrier has a great variation (i.e. higher than 50%) with respect to the correspondent value detected for the total sample. The second column reports the relative frequency of the barriers perceived with a high intensity and an “*” indicates that the difference between the relative frequency of barriers in the particular sector and in the total sample is particularly high (more than 20%). In each column the 10 highest values are marked with a (+), while the 2 lowest values are marked with a (-).

Barrier	Abs Freq (H + L)	Norm Abs Freq (H + L)	Rel Freq (H/H + L)	C 22		C 25		Other	
				Norm Abs Freq (H + L)	Rel Freq (H/H + L)	Norm Abs Freq (H + L)	Rel Freq (H/H + L)	Norm Abs Freq (H + L)	Rel Freq (H/H + L)
G1 – stringent legal requirements	81 ⁽⁺⁾	47% ⁽⁺⁾	58% ⁽⁺⁾	76% ^{(+)*}	56% ⁽⁺⁾	38% ⁽⁺⁾	41% ⁽⁺⁾	41% ⁽⁺⁾	67% ⁽⁺⁾
G2 – bureaucracy	77 ⁽⁺⁾	44% ⁽⁺⁾	58% ⁽⁺⁾	55% ⁽⁺⁾	50% ⁽⁺⁾	38% ⁽⁺⁾	41% ⁽⁺⁾	44% ⁽⁺⁾	69% ⁽⁺⁾
R1 – lack of technical support by control authorities	58 ⁽⁺⁾	33% ⁽⁺⁾	43% ⁽⁺⁾	48%	44% ⁽⁺⁾	33% ⁽⁺⁾	40% ⁽⁺⁾	28% ⁽⁺⁾	44% ⁽⁺⁾
R2 – behaviour of trade unions	19 ⁽⁻⁾	11% ⁽⁻⁾	53% ⁽⁺⁾	12% ⁽⁻⁾	25%*	20%*	78% ^{(+)*}	6% ⁽⁻⁾	33%
R3 – difficulties in the interaction with external agencies	46	26%	26%	39%	15%	24%	36%	23%	27%
R4 – lack of guidelines	61 ⁽⁺⁾	35% ⁽⁺⁾	46% ⁽⁺⁾	64% ^{(+)*}	33%	33% ⁽⁺⁾	47% ⁽⁺⁾	26%	56% ⁽⁺⁾
I1 – lack of technical support by consultants	43	25%	51% ⁽⁺⁾	45%*	40% ⁽⁺⁾	16%	57% ⁽⁺⁾	22%	57% ⁽⁺⁾
M1 – systematically wrong behaviour of management	37	21%	46% ⁽⁺⁾	39%*	62% ⁽⁺⁾	20%	22%*	16%	47% ⁽⁺⁾
M2 – management not adequately skilled	49	28%	41% ⁽⁺⁾	48%*	31%	22%	20%*	24%	57% ⁽⁺⁾
M3 – lack of know. of the critical. by mgmt.	31	18%	29%	39%*	23%	11% ⁽⁻⁾	20%	14%	38%
M4 – Lack of know. of the profit. of the interv. by mgmt.	35	20%	23%	30%*	40% ⁽⁺⁾	13%	33%	20%	11% ⁽⁻⁾
S1 – Systematically wrong behaviour of personnel	52	30%	31%	42%	57% ^{(+)*}	27% ⁽⁺⁾	33%	27% ⁽⁺⁾	15%
S2 – Personnel not adequately skilled	53	30%	30%	52% ^{(+)*}	41% ⁽⁺⁾	33% ⁽⁺⁾	7% ^{(-)*}	22%	38%
S3 – lack of know. of the critical. by workers	45	26%	13% ⁽⁻⁾	42%*	14%	20%	11%	23%	14% ⁽⁻⁾
S4 – lack of awareness of OHS relevance by workers	54 ⁽⁺⁾	31% ⁽⁺⁾	33%	58% ^{(+)*}	32%	22%	20%	26%	40%
O1 – inadequate OHS policy	20 ⁽⁻⁾	11% ⁽⁻⁾	15% ⁽⁻⁾	18% ^{(-)*}	0% ⁽⁻⁾	11% ⁽⁻⁾	0% ⁽⁻⁾	9% ⁽⁻⁾	33%
O2 – scarce involvement of personnel in OHS activities	52	30%	21%	33%	9%	29% ⁽⁺⁾	31%	29% ⁽⁺⁾	21%
O3 – lack of time	76 ⁽⁺⁾	44% ⁽⁺⁾	46% ⁽⁺⁾	70% ^{(+)*}	48% ⁽⁺⁾	27% ⁽⁺⁾	67% ^{(+)*}	43% ⁽⁺⁾	39%
O4 – lack of economic resources	68 ⁽⁺⁾	39% ⁽⁺⁾	59% ⁽⁺⁾	45%	27%*	42% ⁽⁺⁾	53% ⁽⁺⁾	35% ⁽⁺⁾	76% ⁽⁺⁾
O5 – inadequacy of the organization	51	29%	27%	42%	0% ^{(-)*}	22%	30%	28% ⁽⁺⁾	41% ⁽⁺⁾
O6 – absent or ineffective communication	61 ⁽⁺⁾	35% ⁽⁺⁾	36%	48%	50% ⁽⁺⁾	33% ⁽⁺⁾	33%	31% ⁽⁺⁾	30%
O7 – absent or ineffective information	54 ⁽⁺⁾	31% ⁽⁺⁾	41%	52% ^{(+)*}	41% ⁽⁺⁾	24%	27%	27% ⁽⁺⁾	46% ⁽⁺⁾
O8 – prioritization of production over safety	54 ⁽⁺⁾	31% ⁽⁺⁾	26%	58% ^{(+)*}	26%	22%	30%	26%	24%
O9 – difficulty in planning the OHS activities	49	28%	33%	52% ^{(+)*}	35%	24%	64% ^{(+)*}	22%	14%
O10 – difficulty in obtaining authorizations by mgmt.	36	21%	31%	27%	22%	18%	25%	20%	37%
T1 – lack of technical resources	49	28%	37%	42%*	21%	18%	75% ^{(+)*}	28% ⁽⁺⁾	33%
T2 – Absent or ineffective information collection system	50	29%	30%	52% ^{(+)*}	18%	29% ⁽⁺⁾	31%	21%	40%

barriers during the design of interventions, there are also the barriers related to the lack of guidelines, such as: lack of technical support by control authorities (R1), lack of technical support by consultants (I1), and lack of guidelines (R4). This result confirms previous studies in the literature (Swuste et al., 2003), that underlined how SMEs are often unable to properly design OHS interventions. Among the most frequent barriers during the implementation of interventions, there are also barriers related to lack of resources. i.e. lack of technical resources (O16) and lack of time (O17). This result can be understood considering that the resources are mainly used during the implementation of the interventions. It is interesting to notice that lack of time or lack of technical resources are rarely perceived during the design of intervention; this result indicates that few resources are employed for the design of OHS interventions. During the evaluation of interventions the barriers related to the lack of economic resources (O13) and to the Lack of time (O17) are perceived with high frequencies. This

finding indicates that in several cases SMEs' practitioners are aware of the importance of evaluating OHS interventions; however they do not have the resources or the time for conducting such an evaluation. The barriers related to the prioritization of production over safety (O8) and to the difficulty in planning the OHS activities (O10) are mainly perceived during the implementation of interventions. This result indicates that during the design of interventions the task of prioritizing OHS interventions and of matching them with the needs of the production is seldom properly considered. As a consequence, all the difficulties are perceived when the interventions are implemented and all the constraints imposed by the production needs emerge.

4.3. Effect of the firm's size

The effect of the firm's size on the frequency of barriers is presented in Table 6. The idea of the following analysis is to help to

understand which barriers hinder more frequently and with more intensity the OHS interventions, in relation to the size of firm. The companies in the sample have been grouped into four classes:

Micro- (MiEs, employees ≤ 10), the Small- (SEs, $10 < \text{employees} \leq 50$), Medium (MEs, $50 < \text{employees} \leq 99$), and Medium-Large Enterprises (MLEs; $100 < \text{employees} \leq 250$). For each dimensional class, two columns are presented. The first column reports the frequency of the barriers (Abs Freq ($H + L$)) detected for the particular dimensional class. Since the sample is not homogeneous, to make it comparable, it was normalised with the number of enterprises in that particular dimensional class. The value used for the normalization of the absolute frequency is 12 ($4 * 3$) for MiEs, 63 ($21 * 3$) for SEs, 57 ($19 * 3$) for MEs, and 42 ($14 * 3$) for MLEs. An “*” indicates that the frequency of the barrier has a great variation (i.e. higher than 50%) with respect to the corresponding value detected for the total sample. The second column reports the relative frequency of barriers perceived with a high intensity normalised by the absolute frequency of barriers with intensity both high and low (Rel Freq ($H/H + L$)) in that dimensional class. An “*” indicates that the difference between the relative frequency of barriers for the particular dimensional class and in the total sample is higher than 20%. The relative frequency of the barriers detected for the total sample has been reported in the third column, in order to make comparisons clearer.

There are no meaningful differences between this analysis and that for the whole sample. Indeed, the most frequent barriers in the different dimensional classes – marked with a (+) – are generally the same as for the whole sample. In describing the effect of the size on the frequency of the barriers, we observe that the frequency of barriers grows – on average – with the size from micro enterprises to small enterprises, and then it decreases from Small to Medium-Large Enterprises. This can be explained considering three different factors: the awareness of practitioners, the scale effect of resources allocated to OHS, and the scale effect related to organizational complexity.

Because of the awareness of practitioners, the number of perceived barriers increases with the size of the enterprise. Indeed, the more a practitioner is aware of safety issues, the more barriers are perceived. The awareness of practitioners, in turn, increases with the size of the company. For example, the owner of a small enterprise often takes on the role of the ‘safety officer’, but still may not be aware of the OHS issues the staff face. When the size of the enterprise increases, there is likely a staff member that takes on the role of a ‘dedicated safety officer’ with a better knowledge of OHS challenges. Because of the scale effect of resources allocated to OHS, the number of perceived barriers decreases with the size of the company. Indeed, the amount of technical, human and economic resources allocated to OHS increases with the size of the company. The more resources that are allocated to OHS, the more barriers to OHS interventions will be eliminated. Because of the scale effect related to organizational complexity, the number of perceived barriers increases with the size of the company. Indeed, organizational complexity generally increases with size of the company. The more complex the organization, the more barriers to OHS will arise. Complex work organization introduces, for instance, barriers and difficulties related to more complex planning and control activities. In summary, the number of perceived barriers increases with the size of the company because of the awareness of practitioners and because of the scale effect related to organizational complexity, while it decreases with the size of the company because of the scale effect of resources allocated to OHS. These three effects have to be combined and the results seem to suggest that the worst condition is for small enterprises. It is possible to hypothesize that in small enterprises the number of perceived barriers increases because of the awareness of practitioners and because of the scale effect related to the organizational

complexity, but the scale effect of resources allocated to OHS is not able to compensate for the more complex organization, as happens for Medium-Large enterprises.

The relative frequency of barriers with a high intensity is particularly low for micro enterprises. This result can be explained by taking into account the awareness of practitioners and the scale effect related to organizational complexity previously described. It is possible to consider for instance the barriers related to lack of support (R1 and I1) and to lack of knowledge (M3, S3 and M4): if in a micro enterprise the knowledge and the awareness of practitioners is lower, on the other hand the need of knowledge is also lower with respect to a larger enterprise because of the lower complexity of the activities, and the relevance of the barrier is consequently lower.

Barriers such as lack of time (O17) or lack of economic resources (O13) seem to be common to all the sizes of companies. Instead, barriers related to the bureaucracy (G2) and to stringent legal requirements (G1) are mainly perceived in small enterprises and in medium small enterprises. In micro enterprises this result can be explained considering how some legal requirements are simplified, while in medium small enterprises legal requirements could be less perceived because the OHS policy could be more independent from legal requirements. When the size of company increases, the barriers associated with a more complex organization also increase. One of these barriers is, for instance, the difficulty in planning the OHS activities (O10) which is perceived with a relatively high frequency in Medium-Large Enterprises, since the perception of this barriers assumes that the company plans OHS activities, and so that the company is advanced from the point of view of the management of safety.

4.4. Effect of the sector

The effect of sector on the frequency of barriers is presented in Table 7. This analysis aims at understanding the frequency and the intensity of barriers to OHS interventions in different industry sectors.

The companies of the sample have been grouped into 3 clusters, considering the composition of the sample: C22 (rubber and plastic products), C25 (metal products, excluding machinery and equipment), and other sectors. For each sector, two columns are presented. The first column reports the frequency of the barriers (Norm Abs Freq ($H + L$)) detected for the particular sector. Since the sample is not homogeneous, to make it comparable, it was normalised with the number of enterprises in that particular sector. The value used for the normalization of the relative frequency is 33 ($11 * 3$) for C22, 45 ($15 * 3$) for C25, and 96 ($32 * 3$) for other sectors. An “*” indicates that the frequency of the barrier has a great variation (i.e. higher than 50%) with respect to the corresponding value detected for the total sample. The second column reports the relative frequency of barriers perceived with a high intensity normalised by the absolute frequency of barriers with intensity both high and low (Rel Freq ($H/H + L$)) in that sector. An “*” indicates that the difference between the relative frequency of barriers for the particular dimensional class and in the total sample is higher than 20%. The relative frequency of the barriers detected in the total sample has been reported in the third column, in order to easily compare these values with the ones detected in the different sectors.

The analysis found no meaningful differences among frequencies if we consider the industry sector of companies, apart from some isolated cases. The barrier related to behaviour of trade unions (R2) is mainly perceived in sector C25, relative to the manufacturing of metal products. This result suggests that the unionization rate is high in this sector and that there is a relatively high conflict between unions and managers. The frequencies of barriers

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