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The cultural-historical development of occupational accidents and diseases prevention in France: A scoping review

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ABSTRACT

This article aims to trace some of the key trends in the historical development of Occupational Accident and Disease Prevention in France. For this purpose, we have used the analytical concept of contradiction derived from the Cultural-Historical Activity Theory framework (CHAT). We consider prevention as a fragmented object shared by a network of Activity Systems (AS).

We conduct a scoping review to identify contradiction hypotheses on how the French activity system of prevention of occupational accidents and diseases have evolved over time. This review includes 72 theoretical and empirical studies published between 1988 and 2019. The results obtained highlight five contradiction hypotheses related to (i) prevention and remediation, (ii) technological and occupational risks, (iii) employment and improvement of working conditions, (iv) workers' participation or social dialogue and expertise, (v) individual and collective approaches. These contradictions have arisen over time and have emerged as symptoms of incompatibilities in the network of AS that have persisted. The paper ends with a discussion on future prospects and learning challenges for prevention.

1. Background

The complexity of production systems and their necessary adaptation to technological, social, and economic changes contribute to important development in labour organisations (Dias and Lima, 2014). The pace of these changes is increasing (Launis and Gerlander, 2005), and their very nature affects occupational health and safety at the workplace (Launis and Pihlaja, 2007) as much as Occupational Accidents and Diseases Prevention activity (OADP). The implementation and development of OADP relies on the creation and transformation of dedicated institutions whose effectiveness is challenged by current changes in production systems.

This article provides an overview of some major trends in the historical development of the system of OADP in France, based on a scoping review. In this context, the French system of OADP is studied as a network of activity systems sharing an object that is the prevention of occupational accidents and diseases.

We conduct a scoping review to provide information about the development over time of the French activity system of OADP. The aim is to identify hypotheses of contradictions and their manifestations overtime so as to map development trends using the framework of

Cultural-Historical Activity Theory (CHAT). From a corpus of 72 selected documents, we propose an inductive analysis (i) to identify hypotheses of the historical and systemic contradictions of the prevention object, (ii) to study the dialectical relationships between the stakeholders involved, and (iii) to understand the root causes of the problems that hinder the development of OADP. The target is therefore not to propose an exhaustive description of the stakeholders involved in prevention or their interactions, nor an exhaustive description of the legislative arsenal and jurisprudence. In this article, we consider that prevention is a culturally and historically situated object with a polyphonic character, simultaneously technical, political, economic, and social.

CHAT shares an interest in social changes with other approaches, which enables a dialogue and sometimes an articulation of theoretical frameworks with distinct origins. For example, Archer (1995) proposes a methodology for understanding social and cultural change, based on a framework inspired by critical realism. He aims to examine the activities of agents and their effects on social and cultural structures that can either reproduce or transform these structures.

In the field of occupational health and safety, Uhrenholdt Madsen and Boch Waldorff (2019) showed how several institutional rationales

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co-exist in the field of the work environment, and how these rationales are enacted within companies in Denmark. Their work is based on Archer's (1995) critical realism, and adopts a historical and qualitative-actual approach. In France, these results seem to be confirmed by Deaudigeos et al. (2018) who identified, from a lexical analysis, six institutional rationales as well as periods where each of these rationales are dominant. However, their analysis does not allow them to understand the reasons for these dominant changes. Swuste et al. (2010) showed the emergence and stability of two hypotheses regarding the causes of accidents in the literature, i.e., individual causes related to improper behaviour by workers or environmental and organisational causes. Similarly, Swuste et al. (2014) reported on the production and application of occupational health theories in the Netherlands, the United States and Great Britain. Concerning France, Daudigeos et al. (2016) identified three periods corresponding to changes in a given regime, i.e., in the relations between three previously defined control apparatus (i.e., legal apparatus, disciplinary apparatus and apparatus of security). Their intention was to study the interactions between the mechanisms within each regime, rather than the development from one regime to another (p.18).

Taken together, these historical perspectives focus more on the stability of systems, ideas, and institutional rationales or on the identification of periods in dominant institutional rationales, but pay little attention to the qualitative changes and forces that lead to these changes within prevention systems. The originality of our work consists, through the concept of contradiction and the CHAT theory, in seeking to identify plausible hypotheses for such driving forces in the development of occupational accidents and diseases prevention in France.

The central assumption of this paper is that understanding the past can provide information on future developments if we seek to consider the contradictions that set activity systems in motion. While Archer's approach and CHAT share the themes of dialectical change in a social reality, the CHAT framework focuses more on the role of artifact mediation in activity. Using the concept of an activity system (AS) -that we develop below- is furthermore antinomian to Archer's analytical approach in that it avoids analytically separating systems from activity (Allen et al., 2013). Finally, through the concept of contradiction, CHAT focuses on the forces of development and transformation of an AS more than on the forces of stabilisation of that system.

In this context, this article is of interest beyond the French context since it seeks to understand the driving forces behind the development of prevention systems that we analyse with the concept of contradictions: historical inherited tensions inside or between AS. Several recent studies in this field show the relevance of this theoretical orientation, shedding light on the historical transformations of an AS or a network of AS. For example, Adamides (2020) uses CHAT and the concept of contradiction to explain the genesis of changes in the food production system in the United States of America. O'Donoghue and Harford (2020) draw on CHAT to account for major changes in education at the local, national, and international levels. These first two perspectives offer a detailed and historical overview of the development of a system by seeking to explain the transformations under the prism of the concept of contradiction. Ivaldi et al. (2022) seek to account for the development of the concept of co-working. They showed in their article various ways of development that cannot be reduced to unitary phases. In this article, we follow this approach and seek to identify hypotheses of contradictions inherited within the OADP activity systems network. Finally, in the field of prevention and by pursuing a strategy similar to ours, Hurtado et al. (2022) seek to account for historical contradictions and possible developments in occupational health policies in Brazil. Therefore, CHAT theoretical framework seeks to understand, by identifying past and present contradictions hypotheses, the future developments of AS. We present below this theory, the role of history in the development of AS and the concept of contradiction as driving forces behind the qualitative transformation of one or several linked AS.

1.1. Cultural-historical activity theory (CHAT)

Initiated at the beginning of the 20th century by Russian psychologists (Leontiev, 1974; Vygotsky, 1978) and extended by the theory of expansive learning developed by Engeström in the late 1980s, CHAT is today a multidisciplinary framework (Blunden, 2010) focused on the analysis of work, work organisations, and technology (Kaptelinin and Nardi, 2006). As a dialectical theoretical framework, CHAT makes it possible to grasp changes and developmental trajectories of one or several interacting AS. It also enables us to transcend the dichotomy between the micro-level processes and the macro-level structures (Engeström, 2000). As discussed in this article, by capturing the movements in a network of AS, the CHAT framework is useful to enlighten hypotheses of contradictions inside or between AS in the OADP network. The concept of contradiction is therefore central to understand the historical development of AS.

AS is defined as a durable, collective, historical, and systemic process that is object oriented. CHAT distinguishes between objects and goals and between activities and actions (Engeström, 1987). The goals are finite while the object is continuously reproduced by sets of actions performed by their subjects, evolves and is endless. While the actions are carried out over a short time, the activity evolves over a long time. An AS can be represented by seven elements that form a complex mediation system (Fig. 1). In the model of an AS, the subject represents an individual, a collective or an organisation. The object represents the problem space that is converted into results by means of instruments. The rules constitute the cultural norms or rules governing the AS. The community represents the various stakeholders who are involved in the activity. Finally, the division of labour defines individual responsibilities within the AS.

To describe what an AS is, we give below an example from Adamides (2020) (Table 1). He describes the socio-technical system of food as two interrelated activity systems: the food production system, and the food consumption system. The table below summarizes the definitions of the main elements of an activity system and gives examples for each of these elements adapted from the paper of Adamides (ibid.).

An AS does not exist in a vacuum (Roth, 2001), but interacts with other AS. As an example, the effective implementation of OADP is distributed over several AS that interact with another within a network: some AS produce other AS tools, rules, division of labour, etc. Therefore, the third generation of CHAT takes the interaction between multiple AS considered as the main unit of analysis:

"In activity theory, a collective activity system mediated by artifacts, viewed within its network of other activity systems, is taken as the main unit of analysis. Individual and collective goal-oriented actions and groups of actions, as well as automatic operations, are relatively independent but are subordinate units which must ultimately be interpreted in the context of the whole activity system" (Engeström, 2018, p. 14).

In the third generation of CHAT, the minimal unit of analysis can be represented by two AS that partially share an object (Fig. 2).

Mapping the historical development of the French OADP system within the CHAT framework implies identifying the qualitative changes within the AS involved as well as reconstructing the history of the relationships between the various AS involved, their emergence and sometimes disappearance. However, viewed from this angle, the narrative remains descriptive. The key concept that explains qualitative transformations within or between AS is contradiction.

1.2. Contradictions as drivers of the historical development of activity systems (AS)

Contradictions are historical inherited tensions inside or between AS. One important relevant aspect of CHAT is that it conceptualises contradictions as driving forces in the development of AS because their

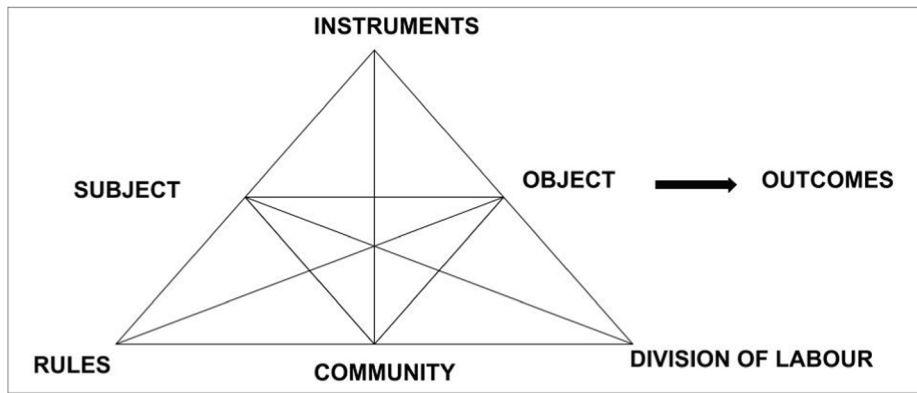


Fig. 1. Triangle model of one activity system adapted from Engeström (1987).

Table 1
Definitions of the main elements of an activity system and examples in the field of food production and consumption, according to Adamides (2020, p.6).

Key element of the activity system	Definition	Example for the food production system	Example for the food consumption system
Subject	The individual, groups of individuals, organizations involved in the activity	Food industry	Consumers families with working women
Object	The object is the problem space to be transformed by the activity	Provide food for convenience / Make profit	Meal and convenience and speed
Instruments	The mediating means through which the activity is carried out	Processing natural ingredients with technology	Process food for easy cooking
Rules	Cultural norms, explicit and implicit norms that governed the activity	Increased regulation for processed food	Meals that needs little time to be prepared
Community	Includes all people that have interest in the object and are involved in the activity	Providers of processing technology, marketers, supermarkets.	Grocers, children, specialist, journalists, maker of cooking equipment, supermarket
Division of labour	How is the horizontal and vertical division of labor carried out?	Producers produce Groceries and supermarkets display and sell Consumers buy Government regulates	Families cook Men and woman work to provide money for food Grocers and supermarket provide food

resolution involves expansive learning and the redesign of the entire AS (Engeström, 1987).

The concept of contradictions is fundamental because it allows to understand why qualitative and systemic changes take place within an AS. These qualitative and systemic changes (i.e., the development of the system) can be understood as collective efforts to resolve and overcome historically accumulated contradictions within an AS.

Taking into account the importance of contradictions as an explanation for the development of AS implies, for the purpose of analysis, considering both the contradictions accumulated within a system and the transformative processes from which the contradictions are resolved.

A cultural-historical analysis is the way to approach contradictions that have arisen over time by accessing their manifestations that are culturally and historically rooted (Sannino and Engestrom, 2018). Contradictions cannot be conceived as problems or conflicts in everyday activities, but instead represent systemic and structural tensions that lead to these everyday problems and tensions. They are historical and systemic phenomena in an AS network from which disruptions, disorders, anomalies, and unexpected outcomes originate. Contradictions within and between AS may take various forms over time and may be embedded in various activities. Such “symptoms” appear as forms of incompatibility between the polarities of an AS (for example, rules and instruments) or between AS. These perceptible “symptoms” are the visible manifestations from which contradictions can be inferred due to their dialectical constitution (Ivaldi and Scaratti, 2020).

In this paper, we will focus on hypotheses of contradictions for the French OADP system. In this sense, we seek to account for the driving forces behind the historical development of this system.

2. Method

Scoping reviews are an emerging method for mapping broad topics, identifying trends in scientific areas and defining the scope of scientific literature on a given topic (Munn et al., 2018; Pham et al., 2014; Rumrill, et al., 2010). This tool is relevant for, beyond historical developments, seeking to account for the hypotheses of contradictions and the rationales historical development of French networks of OADP. It enables the mapping of OADP activity across a broad range of disciplines, contexts and occupational health or safety issues.

The methodology for this scoping review was based on the framework proposed by Arksey and O’Malley (2005) and follows the recommendation of improvements of Daudt, et al. (2013) and Pham et al. (2014). The review included the following five key steps: (1) identifying the objective for research; (2) identifying relevant studies; (3) studying selection criteria; (4) charting the data; and (5) collating, summarising, and reporting the results. A detailed review protocol can be obtained from the corresponding author upon request.

2.1. Research objective

In an activity-based analysis of socio-technical changes, one key research question consists in identifying historical contradictions (Adamides, op.cit.) since contradictions, as structural tensions, trigger processes of resolution manifested as qualitative change in the elements of AS. This article therefore addresses the main contradictions hypotheses that drive the historical development of prevention activity in France.

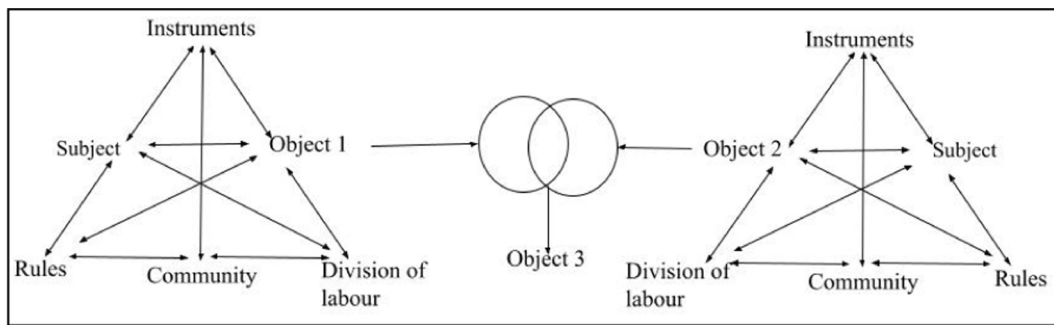


Fig. 2. Two interacting activity systems as a minimal unit of activity in third generation of CHAT.

2.2. Identifying relevant research studies

The identification of studies via databases was inspired by the PRISMA method (e.g., Page et al., 2021). Initial search was implemented on April 20, 2020, in the following databases: Cairn, Psychinfo, Pubmed, Elsevier-Science Direct, Taylor and Francis online, and Web of science (Fig. 3). The databases were selected to cover a broad range of disciplines but also to enable access to French language scientific articles not accessible in international database. The search query focus on “full-text” documents in English or in French and when the search engine made it possible, we added inclusion criteria according to the country (France) and language (French AND English).

The reference lists were downloaded to a bibliographic software

package (Endnote) to file and sort the texts and to remove duplicates. This first step enabled us to identify 2 459 documents and 46 duplicates were removed using the software tool. Finally, 2 413 texts were screened.

2.3. Selection criteria

We used inclusion and exclusion criteria to remove from our selection documents that did not address our central research objectives (Fig. 3). These criteria were applied in a double-blind process led by the two first authors of this article. Inclusion criteria included: (1) full text availability, (2) French or English language. Exclusion criteria included: (1) do not concern the French system of occupational health or safety

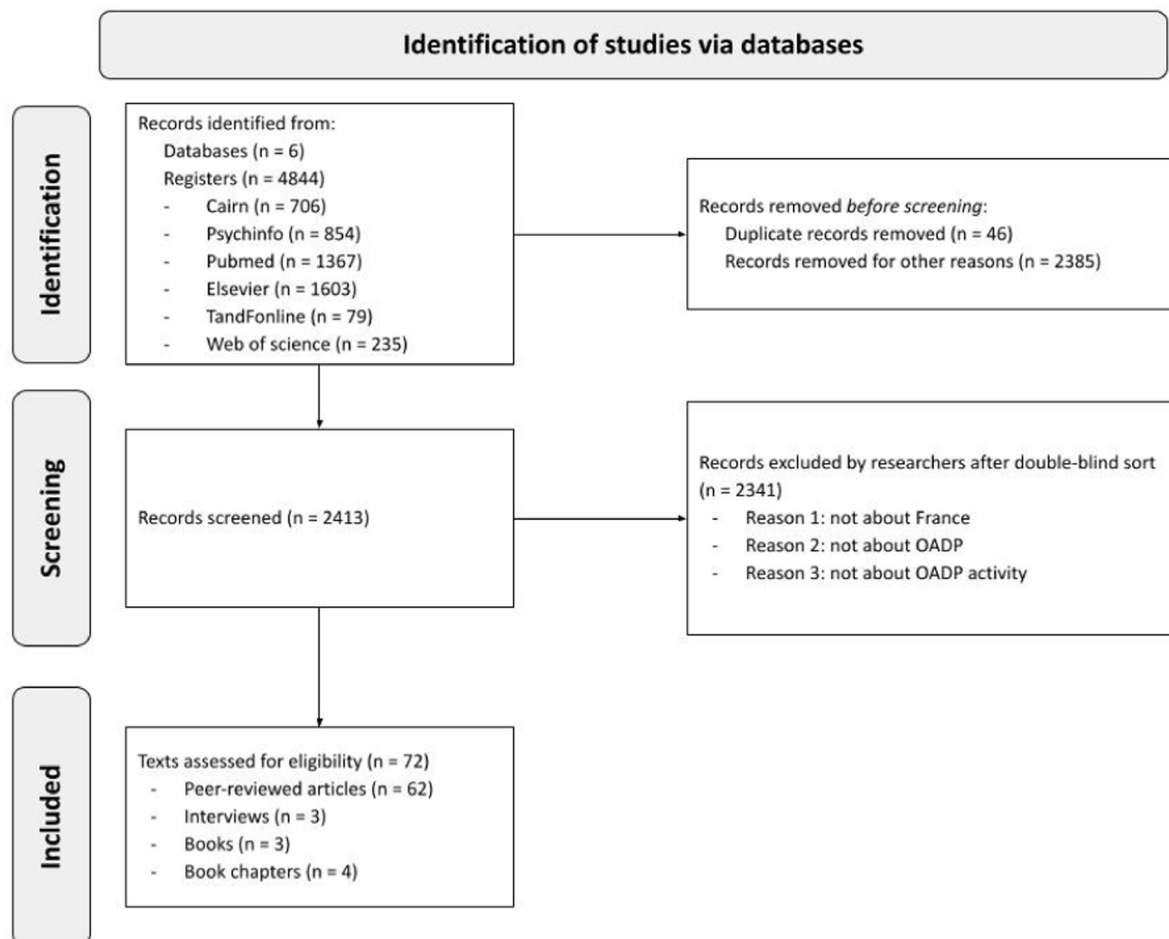


Fig. 3. Flow diagram showing studies conducted via databases, adapted from the PRISMA 2020 statement (Page et al., 2021).

prevention; (2) do not concern prevention of occupational health or safety, (3) do not concern occupational health or safety prevention activity.

The final selection includes 72 texts (Fig. 3), published between 1988 and 2019. 62 peer-reviewed articles, 3 interviews, 3 books and 4 book chapters. 3 documents were written in English and 59 in French. The 72 texts that were eligible for analysis were found to contain information in at least one of the following items:

- Stakeholders whose purpose is OADP activity (25/72; 34.7%): these documents present an actor-oriented description and explore the objects and developments for stakeholders such as occupational physicians, trade unions or Health, Safety and Working Conditions Committees (HSWCCs).
- Risks, safety, and health at the workplace (19/72; 26.4%): these documents deal with a comprehensive understanding of the development of occupational health and safety problems and occupational risks at the workplace (such as chemical or psychosocial risks).
- Surveillance of word-related pathologies (15/72; 20.8%): these documents describe the emergence and development of surveillance activity of health problems within the populations at the workplace and within the networks of stakeholders involved.
- Rules and instruments (13/72; 18.1%): these documents deal with regulatory aspects, evolving legislation and regulatory instruments.

2.4. Charting the data

The first step in our data analysis consisted in examining of all documents selected by reading full text. Each author read and analysed separately a set of documents from at least one of the items listed above (2.3.) with a view to achieving internal coherence in the study sample. The division of the papers selected between authors was done randomly.

The data collected in each document were entered onto a data charting form using the software Excel® (Table 2). The template, created by the authors, was designed as a tool to classify the information contained in each document. The author who read the document noted the data contained in each article, and only the last column dealing with hypotheses on systemic contradictions was inferred by the author. Fig. 4 gives an example of the coding procedure adopted.

The second step consisted in an analysis by AS to map changes in its object, its different naming over time and the developmental period identified. This second template, drawn from the Excel® software (Table 3) was completed with the data from Table 1. Every subject of AS identified in the 72 selected and analysed documents was entered in the second template. For each AS, all the information contained in the selection of documents was then classed in this second template. The aim was to better identify the AS network of OADP in France and to trace their objects and development according to the periods identified in our scoping review. Fig. 5 gives an example of the coding procedure used.

The following steps were based on the results from the two templates presented above. The third step focused on mapping the actual network of AS involved in the OADP system in France. The fourth (and last step) consisted in characterising the developmental movements and the historical contradictions.

3. Results

In this section, we will describe the developmental trends of OADP in France, through the concept of contradictions. The set of documents analysed revealed hypotheses of contradictions within and between AS, that structure the OADP system and underlie its development over time. These contradictions and their manifestations can take various forms over time. We have identified five contradiction hypotheses between (i) prevention and repair, (ii) technological and occupational risks, (iii) employment and improvement of working conditions, (iv) workers' participation or social dialogue and expertise, (v) individual and

Table 2
Analysis template for documents selected.

Authors	Year of publication	Type of doc	Title	pages	Doc objectives	Method	Population concerned	Period	Results	subject	object	outcomes	instruments	rules	community	division of labour	Problems/ conflicts	Hypothesis about contradictions
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DESCRIPTION OF THE DOCUMENT								
Authors	Year of publication	Type of doc	Title	Pages	Doc objectives	Method	Population concerned	Period
Emane, A.	2008	Research article	La santé au travail sous l'angle de la protection et de la réparation des risques professionnels	279-300	Discuss the modalities of occupational risk management: protection and compensation for work-related accidents and diseases	Analysis of legal texts and jurisprudence as well as their effects on occupational injuries and diseases repair policies	Workers in private sectors	1898 - 2000 2002 - 2008

Results							Problems/conflicts	Hypothesis about contradictions
subject	object	outcomes	instruments	rules	community	division of labour		
Juges from court	Protect workers from occupational accidents and diseases and offer them compensation in case of consequences on their health. This implies to identify the causes of occupational accidents and diseases in order to consider compensation.	-Very important role of judges and therefore of jurisprudence. -Great diversity of outcomes (interpretable law, leaving a large part to jurisprudence)	Social Security Code: criteria for defining and qualifying accidents at work and occupational diseases (tables); case law; European law (recent)	Legislation and Jurisprudence	Lawmakers; Judges; Workers; Companies; Health and Social Security Physicians - Labor Inspectors	The lawmaker defines the law; the judge applies or interprets (case law); victims make their statements.	- Difficulty to demonstrate causality (cf. medical causality vs. legal causality). - Difficulty for characterization of the work accident according to the place and time of work. - The gap is widening between the medical or social perception of the work-related disease and its legal assessment with problems to consider multifactorial diseases. - The law does not repair what is supposed to be protected but what is declared or real problem of under-declaration by the victims.	Contradiction between legal instruments of repair and protection of workers health

Fig. 4. Example of the coding procedure with a template for one selected document.

Table 3
Analysis template by activity system.

Subject of AS	Date of appearance	Current name	Previous name	Current object	Previous objects	Periods identified
HSWCCs	1982	Social and economic committees, Social and Economic Committee, with a specialized commission for health, safety and working conditions	-HSC (1947-1982) -Commission for the improvement of working conditions within the enterprise councils Safety committee (1941-1947) -Register of observations on safety for miners (1890)	To contribute to the physical and mental protection of the workers of the company, promotion of prevention and improvement of working conditions + expansion on work organization and procedures	HSC: to allow workers to deal with occupational health (sanitary - hygienist) and safety issues (application of regulations and conformity of technical devices) - organization of participation of workers	1941-1947 / 1947-1982 / 1982-2017/ 2017-today

Fig. 5. Example of coding procedure with template by activity system for one selected document.

collective approaches. In the following sections, we will present in detail these five hypotheses of historical contradictions built regarding the literature included in our scoping review. We will rely on illustrative examples of the manifestations of each contradiction by describing the AS involved in the OADP network.

3.1. Contradiction: prevention vs repair

3.1.1. Historically, a twofold orientation for OADP

The concept of prevention, which is part of human activity, does not

originate in the modern era. Its organisation in a network of AS, as well as its various instruments and rules, started to be formed with the Industrial Revolution and the development of modern form of work and wage employment. As a consequence of these socio-productive upheavals, the labour code was established and the legal framework for prevention was built.

- Legislation

Ever since the first laws were drafted, prevention has been defined

with a two-fold focus: prevention and repair (Buzzi et al., 2006). Some traces can be found in the early institutionalisation of prevention systems in France. One example is King Charles IX's order in 1566 that commanded contractors to install safety barriers on the roofs of houses being built from falling off. Where safety rules were breached, fine imposed on contractors were used to finance workers who could no longer work (Léoni, 2017). Today, repair is based on a model of tariffs. This model covers the costs for victims of work-related accidents and diseases and finances research and training such as that provided by the French Institut national de recherche et de sécurité (National Institute for Research and Safety for prevention of occupational accidents and diseases). This tariffs instrument combines financial mechanisms to share the costs of the consequences of occupational risks between companies and to encourage the reduction of work-related accidents and diseases by implementing preventive measures and actions in companies (Jolivet, 2015).

- Contradictory Objects

However, to this today, these two dimensions of prevention and repair are most of the time set in opposition or treated separately, while they are embedded in a unique system. Prevention is oriented toward the future, while repair is oriented towards assuming responsibility for the failure of prevention.

3.1.2. Liability: A key concept of OADP

In summary, the system is based on the notion of liability of the employer "considered as the main actor in the decision on whether or not to prevent" (Jolivet, op.cit., p. 23), which seems to be a specific feature of the French social and legal system.

- Liability as an Organisational Procedure in the Division of Labour

The law of 1893 on health and safety introduced, for the first time, a general obligation of prevention on the part of the employer (Léoni, op. cit.). In 1898, the first law on occupational accidents introduced the automatic liability of employers based on the occupational risks created by the company and, in exchange, created a fixed compensation and the prohibition of recourse to civil and criminal liability (Kessler, 2017). This law constituted a break from the past by adopting an individual liability approach, which was prevalent at the beginning of the Industrial Revolution, in favour of a system of collective solidarity, then largely developed in 1946 with the creation of the Social Security system.

Judges also contributed to these regulatory developments in the definition of work-related accidents. The civil courts, faced with an increasing number of claims for compensation from accident victims, were responsible for objectifying the occupational accident by deciding on its nature, its causes and the employer's liability as to its occurrence. This jurisprudence engaged the liability of the employer to ensure the safety of its employees (Ewald, 1981). For more than a century, judges were actively involved in the organisation of OADP. The object of this AS is therefore to define what the law protects and then to define what it repairs (Emane, 2008). Through their decisions, they create rules, instruments, and the division of labour.

The current approach mixes collective solidarity and individual liability: it engages the liability of both employers and employees for OADP (e.g., Heinrich et al., 1980). Liability is related to the principle of subordination, which is accompanied by social rights for employees (Héas, 2017). In practice, the social system of prevention and repair benefits all workers with an employment contract in both the private and public sector, with the exception of self-employed and independent workers.

3.1.3. Surveillance: A third object for OADP?

Moreover, the historical contradiction hypothesis between prevention and repair has taken a new form, revealing the inherent tensions

between public health and occupational health. Occupational health and public health are governed by different rationales (Fantoni-Quinton et al., 2004). From the very beginning, the OADP system has created spaces for social negotiation in terms of compensation for victims to the detriment of the inclusion of occupational health in a public health rationale (Sarfati and Waser, 2013). The creation of surveillance activity for OADP can illustrate this point.

- Creation of new AS for surveillance in OADP

Since the late 1990 s, France has structured its network for monitoring the health impacts of exposure at the workplace to substances, particularly chemicals (Boullier, 2016; Council, 2019; Dab, 2012; Henry, 2011; Vogel, 2009). This surveillance network involves occupational physicians as well as new AS (national epidemiological institutes such as Santé Publique France). In other words, a third object had been created with the emergence of surveillance activity for occupational diseases, which completed the prevention-repair system.

- An expansion of OADP for solving the historical contradiction?

However, surveillance activity for OADP reveals the historical contradiction hypothesis between prevention and repair. Its great complexity renders it important to trace the links between working conditions and health problems. Most of them are complex pathologies in interaction with life beyond work, with impacts that extend over time and in some case with an unstable etiology, which could be a matter of controversy (Lhuillier, 2010). Changes and transformations in work and employment have also made it more complex to link work and health (Emane, 2008).

In fact, such arguments explain why it had been so difficult to legally recognise occupational diseases as consequences of work. The first law was passed in 1919, more than 20 years after the first law on occupational accidents (Buzzi et al. op.cit.). The argument of the "free choice" of workers in professions considered to be dangerous with risk-taking financially compensated in proportion to the risk taken has often been emphasised.

3.1.4. Compensation: Expansion revealing the contradiction

Today, the consequences of work on health are still often the targets of negotiations between employers, workers representatives and public authorities. In recent years, the negotiations for the creation of rules and instrument of the prevention of arduous work are an example examined by several articles in our selection (Bugand and Trouiller, 2013; Chouikha et al., 2017; Fantoni-Quinton and Czuba, 2015; Jolivet, op. cit.).

- Expansion of object to prevent arduous work

Arduous work is an issue of social justice that has historically been linked to retirement and not prevention, as developed in the paper of Jolivet (2015). This issue has been a historical concern. But the first law dealing explicitly with it was enacted in 2010, after a decade of inter-professional negotiations at the national level. This law introduced a definition of arduous work by considering exposure factors that may cause lasting, identifiable, and irreversible impacts on health, related to physical constraints, physical environments, and the pace of work (e.g. night shift). This law was extended in 2014 and recognised for the first time the potential effects of arduous work on health and life expectancy.

- Development of new rules and instruments

The idea introduced by the 2010 law is that arduous work is a direct outcome of the working conditions and does not result from the nature of the job itself. Moreover, mechanisms of compensation are not related to the job performed but to the individual. While these rules were

created for reasons of equity, it should be noted that their application is differentiated. Indeed, these regulations can be applied to private sector employees, while the public sector is covered by other rules.

The legislator introduced instruments to promote the prevention of arduous work through the implementation of action plans and social pacts in Occupational branches or in companies. These instruments involved AS historically present in the network, notably occupational physicians and labour inspectors. Other AS have also been involved, for example Human Resources departments, whose role is to negotiate pacts and manage action plans. Indeed, this law operates a redesign of many AS in the OADP network (such as employers, workers and representatives, etc.) by creating new labour division, rules and instruments.

These evolving laws and regulations might open the possibility of preventing arduous work by transforming working conditions. However, as Jolivet has pointed out (*ibid.*), a semantic shift of object from repair to compensation is noteworthy, which underlines the impossibility of repairing undesirable effects on the health and life expectancy of the workers concerned. In this context, compensation appears less as an encouragement to prevention and more as a form of social negotiation on the health consequences of working conditions and on the societal acceptability of OADP. Thus, prevention clearly appears as a social and collective process organized and with labour division, supported and sometimes limited by rules and instruments.

3.2. Contradiction: technological and environmental risks vs occupational risks

This second contradiction allow us to deepen this analysis. The prevention of occupational risks and the prevention of technological risks have different histories and call for different rules and networks of AS. As a result, the implementation of occupational health prevention measures does not automatically include the introduction of measures to prevent the risk of injuries and accidents in industrial facilities or the environmental consequences, and vice versa.

3.2.1. An illustration with the labour inspection's AS

Occupational and technological risks prevention originate in the Industrial Revolution. Concerning technological risks, since 1810, the aim has been to control disruptions at industrial plants by classifying their dangerousness. A new AS soon appeared with the creation of an inspection body for listed facilities. However, Galland (2008) pointed out that their function was not clearly defined. As a result, the task of inspecting listed facilities was assigned to the labour inspectors from the 1920s to the 1970s, in addition to their other tasks.

Created in 1892, labour inspectors were the first AS whose purpose is expressly the prevention of safety at work, empowered with instruments of control, inspection, and advice. The object of this AS is to verify the application of regulations to restore employees' rights (Billard, 2010). In practice, their object is to check compliance with the many regulatory rules and to prevent hazards related to the use of plant and machinery. They have therefore been associated with technological risks prevention. Nevertheless, the notions of prevention of occupational or technological risks have not yet been fully formulated.

- Development of legal rules and instruments for technological risk prevention

Galland (*op.cit.*) highlighted the fact that the notion of technological risks appeared in the early 1970s, in a context of technological development of processes and products and industrial clustering and in the light of the increasing visibility of environmental issues in public and political debates.

This emergence in France is in fact linked to a serious industrial accident that occurred in a facility in an area near Lyon in January 1966. This accident caused significant damage and killed 18 people, including 11 emergency workers. According to Galland (*op.cit.*), this event has

resulted in a significant change in how the public perceived the industrial risks and hazards. The labour inspectorate, which became the focus of criticism, flagged a lack of technical expertise to prevent technological risks and to control the application of regulations. In fact, these difficulties are visible since its creation in 1892. This AS was powerless to make the legislation respected, on one hand regarding the pressures of the industrials on politics and on the other hand facing the suspicion from workers who were very vigilant on hygiene issues (Buzzi et al., *op.cit.*). It should also be reminded that this task had been added to their missions in the 1920s despite a gap compared to the object of this AS. This led to the creation of a new AS, the regional department for industry, research, and environment, created in 1983, whose aim was to inspect listed facilities (since 2009, the missions of this AS have been transferred to the Regional Departments of enterprises, competition consumption, labour, and employment or to the regional departments of environment, planning and housing).

- Other AS from OADP Aside from Technological Risks

Despite the historical rooting of occupational physicians in industrial hygiene (Buzzi et al., *op.cit.*), they were not involved in the prevention of environmental damage and technological hazards. The scope of this AS seems to be limited to the boundaries of the entities concerned and strictly centred on the relationships between individuals and their work environment, since their object is to prevent occupational hazards and to repair or compensate the damages on health of employees as a consequence of their work. The concern of occupational physicians, who emerged at the beginning of the 20th century in the industrial hygiene movement; was health at the workplace. To complete this network, since 1945, according to the creation of the Social Security system, other AS were created, such as expert prevention affiliated with the Social Security (notably inspectors and engineers from the National and Regional Retirement Insurance and Occupational Health Office-CNAM/CARSAT, and experts, researchers and instructors of the French National Institute for Research and Safety-INRS created in 1968). Although some are equipped with control and inspection instruments, the division of labour in OADP network excludes them from the prevention of technological risks.

Consequently, we can deduce that rule and instruments organized a formal labour division between AS in the prevention network.

3.2.2. A qualitative expansion of OADP?

Simultaneously for occupational risks, the 1970s were also a period of development. The French government sought to modernise public and political action and aimed to reshape the approach of occupational health and safety at the workplace (Buzzi et al., *op.cit.*) To emphasise this desire for modernisation, the notion of "improvement of working conditions" was introduced, considered to be more qualitative and globalising (*ibid.*). This development can be seen as a qualitative expansion of prevention through a new definition of its object. To implement this policy, the government created in 1973 the Agence Nationale pour l'Amélioration des Conditions de Travail (French National Agency for the Improvement of Working Conditions), a new AS in the network of occupational prevention. Simultaneously, a new rule was developed in 1976 which introduced the idea of "integrated safety" which generated a movement to set machine conformity, by setting standards for both manufacturers and users (Omnès, 2006). This seems to be a further step towards linking occupational and technological risks.

3.2.3. New instruments and common rules for OADP and technological risks

If both technological and occupational risks have different historical developments, in the 1980's a closer connection seemed to be achieved around common methodological principles of a priori risk assessment. Galland (*op.cit.*) presented these common principles in these terms. These principles were first developed for the prevention of technological

risks. In 1982, a new rule was adopted with the so-called “SEVESO directive”. The directive required industrialist to realise a risk study if their facilities may cause risks for residents and the environment. This approach was then extended to the prevention of occupational risks, involving different stakeholders inside the company (e.g., the Health, Safety and Working Conditions Committees, which were expanded in 1982, can give advice on the risk assessment) and other AS of occupational prevention (such as labour inspectors, occupational physicians, and experts linked to the social security system).

Thus, the contradiction hypothesis between technological risks and occupational risks sheds light on the distribution in prevention management regarding the AS involved. Despite some local experiments that should be highlighted (Chardeyron and Stadler, 2008), difficulties persist today to converge actions for risks prevention in and from work organisations systems (WOS), due to a lack of a common culture between the multiple AS involved (ibid.).

3.2.4. Conflicts of objects and division of labour

The contradiction hypothesis most often reveals historically constructed conflicts of objects and division of labour between antagonistic AS (notably ministries of labour, health, and companies), following Chaumette (2008) in the field of maritime fishing. Such conflicts generate changes in institutional structures, as we have seen with the development of objects, rules, instruments, and the creation of new AS. Despite these developments, technological and environmental issues remain difficult to include in occupational risks prevention, as Chaskiel (2013) illustrated using the example of nanotechnologies in industrial sectors. From our point of view, this contradiction hypothesis is related to a strict boundary between the inside and the outside of a given firm. What concerns the inside of the company is a matter of occupational risks, what affects the outside (the environment, the residents, etc.) is a matter of technological risks. However, in both cases, when an accident occurs, the WOS are at the origin of the problem.

3.3. Contradiction: employment versus improvement of working conditions

OADP in WOS seems to be even more complex under the influence of the evolution of work and employment, in a context of structural unemployment and under the effect of more flexible policies of employment and liberalisation of the labour market. Successive governments have indeed promoted more precarious forms of employment, considered to be a preferable option to non-employment, to contain the growth of unemployment, such as temporary employment for example (Fantoni-Quinton et al., op.cit.). Other policies have been also promoted as the diversification of public policies to promote the employment of seniors (Chouikha et al., op.cit.).

3.3.1. The example of the AS of occupational physicians

In this context, social negotiations between trade unions and employer organisations are an instrument for defining financial compensation to modernise the labour market and ensure job security in favour of the preservation of employment and due to the lack of options for preventive measures, as we have seen with the example of arduous working conditions. This may result in a fragmentation of career paths, with difficulties in assessing exposure to risk factors and in multiplying such exposure, which is one of the historical objects of occupational physicians.

The occupational physician AS is oriented towards a multi-modal object that covers the fields of prevention, repair, and surveillance: to guarantee the medical evaluation of employees, to alert and track work-related diseases, to register and manage reported occupational diseases and to publish aptitude assessments. The publication of Buzzi et al. (2006) traces the development of this AS and describes the place of professional aptitude as an object of this AS.

• Contradictory Objects or Dilution of Prevention?

Historically, occupational medicine emerged, in France, at the beginning of the 20th century around industrial hygiene and protection of vulnerable communities. From the very beginning, the medical visit for new hires had been at the core of occupational medicine (called factory medicine at that time). That involved checking for predisposition for some contagious diseases (e.g., tuberculosis) and consulting a medical case report to decide on orientation and professional selection.

Occupational physicians were one of the pillars of the workforce control system. At the beginning of the 20th century, some employers had adopted the principle of a medical check-up, that resulted in firing employees considered to be susceptible to illness. The selection of workforce by occupational physicians is an instrument for employers, corresponding to a rationale of protecting the employment-related economic interests. As a result, the workers, because of the control it exercised and its disregard for medical secrecy, condemned factory medicine.

Occupational medicine has undergone successive reforms led by every government, at times directing its role more towards the selection of the workforce, at other times more towards prevention and the reinforcement of medical monitoring, since the occupational medicine was imposed in companied from the beginning of the 1940s.

However, these successive reforms reflect a huge concern to legitimate the usefulness and effectiveness of occupational medicine, which is constantly disputed by other AS, such as public authorities and company stakeholders. The succession of reforms reveals the difficult position of occupational physicians in the OADP network. Even more, it reveals the contradictory expectations in which they are historically caught on the one hand, the preservation of industrial, economic and productive concerns (selection and professional orientation) and, on the other hand, the concerns of health and prevention of occupational risks. In the 2000s, an important reform with the opening to multidisciplinary should be noted, whose main outcomes have been to replace occupational medicine services by occupational health services. It introduced a broader approach towards occupational health extending beyond the strict medical field, transforming other AS such as ergonomists, psychologists, toxicologists, etc. However, the principles of selection have not been completely abandoned.

3.3.2. Object-Related tensions between OADP and economics

At another level, Chaskiel (op.cit.) showed that the OADP object has often been marginalised by the benefits of employment in terms of production of goods and services, in Occupational negotiation processes. As a consequence of an “industrialist view of the world of work” (ibid.), trade unions have tended to often privilege compensation for health problems rather than prevention. Trade unions are historical AS in industrial relations that centre on employment, wages and working conditions. Their object is therefore not prevention, even if they participate in it especially through bodies such as the Supreme Council for the Prevention of Occupational Risks created in 1976 at the national level (a consultative body attached to the Ministry of Labour which organises debates between social partners on prevention and repair), or through bodies in companies such as Health, Safety and Working Conditions Committees (HSWCCs).

3.3.3. Contradiction hypothesis resulting from the development of OADP

Chaskiel (ibid.) showed in his paper, with the example of the use of nanotechnologies in industries, that some trade unions have opposed a precautionary principle, associated with prerequisites for the development of an industrial activity based on these technologies. In fact, he pointed out that public debates on the environment have led to changes in the trade unions’ approach to economic, environmental and health issues.

- Public sphere AS influencing the expansion of OADP instruments

This increasing influence of the public sphere in OADP has also led to the implementation of new rules and instruments across Europe, such as the REACH directive (Registration, evaluation, and authorisation of chemicals). Created in 2006 simultaneously with the European Chemicals Agency (ECA) (Boullier, op.cit.), REACH is an integrated instrument for managing the commercialisation of chemical substances throughout the European Union. The aim is to reduce exposure to chemical risk factors for the workers and the environment. Therefore, it could be a useful instrument for an a priori risks assessment. In practice, it induces a new division of labour in the network of AS involved. It is based on a regulatory requirement for companies to disclose data on the molecules they produce and data to be examined by committees of experts to give the authorities the opportunity to evaluate these molecules (ibid.).

3.4. Contradiction: Workers' participation and social dialogue vs expertise

The network of AS for OADP in France is organised through a division of labour that would appear to be strongly influenced by the notion of expertise, considered as an instrument for OADP activity.

- Expertise as an Instrument in the OADP Network

This instrument has been made widely available and thus takes multiple forms. OADP experts related to the Social Security system (as CNAM, CARSAT, or INRS), occupational physicians, legal specialists, health, and risks assessment specialists, etc., may provide the expertise. However, Henry (2011) highlighted that “the attachment of occupational health policies to the area of social relations produces particular forms of expertise and association (or non-association) of knowledge to public decision-making that remained in place until the asbestos crisis of the mid-1990s” (p.710). To illustrate this point, several authors have pointed out that industrialists might “foster ignorance” on issues that could be contrary to their economic interests, by seeking to communicate biased knowledge on occupational health issues regarding chemical substances (Counil and Henry, 2016; Dedieu and Jouzel, 2015). Consequently, this might limit the activity of OADP, particularly in an a priori risk assessment as discussed previously (3.2.4.).

3.4.1. A contradiction revealed by crises in the OADP network

Several articles selected have reported the example of the asbestos crisis in France. During the 1990s, the asbestos crisis had led some trade unions to publicly express criticism that were usually confined to the joint occupational risk management bodies, and in so doing, turning the asbestos problem into a public health scandal (Jouzel, 2008). Occupational health policies have historically been linked to the field of social relations producing forms of expertise and knowledge. Since the law of 1898 on occupational accidents, the idea was to create a socialisation of risks to avoid lawsuits and to organise paritarianism aimed at imposing the authority of the state on employers and trade unions (Buzzi et al., op. cit.). However, the asbestos crisis in the mid-1990s highlighted the limits of OADP decision-making, crystallized in unequal relations of domination and power between AS of the network (Henry, 2011).

- Creation of New AS During Asbestos Crisis

Asbestos is a carcinogenic substance whose toxic effects on human health have been known since the late 1970s. Exposure to asbestos concerned a large number of workers in industries, construction, and services. From 1982 and until 1995, the Comité permanent amiante (CPA: French asbestos standing committee), created by industrialists, brought together the main AS involved in the management of asbestos-related occupational risks (such as public authorities and representatives of the ministries of labour, health and environment experts, experts related to Social Security as INRS representatives and trade unions). CPA

was both a pressure group financed by industrialists and a forum for improving working conditions, whose outcomes were to impose the usual standard of having to work with a dangerous product (Henry, 2005). The purpose of this AS was to organise debates with experts on how to control the use of asbestos in the workplace to avoid a strict prohibition (Jouzel, 2008; Jouzel and Prete, 2015).

- Crisis as a Developmental Period for OADP

However, in the mid-1990s, some trade unions had left the CPA to join militant for occupational health and victims' associations. This led to the public condemnation of the activities of this informal group and to express political and legal support for asbestos victims. As a result, the strategies of victims have resulted in publicly disclose health problems at the workplace and not let them be confined to a circle of experts. Such strategies have contributed to reveal the deficiencies of OADP network in France (Jouzel, 2008; Henry, 2011).

To end the scandal, in 2000, the public authorities created an Asbestos Victims Compensation Fund, financed by the industrial sector. The objective was to stop the growth of asbestos-related lawsuits. The creation of this fund modified the principles introduced since the law of 1898 on occupational accidents, with a fixed compensation for workers victims of accidents. In this case, the compensation of occupational damages was “integral” for recognized victims of asbestos. Nevertheless, the mechanisms for the repair of occupational hazards were not entirely revised and integral repair was not extended to all victims of work-related injuries (Jouzel, 2009). However, another outcome of asbestos scandal has changed the system of OADP more deeply. After, first court decisions against the French State in the asbestos scandal (1998), the “asbestos judgments” of the French Supreme Court in 2000 have imposed the rules of employer's inexcusable fault, which can be demonstrated to obtain an increase compensation (Jouzel, 2008). In that way, asbestos crisis led to transform the rules of employers' AS, which is then no longer based on an obligation of means but on an obligation of results.

3.4.2. Contradiction revealed by interactions between different AS

To quote from Cassou and Pissarro (1988), one possible explanation for the tensions in the OADP network is that the participation of the workers in the prevention process remains very limited by being too indirect, due to the persistence of a negotiation system mainly external to the companies. The workers and their representatives may provide expertise as experts in their own work, but such expertise suffers from a lack of legitimacy. From our point of view, these biases in the production on knowledge about OADP and the use of expertise also have the effect of limiting the possibilities of participation for employees and their representatives in decision-making on corporate and labour governance.

In 1967, a reform established paritarianism as a method of management of Social Security institutions. The principles of equal representation of employers and representatives of workers in these institutions, actually led fact to the exclusion of the trade unions from the decision-making entities (Henry, 2005). As a result, the division of the responsibilities gave the presidency of OADP institutions to members of employers' organisations.

In fact, this reflects the high degree of dependency on employers who have the ability to take forward (or not) measures for OADP (ibid.). A contradiction of objects appears here between different AS, between those whose aim is prevention, and those whose aim is industrial or service production. This contradiction may produce tensions in the activity of OADP, revealed by the emergence of AS in the OADP network. These emerging AS are “institutional inventions” (e.g., Henry, 2012a), in many cases arising from social movements or civil society, bring together different AS of the network and new AS. They appear to be related to specific problems and reveal weaknesses or failures of the permanent organisations of the network, as seen with asbestos.

3.5. Contradiction: Collective approach vs individual approach

OADP is supported by a whole set of rules and instruments that organise the division of labour within the network of AS, as presented in the previous sections (e.g., 3.2, 3.3, 3.4.). A priori risk assessment is an instrument for implementing preventive measures in work situations (3.2.4). The target is to produce a collective prevention for all the workers in the work situation. However, such a collective approach is in tension with individual approach of health and repair. For example, occupational physicians can participate to collective prevention, but their object and main instruments drive to individual approach (professional selection, medical monitoring and health problems surveillance, etc.).

Moreover, it is necessary for employers to evaluate the effectiveness of these measures on exposure to risk factors (e.g., Jouzel and Prete, 2017 on the inefficiency of personal protective equipment (PPE) revealing the gaps between object and instruments for the prevention of chemical risks in agriculture). But some types of risks appear more complex to be taken into account, that could be explain by the tension between the temporality of the production of scientific knowledge on exposures and their effects, and the temporality for the implementation of prevention actions.

We can deduce a contradiction hypothesis between the object of the activity, which is very exigent in terms of knowledge in various fields, and the subjects' knowledge that often rely on legal training and not in work analysis (Dugué and Petit, 2018).

3.5.1. Contradiction embodied in the system

An example can be found with the assessment of psychosocial risks (PSRs) in companies and Health, Safety and Working Conditions Committees (HSWCCs). This example is illustrative of the tensions between collective and individual approaches of prevention. Such risks may be difficult to perceive because they are diffuse, isolated, and delayed over time (Litim and Castejon, 2010). Moreover, the roots causes of PSRs seem to be less visible since they are not related to physical or technical elements of the work situation. Nevertheless, the difficulties to take into account PSRs in companies and in HSWCCs appear to be less related to the characteristics of the PSRs than to the functioning of the committee.

- HSWCCs AS for development of OADP in Work Organisations

HSWCCs' object is to contribute to the physical and mental protection of the company's employees, to promote prevention and to improve working conditions and WOS.

This committee was required in companies with more than 50 employees and comprised members appointed by a college of elected members of the Works Council (CE) and workers representatives. The HSWCC was a forum of dialogue that involved different AS who met at least once a quarter: the company's management (often as chairperson and CEO) and several elected workers representatives (including the secretary), occupational physicians, labour inspectors or experts related to Social Security institutions were also invited members.

HSWCCs were created by the French Ministry of Labour in 1982, through the merger of two existing corporate bodies: health and safety committees (HSCs, since 1947) and committees for the improvement of working conditions of enterprise committees (ECs, bodies that managed the economic and social policies of companies).

- HSWCCs instruments for OADP activity

Historically, the target has been to gradually eliminate arduous work and hazards to protect employees' physical health (Litim and Castejon, op.cit.). This new rule expanded the scope and instruments for new HSWCCs' AS. HSWCCs dealt with work organisation and was qualified to issue opinions on the employer's projects that may have consequences on health, safety or working conditions and in the event of serious health

risks for employees (Dugué and Petit, op.cit.). For this purpose, a legal recourse for external expertise was established in 1982 among a variety of possible instruments (Cristofalo, 2012). External experts are instrumental resources for employee representative bodies to provide information and detailed recommendations on company projects on technology, organisation and working conditions (Henry, 2012b). Since 2017, a new body has replaced HSWCCs and ECs: the Economic and Social Committee (ESC) with a view to grouping staff representative bodies together in a unique body. For specialists, the disappearance of the HSWCC and its merger into ESC could be a source of concern for occupational health and safety, especially by linking these issues even more strongly to employment or wage issues (Barnier et al., 2020).

3.5.2. Contradiction impacting the global debate on OADP in WOS

From 1982 to 2017, various rules derived from existing legislation and jurisprudence in France have given to the HSWCCs an increasingly important role in OADP (Dugué and Petit, op.cit.). Nevertheless, following the work on HSWCCs in the agricultural sector by Bernard and Nicolay-Stock (2007), we can hypothesise a contradiction between its object (prevention) and its instruments, which are mainly corrective actions. As Jamet and Mias (2012) have pointed out, one of the difficulties is that the HSWCCs have little influence on the company's prevention policy, which is often monopolised by the Health and Safety Departments (HSDs). However, this AS is rarely mentioned in the documents of our scoping review. Its object is prevention, but their instruments are more oriented towards the technical measures of prevention, notably risk assessment, individual protection, and safety guidelines (Legrand and Mias, 2013).

Since not all employees are exposed to the same risk factors, the assessment provides the information needed to adopt differentiated measures according to the characteristics of the work carried out, by adapting the work to the individual, transforming the work environment and/or work organisation, or requiring the use of PPE. This would lead to an increasing individualisation of preventive measures (ibid.), rather than a more global and collective debate on WOS.

4. Discussion: Prevention as an evolving object

The five contradiction hypotheses presented indicate that OADP is part of a socially and culturally rooted system. OADP is not only a technical issue, but also a social, cultural, and political issue (Durodié, 2017). From this standpoint, this article offers a better understanding of these dimensions to meet new challenges for the development of the prevention system and its cultural anchorage. In this section, we propose to look beyond the French case and to discuss the general lessons to be learned from this scoping review using the CHAT framework.

The activity of OADP involves a large number of AS which interact with each other, forming a network. AS in the network occupy different places and collaborate in a more or less irregular manner. AS are relatively well organised while their boundaries are difficult to define. In other words, OADP can be regarded as complex, polymorphic and fragmented objects. Examining OADP as this kind of object implies underlining its fragmented nature, embedded in a distributed collective network of activity systems. In fact, no AS can pretend to control this object by its own action.

Anchored in a dialectical orientation, the concept of contradiction makes possible to define the principle generating the development of AS or that lies behind a network of AS, beyond the historical development of the manifestations themselves. For example, Victor and Boynton (1998) identify the historical development of work organisation: from craft to co-configuration. Their work distinguishes different ideal types of work organisations. Our aim in this scoping review was different. Beyond the analysis of the historical and concrete development of the OADP network of AS, we have sought to consider the intrinsic rationale of the historical development of the activity of OADP. In other words, we have attempted to identify the main contradictions hypotheses. Within

these contradictions, the contradiction between prevention and repair constitutes the initial contradictory concept that develops within the network of AS for OADP over time. In this work, this contradiction hypothesis appears to be shaped by the historical developments of OADP as a whole. It still constitutes an active contradiction in the development of the French OADP system.

In this framework, compensation and repair are mechanisms that do not allow risks to be avoided but rather to be compensated individually (support for professional career transition, for example), either by reducing working time (lowering the retirement age, for example) or financially. OADP aims to avoid the risk by presenting it as an avoidable consequence of productive activity.

In so doing, it implies transforming the productive activity to transform OADP (adaptation of workstations, organisational changes, etc.). From our point of view, the results open up perspectives and reflections for practical implications in prevention and for transformative interventions in WOS. Indeed, instruments and rules appear as key elements for the transformation of labour division and object in the OADP network. In that way, transforming instruments and rules seems to be a way to overcome the contradictions presented and could make prevention a collective process to improve its efficiency. Implementing and experimenting these levers of transformation in WOS and prevention policies represent interesting new prospects and future developments of this research.

4.1. Contradictions as driving forces of development

The corpus of documents analysed reveal contradictions hypotheses within and between AS that are historically present in the activity of OADP. The five hypotheses of contradictions presented in this paper are conceptual abstractions, which shed light on the main characteristics of system structure. Therefore, their manifestations take various forms over time and have their roots in various activities and actions. We can take two examples extracted from our results. Firstly, occupational physicians deal with a multifaceted object that reveal a contradiction hypothesis between prevention, repair, and surveillance. Prevention in work situations is a projection oriented towards the future; while health problems considered in surveillance and repair activity are outcomes of prevention failures. Secondly, examples discussed with the principle of subordination and with the participation of workers and representatives are probably symptoms of a contradiction within the labour division with on one hand a vertical division of labour and tasks, and on the other hand a more democratic division of labour. This historical contradiction has been partly condemned by victims' associations and trade unions when the asbestos scandal erupted, highlighting the outcomes of a debate confined to a circle of experts.

These examples illustrate that the historical and systemic hypotheses of contradictions still affect the current activity of OADP within the network of AS. Failing to identify the historical and systemic roots of the problem and how they emerged could be a missed learning opportunity and could limit the developmental process of OADP activity (Lopes et al., 2018). As witnessed during the asbestos scandal in France, some health problems could remain confined within companies or within in a circle of experts, whereas the impacts concern the environment and the whole society. However, concrete solutions for OADP problems require the involvement of a network of AS at a local corporate level, hence the strength of a global/local dialectic. Such a dialectic includes relationships between the public and private spheres, marked by power relations and tensions between the different AS (Lémonie, Grosstephan and Tomás, 2021), and that must not be overlooked. The analysis with the concept of contradictions shows that the power relationships occur and reproduce themselves over time, embedded in the division of labour, in rules, in the design and use of instruments, etc. OADP is a social system, through which tensions run, and within which different views of the object are expressed. In this way, the question of power relations should be raised. This is a possible new development for concrete actions and

interventions in WOS to transform the work situations and the structure of the collective activity of OADP.

4.2. The limitations of the study

Two main limitations deserve mention. The results focus on the development of the structure of the network AS for OADP, using the AS as a unit of analysis. It must be stressed that beyond the evolution of structures, the conception of risks and risk-taking at the workplace, their acceptability and social acceptance are also medium and carrier of development of rules, instruments, objects, etc. (Colombo et al., 2019; Blanc et al., 2020).

The research team involved in this scoping review was dependent on the amount and quality of the information detailed in each text of the selection. The scoping review method provides an overview of broad questions in a body of knowledge. The selection included texts from various fields of research, with different methodologies and scientific practices. We sometimes chose to add other references, not initially included in the selection, to complete missing information (historical dates, changes in legislation, for example) that the authors were already familiar with, due to their expertise in this field. The five contradiction hypotheses presented are therefore neither exclusive nor exhaustive and can be enriched with further work.

In particular, the influence of international organisations in the development of French OADP activity, for example the role of the International Labour Organization (ILO) (e.g., Niu, 2006), is not discussed. The influence of European policies, with the exception of the European REACH regulation for chemicals that we have presented, is also given little attention. However, since the beginning of the 1990s, French rules and instruments for OADP has evolved significantly under the influence of the European Union (e.g., Lerouge, 2017). The selected documents also marginally mention the development of forms of employment, the employment flexibility policies, or the development of forms of work that are likely to change the rules, instruments, or objects and outcomes of OADP. For example, remote or itinerant working was widespread during the Covid-19 pandemic and may create an extension of the workplace to the personal home or to another external place. However, the database survey was conducted in April 2020. Therefore, publications on the Covid-19 pandemic had not yet been published at that time.

As a result of these limitations, new investigations are needed to help reflect on how the predominant models in the world promote contradictions or advances within French OADP. Such research should aim to confirm and enrich the contradictions hypotheses presented in this paper, to address them through a stable and effective approach. The target should then contribute to opening new possibilities for the development, well-being and protection of workers.

4.3. Learning challenges in the development of OADP activity

By highlighting the dialectical relationships between AS and the contradictions historically accumulated in the network, our objective was to account for the fragmented object and distributed nature of the activity of OADP, without denying the complexity nor reifying its organisation. Indeed, the concept of a learning challenge could be a tool for an operative application of the findings, moving from the historical analysis of the network's contradictions to more concrete actions intended to overcome them.

The network of OADP involved a large diversity of AS at the international, national, and local levels, whose actions are organised, divided, and interrelated. Their actions are mediated and intermediated by instruments that organise their action towards the targeted objects: prevention, repair, surveillance. These objects clash that is symptomatic of the contradictions historically present in the system as we discussed above. Moreover, OADP is not only part of a health or social rationale, but also of an economic rationale from which it cannot be disconnected.

In this regard, we can mention the work of Jouzel (2008), who

highlighted the strategies used by industrialists to encourage production of ignorance in the chemical sector to preserve economic interests and interests linked to innovation, thereby limiting the possibility of promoting OADP in France and in Europe (Council and Henry, 2021), even though companies are central AS of the OADP network and have been steadily growing in importance. Another example is the CPA during the asbestos crisis. This AS delayed the development of prevention, to the detriment of workers exposed to asbestos by attempting to protect economic and industrial interests. Such anomalies indicate tensions between objects, economy and prevention, which are probably manifestations of a primary contradiction between use value and exchange value. The primary contradiction, in the framework of CHAT, has been inherited by capitalism and resides in every commodity between use value and exchange value (Engeström and Sannino, 2011). The primary contradiction between exchange value and use value that emerges from this analysis creates tensions between prevention, economy, and innovation. Indeed, our scoping review shows that prevention seems to be considered as a constraint to economic development and to innovation processes in WOS.

However, numerous studies, notably in ergonomics, have highlighted the links between occupational health and the performance of individuals and systems, in work systems transformations and design (e.g., Fadier and De la Garza, 2006; Lavoie and Tavenas, 1996). OADP could therefore be regarded as a resource for economic development and innovation, and vice versa. Consequently, a learning challenge could be to reintegrate prevention into social and cultural structures, while it remains confined to work situations with specific and temporal boundaries. Such a challenge goes far beyond the French experience, in a context of economic globalisation, creating more complex socio-technical systems, that shifts the organisational, geographical, cultural, and temporal boundaries of work (Carayon, 2006). From this point of view, the development of OADP may be supported by collaborative activity across boundaries of the WOS. In this regard, we share the concerns raised by the International Labour Organisation (Niu, op. cit.). This challenge questions the development of global and national preventative measures for safety and health at the workplace, involving international, national, and local AS to find ways to overcome these historically rooted contradictions.

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CRedit authorship contribution statement

Leïla Boudra: Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization, Supervision, Writing - original draft, Writing - review & editing. **Yannick Lémonie:** Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization, Funding acquisition, Writing - original draft, Writing - review & editing. **Vincent Grosstephan:** Visualization, Validation, Resources, Methodology, Investigation, Formal analysis, Data curation, Conceptualization, Writing - original draft, Writing - review & editing. **Adelaide Nascimento:** Visualization, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization, Writing - original draft, Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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