STOPCOLLISION

Stop Collision Project

Machine-pedestrian clashes:
Towards risk elimination!

Intermat - 04/2024

Overview

- Introduction
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  - François RENAULT - Kiloutou
- Project Background
- Stop Collision Project
- Deliverables
- Next Steps

Project Background

Introduction : « Ploegam » movie

Experiments with machine equipped with automatic stop

Experiments carried out by various actors:

- Hydroskip dumper (03/2020)
  BALFOUR BEATTY, SAFETY SHIELD GLOBAL (UK)
- Articulated dump truck (11/2020)
  PLOEGAM, ARCURE and PON EQUIPMENT (Netherlands)
- Hydraulic excavator (01/2021)
  FLANNERY, ARCURE et X-WATCH SOLUTIONS (UK)
- Wheel loader (03/2021)
  REMONDIS, ARCURE et ZEPPELIN (Germany)
- Hydraulic excavator (10/2023)
  KIWITRON and CGT S.p.A (Italy)

Emergence of an offer from machine manufacturers

Machines on the market:

- Kobelco hydraulic excavator, since 11/2018, not yet distributed in Europe
- Liebherr wheel loaders, since 01/2021
- Volvo wheel loaders, since 01/2023

Machines with collision avoidance systems **announced by manufacturers:**

- Bomag compactors (2024)
- Hamm compactors (2024)
- Wacker-Neuson dumpers (2024)
- Bobcat skid steers (2025)

Conclusions at the end of the inventory

- In the event of a "**retrofit**" (automatic braking system used on an existing machine), the problem of **maintaining CE conformity** arises, a it is a substantial modification of this machine.

- Currently, there is **only one family** of machines for which automatic braking offered by manufacturers in Europe, wheel loaders.

  ⇒What about **other families**?

  ⇒What about **other movements** than the reverse mode?

  ⇒What about the **performance** of the proposed systems?

⇒**Need to go faster and further**

Need to go faster and further...

- Inclusion of **engineering** and **experimentation** work in the OPPBTP's @H2025 strategic plan

  "It is proposed to work on the detection of vehicle-pedestrian collisions with machine stop control, for which the technologies exist, but their implementation in the context of the construction site remains to be invented."

  in the framework of **Strategic Priority 3**:

  « Carry out prevention engineering for the professions of tomorrow, with the objective of integrated prevention from the design stage, driven by innovation »

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Stop Collision Project

Project goals

- **Encourage equipment manufacturers** to consider the elimination of collisions in the design of the new equipment they will put on the market, so that an offer can be developed that meets this need of the profession, and so that companies can choose these machines, whether for purchase or rental.
- **Promote the use of standardized safety components** by the various stakeholders (manufacturers, dealers, equipment manufacturers) to move beyond the stage of driver assistance systems at the stage of safety systems, and thus achieve zero risk.
- **Demonstrate the reliability** of construction machinery with automatic emergency braking, under conditions of use that are those of construction sites.
- **Encourage companies** to buy or rent these "safe by design" machines, once these machines are available in the market.

Project partners

Phase 1

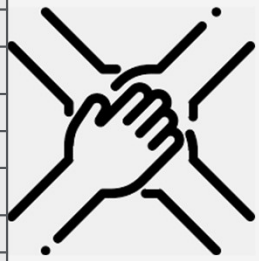
- Equipment Directors of large companies
- Equipment Directors of the 2 rental majors
- Professional organizations

Phase 2

- Manufacturers' Professional Organizations: Evolis and Seimat
- Machine manufacturers

Partner representatives

Construction companies		
BOUYGUES CONSTR.	Adrien VACHERAND	External Rental Manager
BOUYGUES TP	Xavier BRUN	Technical Projects Manager
CHARIER	Orianne HENRI	Prevention Manager
COLAS	Olivier GUEZET	Equipement Innovations Director
EIFFAGE GC	Fabrice BLANC	Equipement Director
EIFFAGE GC	Joël DUFOUR	HSE Manager
NGE	Thierry ROBERT	Equipement Director
SADE	Laurent BOUHIER DE L'ECLUSE	Equipment and Purchasing Director
SOLETANCHE BACHY	Ludovic SAVEAN	HSE Manager France Nord Agency
VINCI CONSTRUCTION	Marc BOHIN	Equipment Director Vinci Construction Grands Projets
VINCI CONSTRUCTION	Anthony FLANDIN	Equipment Director Networks Division
Professional organizations		
CNATP	David LEMAIRE	General Secretary
DLR	Mathieu ARMENGAUD	MSEQ Manager
FFB	Mathieu DELARUE	HSE Jurist
FNTP	Dominique CHEVILLARD	Technical and Innovation Director
Rental companies		
KILOUTOU	François RENAULT	Equipment and Sustainability Group Director
KILOUTOU	Marie-Line MOISON	Industries & Services Sales Director
KILOUTOU	François RIQUIER	Regulation Controller
LOXAM	Thierry LAHUPPE	Equipment Director
Prevention Organizations		
OPPBTP	Sébastien MARIE	Stop Collision Project Manager
OPPBTP	Louise ALBRAND	Legal Field Manager
OPPBTP	Anthony SAEZ	External Communication Officer



Key dates

02/2022 : Presentation at the Public Works Forum

06/2022 : Partner Buy-In

09/2022 : Launch of the project

12/2022 : Accident analysis

03/2023 : First Manufacturers' ranking

06/2023 : Specifications " Expectations of the branch "

Expleo deliverables

09/2023 : Results of the " users survey "

12/2023 : Points on the responsibilities of the different actors

Phase I
Production of deliverables

04/2024 : Sharing of deliverables with the various manufacturers

2024 : Development of partnerships with stakeholders adhering to the approach

2024-2025 : Experiments on flagship sites or for specific equipment families

Phase II
Active incentive

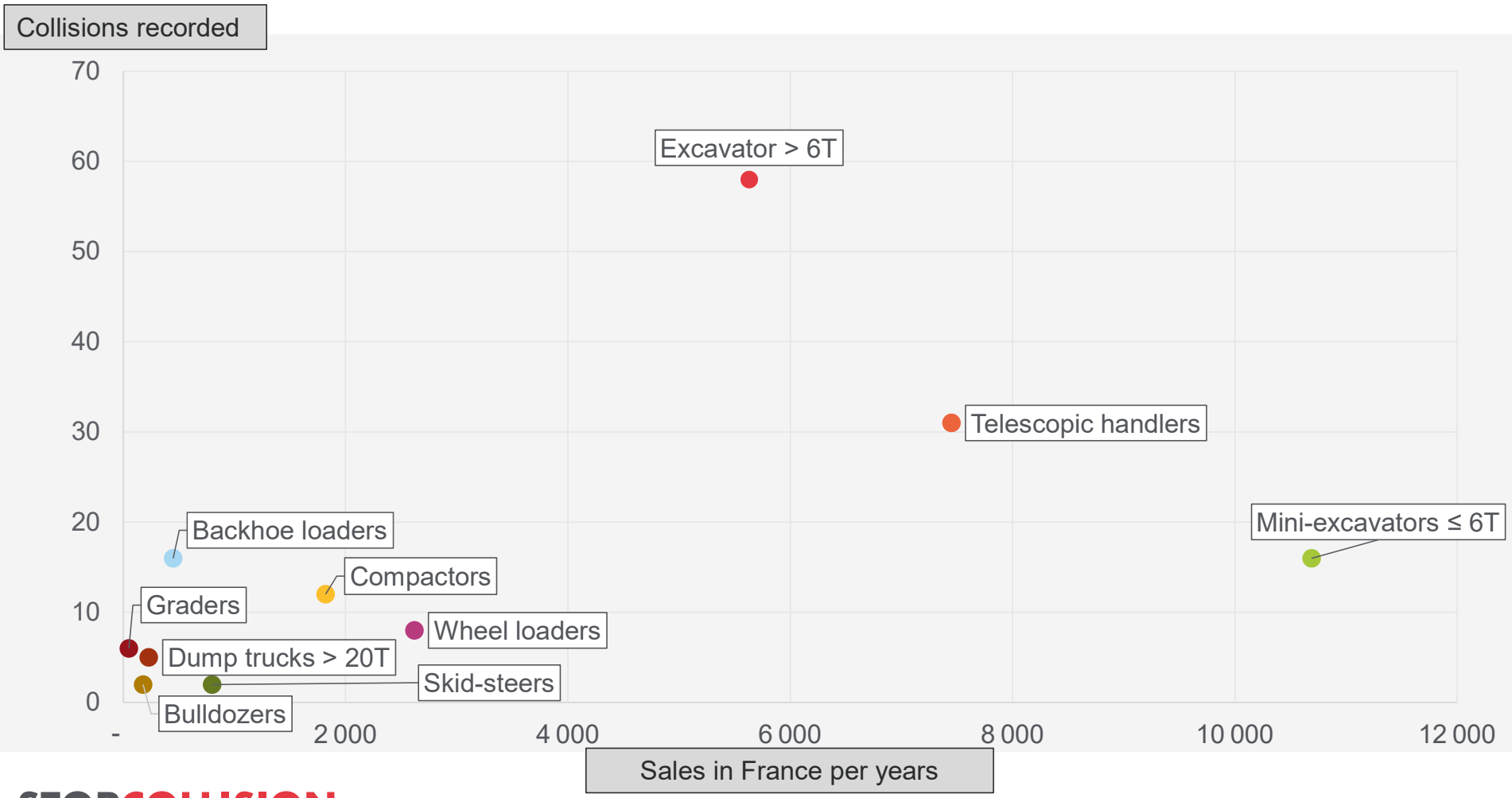
Delivrables

Accident analysis 1 / 2

Objective: **To collect factual data** on equipment involved

- More than 170 machine-pedestrian collisions were recorded in France, in the EPICEA© database of the INRS and in OPPBTP AT database.
- This represents between 10 and 20 serious and fatal accidents at work per year.
- The most involved families of machines are the following:
  - Hydraulic excavators > 6 T (58)
  - Telehandlers (31)
  - Mini excavators ≤ 6 T (18)
  - Backhoe loaders (16)
  - Vibrating compactors (12)
  - Wheel loaders (8)
  - Graders (6)
  - Hydroskip dumpers (5)
  - Articulated dump trucks (5)
  - Skid steers (2)
  - Wheel loaders (2)
  - Bulldozers (2)

Accident analysis 2 / 2



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Manufacturers ranking 1 / 2

Objectives:
=> To know the advances and developments of the various manufacturers
=> To challenge the manufacturers among themselves

First survey launched in 01/2023:
- Responses from 15 machine manufacturers
- Exchanges covered by NDA
- **Anonymized classification communicated to each manufacturer**

Second survey launched in 11/2023, to **identify the obstacles** to be removed on the diffusion of Collision Avoidance Systems and confirm the will of manufacturers on certain points: standards, inter-manufacturer work, Proof of Concept. Analysis of responses in progress

Manufacturers ranking 2 / 2

Annexe – Critères de notation

De quelle manière prenez-vous en compte, lors de la conception des machines, le risque de heurt engins/piétons ?	0 : pas de réponse 1 : pas de prise en considération 2 : volonté générique affichée 3 : 2+ solutions à date + approche "structurée" (solutions passives) 4 : 2+ solutions à date + approche "structurée" (solutions actives) 5 : 4 + vision concrète et innovante
Existe-t-il dans votre gamme des engins dotés de système de détection d'obstacles et de piéton ?	0 : Pas de réponse / Non 1 : Oui
Si oui lesquels ?	0 : Non 1 : premières installations / peu de modèles 2 : disponible sur plusieurs gammes
Si oui, quel % des ventes des modèles concernés sont avec le système ?	0 : Pas de taux de monte 1 : Quelques modèles / < 10 % 2 : > 10%
Si oui, quelle technologie est utilisée ?	0 : Rien 1 : Réponse incomplète 2 : Technologies simples / informations trop génériques 3 : Uniquement basées sur le conducteur qui doit regarder 4 : Technologie prometteuse / reconnaissance piéton 5 : Multi technos + avertissement / intervention
Quels développements prévoyez-vous à ce sujet ?	0 : Pas de réponse 1 : Dans l'attente 2 : Développement commercial (augmentation de la couverture de la solution actuelle) 3 : Intention d'intégrer des technologies permettant l'évitement de heurts piétons 4 : Roadmap existante de déploiement de technologies
Existe-t-il dans votre gamme des engins dotés de systèmes d'évitement des collisions, au sens de la norme ISO 21815 ?	0 : Pas de réponse / Non 1 : Oui
Si oui lesquels ?	Pas de note sur cette question
Si oui, quel % des ventes des modèles concernés sont avec le système ?2	0 : Pas de taux de monte 1 : Quelques modèles / < 10 % 2 : > 10%
Si oui, quelle technologie est utilisée ?2	0 : Rien 1 : Réponse incomplète 2 : Technologies simples / informations trop génériques 3 : Uniquement basées sur le conducteur qui doit regarder 4 : Technologie prometteuse / reconnaissance piéton 5 : Multi technos + avertissement / intervention
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⇒ Surveys to be repeated to measure offer evolution

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Expectations of the branch 1 / 2

- Objective :
  ⇒ **To reach a consensus** between different user companies to guide the work of manufacturers

- Specifications based on **existing standards**, and specifying the expected performance
  - NF EN ISO 13849-1 :2016 : « Safety of machinery – Safety-related parts of control systems - general principles for design »
  - ISO 21815-1 :2022 : « Earthmoving machinery — Collision warning and avoidance – General requirements », not yet taken up by AFNOR in the French collection.

- **Specifications** that may form an **appendix** to the consultations of the companies

Expectations of the branch 2 / 2

Collision warning and avoidance systems
Specifications – Revision 2

Preamble

The requested system shall comply with NF EN ISO 13849-1 :2016 "General principles for the design of safety-related control systems".

The system requested is a collision warning system (*CWS*) and a *collision* avoidance *system* (CAS) as defined in ISO 21815-1 "Earth-moving *machinery — Collision warning and avoidance — Part 1: General requirements*", not translated into French in 03/2023,

Whether or not the mobile machinery equipped with this system is an earthmoving machine, **this system shall comply with ISO 21815-1:2022**, and with the performance requirements defined in Chapter 4 of this standard, except for the provisions mentioned below, which apply instead of or in addition to the provisions of the standard.

These specifications do not apply to road-rail machines, which are subject to SNCF approval and are the subject of particular specifications established with the Syndicat des Entrepreneurs de Travaux de Voies Ferrées de France (SETVF).

The tenderer must inform the applicant whether any of the requirements of these specifications have a significant impact on the level of price of his proposal. Where applicable, it must provide an estimate of the financial impact.

It.	Description	Mandatory	Optional
7.2	The collision avoidance system shall not be capable of being override in the event of proximity to a person.	1	
7.3	It shall be possible to deactivate the collision avoidance system in the event of proximity to an obstacle.	1	
7.4	The system must ask the driver for confirmation before entering override mode.	1	

Annex C – Specification Compliance Matrix

Requirement Number	Requirement	OK	Not OK	Tenderer comments	Client comments
1	**Compliance with standards**				
1.1	- Performance level D mini for detection				
1.2	- Performance level A mini for warning				
1.3	- Performance level D mini for avoidance				
1.4	- ISO 21815-1:2022 compliance				
2	**Object to detect**				
2.1	- People detection				
2.2	- Detection of any obstacle				
3	**Information in case of malfunction or departure from the range of use**				
3.1	Frequency of self-diagnosis and verification of operating range				
3.2	Equipement not blocked if system is not available				
4	**Provisional conditions of use**				
4.1	- Temperature				
4.2	- Luminosity				
4.3	- Fog, rain, snow, dust				
4.4	- Speed				
4.5	- Slope				

Automatic Emergency Braking: A complex topic

Expleo deliverables 1 / 2

Objectives :

⇒ To take stock of the **state of the art** of automatic emergency braking(AEB) technologies used in the automobile

⇒ To recommend **viable technologies a**nd **system architectures** to integrate these devices into construction machinery.

- Mission entrusted to **Expleo**, an engineering company specialized in "ADAS"(*Advanced Driving Assistance Systems*)

Expleo deliverables 2 / 2

- **State of Art** (SoA)
  Analysis and recommendation of adapted technologies
- **System Specification Folder** (DSS)
  Requirements that the system must meet
- **System Architecture Folder** (DAS)
  Possible architecture of a system and its physical components
- **Validation strategy** (PVAL)
  Tests to which the system must be subjected during its development
- **Economic feasibility study**
  Estimating the costs of developing a Collision Avoidance System

User survey 1 / 3

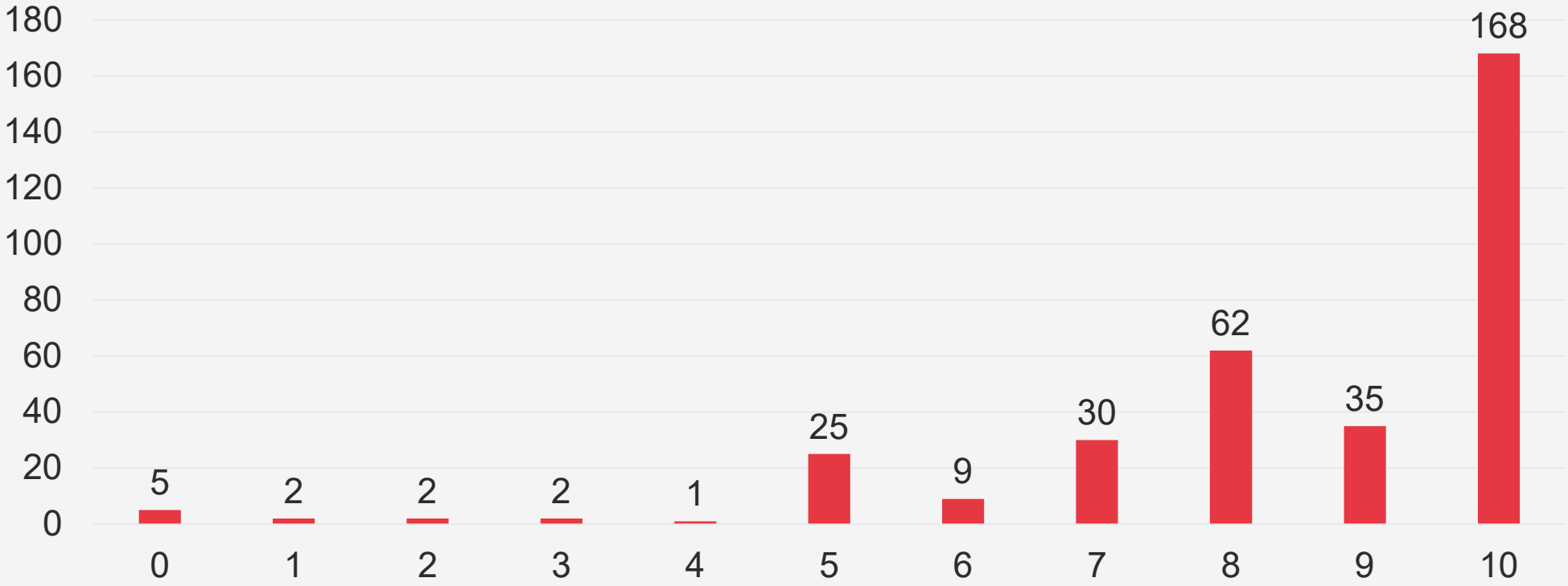
⇒Objective: **To measure stakeholder interest** in Collision Avoidance Systems, and to determine which machines and movements are the market expectations

- **340 answers**, the vast majority of which came from companies that use machines. The majority of contributors work in job-related jobs: site supervisors, construction site managers, etc,...

- The "Net Promoter Score" obtained illustrates a **plebiscite** of collision avoidance systems.

User survey 2 / 3

Q: Would you use or recommend machines equipped with collision avoidance systems?



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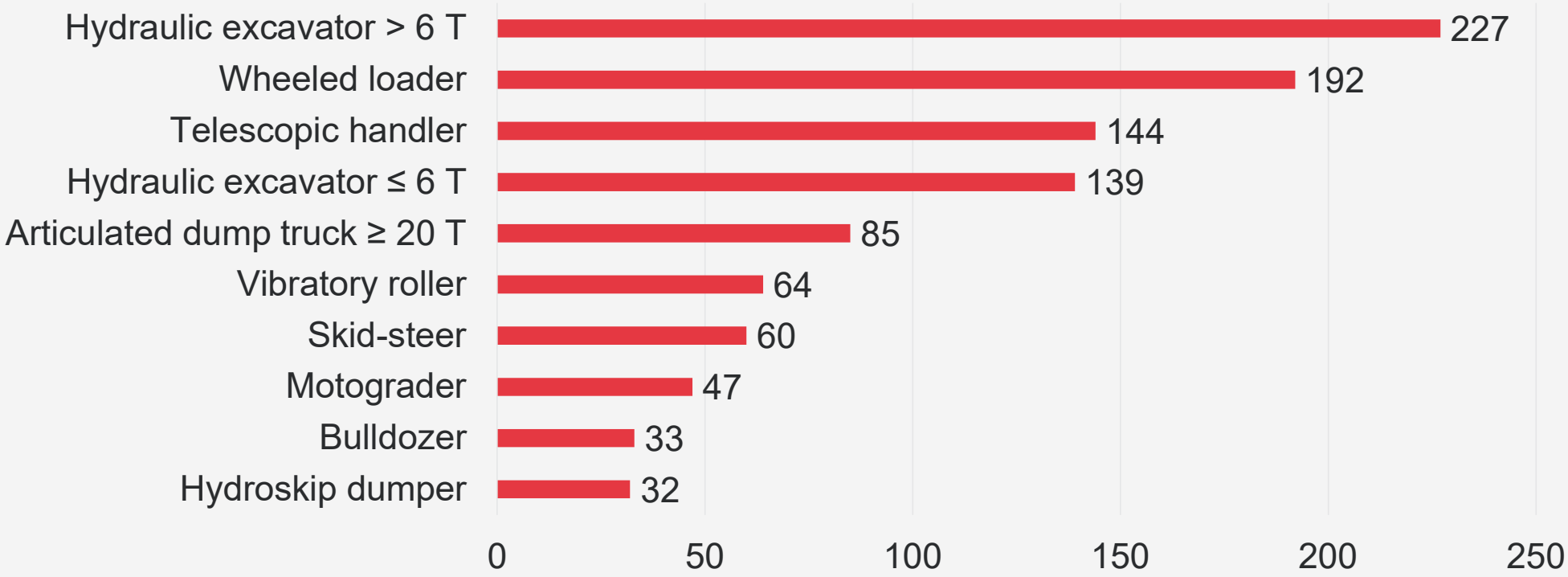
User survey 3 / 3

Q: Select the 3 families on which you think Collision Avoidance Systems should be equipped as a priority (3 answers).



Responsibilities of the actors 1 / 2

- Objective :
  ⇒ **Clarify the responsibilities** of the various stakeholders (manufacturers, companies, operators,…) in the event of accidents related to the failure of a machine equipped with automatic emergency braking, through the analysis of regulations and case law.

- Case of an ex-factory Collision Avoidance System processed.
- Case of retrofit on an existing machinery non taken in account

Responsibilities of the actors 2 / 2

- Findings:
  - Collision Avoidance Systems are similar to fairly "classic" aggravating motion shutdown systems, such as a crane's state of charge (CEC) controller.
  - We are not subject to regulations on autonomous vehicles and machines: there is a driver, who remains responsible for driving his machine.
  - The acquisition or rental of a vehicle with a Collision Avoidance System will not impact an employer's safety obligation towards these employees.

⇒Analysis shared with manufacturers' representatives with a view to a common position

Analysis of EVOLIS and SEIMAT feedbacks under progress.

Next Steps

Next Steps

To continue and strengthen the active incentive (phase II)

- **Share the results of our work**, and the industry's desire to eliminate the risk of machine-pedestrian collisions, at Intermat 2024
- **Publication of the deliverables** produced on www.stopcollision.com
- Participate in the implementation of **experiments** and tests to **accelerate the development** of the offer for certain families of machines and on flagship sites
  - Work undertaken with the SETVF with the manufacturers of road-rail machinery and to be undertaken for other families of specific machinery.
  - Support of the project by the Société du Canal Seine-Nord Europe.

To work for the adoption of the ISO 21815 standard in the French collection by AFNOR.

Part of SCSNE-OPPBTP partnership agreement

« In accordance with its innovation policy, signed by the Supervisory Board on June 29, 2023, the Société du Canal Seine-Nord Europe confirms its support for the STOP COLLISION project. As such, it accepts that its operation will serve as a testing ground to carry out certain phases of the project under the leadership of the OPPBTP, in partnership with many partners. »

« The SCSNE supports innovation driven by companies that apply for its contracts. As such, innovations related to the prevention of the risk of vehicle/pedestrian collisions are taken into account in the criteria for awarding contracts and the rating of companies. With the contribution of the OPPBTP, it conducts information campaigns on the various innovative techniques prior to calls for tenders to enable candidate companies to initiate the necessary investments in order to meet the expectations of the canal market. »