Institut de recherche
Robert-Sauvé en santé
et en sécurité du travail

PRÉVENTION DES RISQUES
MÉCANIQUES
ET PHYSIQUES

Safe set up of cobots in industry: Research status in Québec and multidisciplinary perspective

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Outline

Context

- IRSST
- PRMP team

The evolution of robots

- Safety of cobots

IRSST Research results

- Why use cobots?
- Risks induced by cobots
- Findings from users and research

Development of thematic programming

- Purpose and framework of thematic programming
- Research themes and project ideas
- Resources and collaborations
- Impacts for the work environment and for the IRSST

The IRSST

Founded in 1980

- Private non-profit organization that carries out and finances research

Bipartite Board of Directors

- 7 employers' representatives
- 7 workers' representatives

Tripartite Scientific Advisory Board

- 4 employers' representatives
- 4 workers' representatives
- 6 members from the scientific and technical communities
- Express opinions on the relevance, priority and scientific merits of projects

The Mechanical and Physical Hazards Prevention Team

PRMP Research Areas

Assessment of mechanical and physical hazards caused by machines or the working environment

- Aims to identify, estimate and evaluate both the risks induced by the machines and those related to the environment of the worker

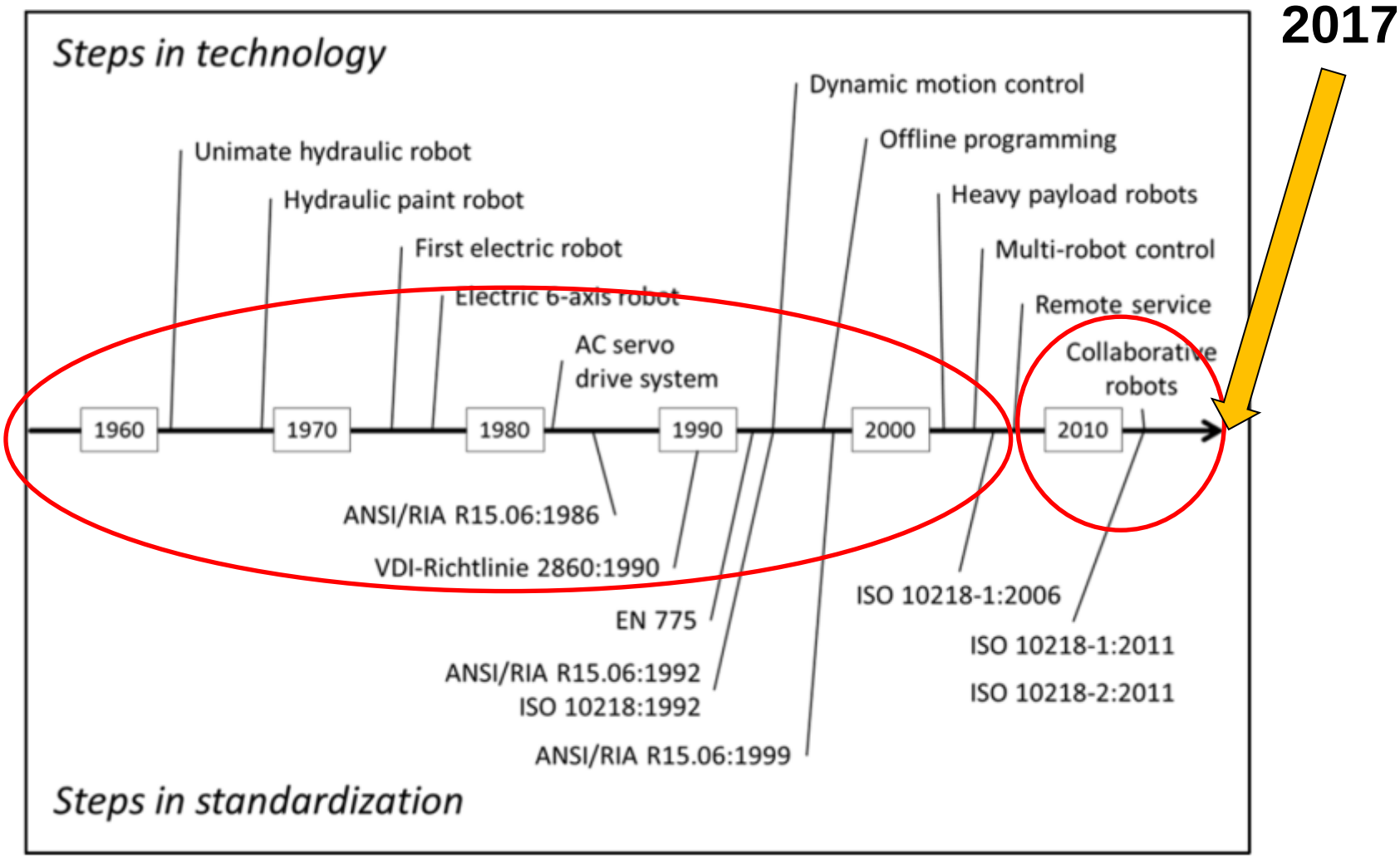
Reduction of mechanical and physical risks

- Focuses on elements that reduce risk

Consideration of the human factor in the assessment and control of mechanical and physical hazards

- Focuses on the effect of humans in the risk assessment and control process

Evolution of robotics



Source: Fryman, J. et al. (2012). Safety of Industrial Robots: From conventional to collaborative applications In : Proceedings of SIAS 2012, Montreal, Quebec, Canada (p. 198–203)

The Safety of Collaborative Industrial Robotics

Conventional industrial robots

- Fixed or movable guards to separate robots from workers
  - No sharing of workspace in production mode
  - No contact
  - Limited access to the robot: maintenance, adjustment, etc.

Collaborative industrial robots

- Change of paradigm (ISO 10218-1:2011; ISO/TS 15066:2016)
  - Sharing a workspace
    - New risks due to workers / cobot proximity
  - Interaction and contact allowed under certain conditions
    - How collaborative robots work

IRSST Research results - Why use cobots?

Acquisition cost a priori lower than conventional robotics (eg. rapid return on investment)

Simplified programming for SMEs (eg guided learning)

Exploitation of two additional qualities

- Robot power, endurance and precision
- Intelligence and decision-making power of the human being

Provides flexibility (eg change in production)

Allows a theoretical gain of space (no guard)

- ☒ The safety distances are greater without guard ...

Allows to limit TMS on repetitive tasks with low added (easier to repair the robot than a worker ...)

However

- ☒ The cobots are slower than the robots (loss of cadence ...)

Research results - Risks Induced by Cobots

Generation of new risks compared to conventional robotics due to the sharing of the workspace

- Risk of collisions
  - Sharing Workspace and Task
- Risk of musculoskeletal disorders (MSD)
  - Who manages the cadence: the cobot or the worker?
- Psychosocial risks
  - Continuous presence of the cobot around the workers
  - Anticipation of cobot movements and reactions

The solution will not only be technical, but will also have to go through the human, hence the joint approach of engineers / ergonomists.

Findings from Users and Research

Normative Requirements and Recommendations

- Businesses and integrators lack benchmarks to securely implement and use cobotic applications

Expression of needs

- Specific risk analysis for this type of application
  - New management of risk reduction
  - Importance of working physical space
- Implementation of collaborative modes of operation
  - Modes of operation
  - "Roles and responsibilities" of cobots and workers
- Collaborative human-robot security work
  - Analysis of work activity

Objective of the Thematic Programming

Helping companies to implement and use collaborative robotics equipment in the workplace in a safe and efficient manner

- Developing methods and tools
- Implement normative requirements and recommendations
- Minimize the impact for the worker on health and security at work

Only industrial applications are covered

- Therefore, service applications are excluded

Prevention objective

- Identify risks before massive use of cobots in companies (Murashov et al. - 2016)

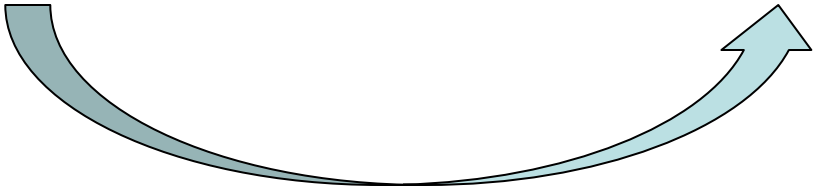
Thematic Programming Framework

Machine safety aspects of collaborative robotics (PRMP)

- Reliability of safety-related control systems
- Stop management
- Specific safety sensors
- Programming (software) of the robot

Man-Robot Collaboration (OHS and Sustainable Prevention Work Environment - PDSSTET)

- Establishing a collaborative workspace
- Analysis of expected and actual work activity
- Power and force limit values in the event of contact (ISO / TS 15066)



Research topics

1. Preparatory analyzes for implementation

- Integration of health and safety at work requirements into the preparatory process
  - Expression of needs / Specifications
  - Analysis of the activity
  - Specific risk analysis

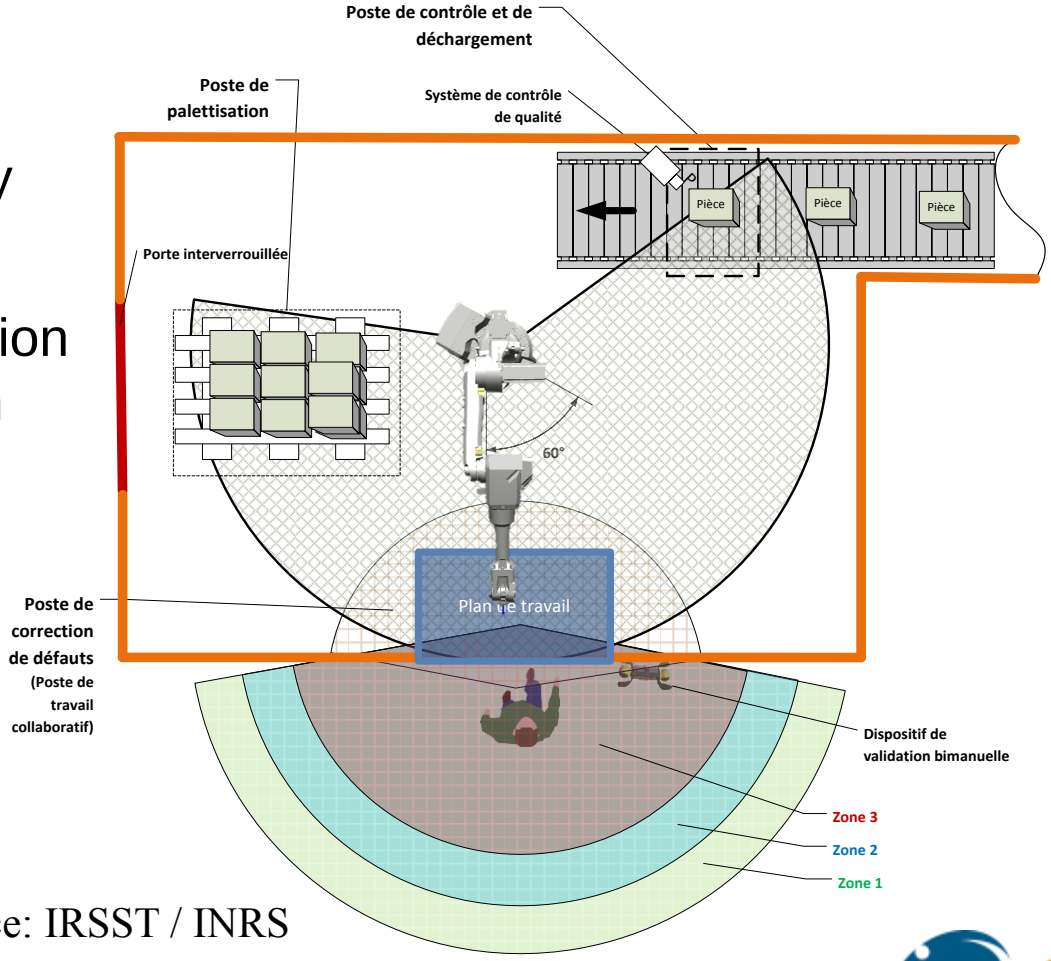
2. Integration of risk reduction means

- Implementation, limitations and impacts on real work activity
  - What safety features are available to industrialists?
  - Do these devices achieve the performance level required for the safety control system?
  - What is their impact on collaborative activity?

Theme # 1 - Topic 1.1

Development of a risk analysis approach that integrates analysis of planned human-robot collaborative activity

- Business survey
- Case Studies
  in Implantation Laboratory
- Proposal of an approach
- In-company experimentation
  of the proposed approach



Source: IRSST / INRS

Theme # 2 - Topic 2.1

Integration of the person detection means in the collaborative space

Recurring problem in machine safety (eg pedestrian-vehicle collision)
Many devices that are not "safe" (eg Kinect)

Work on the implementation of the "Safety Distance" principle
Laboratory and Enterprise Comparison of Available Devices

Theme # 2 - Topic 2.2

Implementation of the mode of collaboration based on the limitation of the robot's power and strength

- Are these limits applicable and safe? Taking the context into account?
- How robot programming plays a role?
- Technologies / principles limiting efforts in case of contact or collision?

Review of literature on collaborative robots and the means available to limit efforts in the event of contact or collision

Development of a protocol and a test bench to test the implementation of limit values in real conditions (ISO / TS 15066: 2016)

Theme # 2 - Topic 2.3

In-company feedback: impact of risk reduction measures on human-robot collaborative activity

- What could have been better thought through at the level of collaboration, software programming and work activity?
- Are the anticipated benefits for the worker there?

Returns of experience in companies

- Difficulties of integration, level of reliability, efficiency
- Real collaboration water
- Improvements in work activity and health and security at work

Planned spin-offs

For the environment

- Methods and tools to promote a safe and efficient implementation of collaborative robotics
- (Eg, decision support tools, case studies, guides, videos, checklists, web application)
- Improving prevention and limiting accidents at work in the future

For the IRSST

- Access to collaborative robotics equipment
- Development of expertise on collaborative robotics, a turning point in the field of machine safety
- Development of internal, national and international collaborations

Questions / Feedback

Thanks

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