**Robotics and Autonomous Systems
International Law and Social Neuroscience Insights
Munich, 20 June**

Robotics and the Law: A European Perspective

Autonomous Systems: Why Intelligence matters

Amedeo Santosuosso – Barbara Bottalico
University of Pavia (I)
European Center for Law, Science and New Technologies (ECLT)
http://www.unipv-lawtech.eu/

Outline

A. What is changing in robotics and law
    a. From robotics to autonomous systems
    b. The increased role of Intelligence

B. EU legislation: basic features

C. The case of autonomous systems and industry: Industry 4.0.

D. Conclusive remarks
    a. European attitude toward regulations and technological innovation
    b. Autonomous Systems: Why Intelligence matters

Outline

A. What is changing in robotics and law
   a. From robotics to autonomous systems
   b. The increased role of Intelligence

B. EU legislation: basic features

C. The case of autonomous systems and industry: Industry 4.0.

D. Conclusive remarks
   a. European attitude toward regulations and technological innovation
   b. Autonomous Systems: Why Intelligence matters

From robotics to autonomous systems

The term **autonomous systems** can be used broadly to encompass many kinds of

- Artificial agents
- Decision-capable agents
- Operating without the direction of a human being.

Examples:

- physical robots and drones
- purely digital software agents (**non-physical** robots).

From robotics to autonomous systems: the case of EMBODIMENT

"**A system acts upon its environment to the extent it changes that environment directly**.
A technology does not **act**, and hence is not a robot, merely by providing **information** in an intelligible format.
It must be in some way. A robot in the strongest, fullest sense of the term exists in the world as a **corporeal object** with the capacity to exert itself physically.
But again**, I am talking in terms of a continuum**".

R. Calo, Robotics and the Lessons of Cyberlaw, 2015

From robotics to autonomous systems: the case of embodiment

J. L. AUSTIN

HOW TO DO THINGS WITH WORDS

The William James Lectures delivered at Harvard University in 1955

Philippe-Joseph Salazar

PAROLES ARMÉES

Comprendre et combattre la propagande terroriste

lemieux éditeur

SPEECH ACTS

AN ESSAY IN THE PHILOSOPHY OF LANGUAGE

JOHN R. SEARLE

Professor of Philosophy University of California, Berkeley

1969

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

From robotics to autonomous systems: the case of embodiment

A. Acts vs. Information: the lesson from *speech acts theory*
- We can do things with words
- However *doing things with words* is **NOT** the same than doing things with physical action.
- It rather shows **how wrong is the idea that words are, by definition, external and different in kind from actions**.

B. Effects of adopting such a broad definition
- It has the advantage of encompassing a large spectrum of technological agents
- However it **does not imply regulations should be the same** for all the items falling into the definition.
- ….

Outline

A. What is changing in robotics and law
    a.   From robotics to autonomous systems
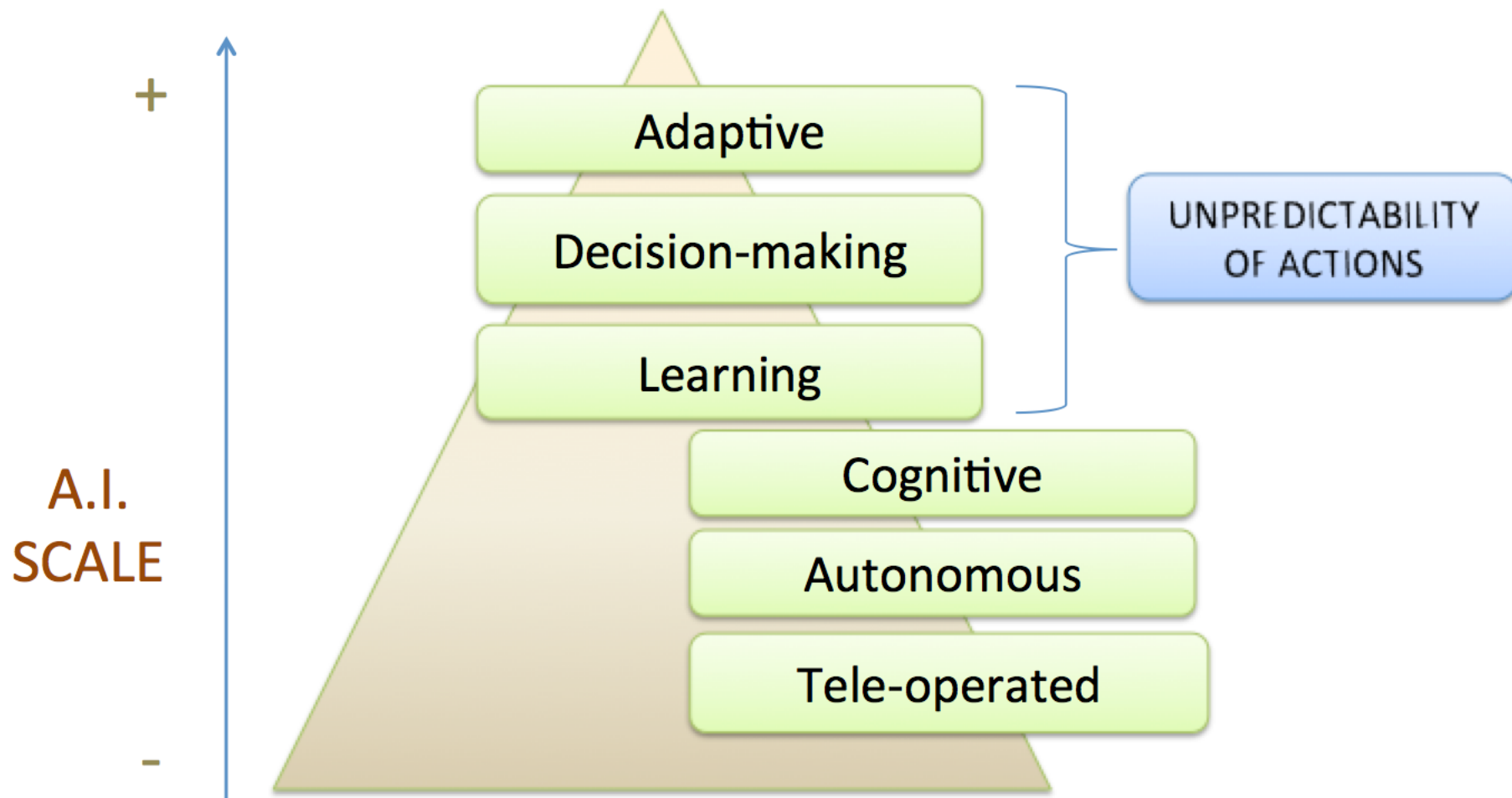   b.   The increased role of Intelligence

B. EU legislation: basic features

C. The case of autonomous systems and industry: Industry 4.0.

D. Conclusive remarks
    a.   European attitude toward regulations and technological innovation
    b.   Autonomous Systems: Why Intelligence matters

From robotics to autonomous systems

SRA Technical Glossary and SRA ELS Glossary appendixes to:
The Strategic Research Agenda (SRA) for Robotics in Europe, 07/2009
Europ - http://www.robotics-platform.eu/cms/index.php

Autonomy and Cognitive ability in current literature

- **Focus on the ability to accomplish a task by itself, <u>without external directions</u>.**
  - ✓ Capability that enables a particular action of a system to be *automatic* or, within programmed boundaries, *self-governing*." (US Military Defense Science Board, DSB 2012, Section 1.1)
  - ✓ "the capacity to operate in the real-world environment without any form of *external control*, once the machine is activated and at least in some areas of operation, for extended periods of time." (Lin, Abney and Bakey, 1988)

- **Focus on <u>cognitive capacity</u>, and in particular on the capacity to obtain new knowledge, interacting with the environment.**
  - ✓ "an agent's *capacity to learn* what it can to compensate for partial or incorrect prior knowledge." (Russell and Norvig, 2010)

- **Focus on <u>the internal cognitive architecture </u>of the system:**
  - ✓ A system is autonomous to the extent it does not merely react to external stimuli, but rather *integrates such stimuli into its cognitive structures, by modifying appropriately its internal states* (Castelfranchi-Falcone, 2005)

Three dimensions of autonomy

a. Independence

b. Cognitive skills

c. Cognitive architecture
   i. **teleonomy** (direction to a purpose),
   ii. **adaptiveness** (the capacity of getting inputs from the environment and changing internal states in such a way as to better respond to challenges), and
   iii. **teleology** (the capacity of having representations of the environment an goals to achieve, and to identify appropriate means).

These aspects of autonomy **do not necessarily coexist** and converge.

(Sartor-Omicini 2015)

Effects on responsibility

- **A landmine**

is completely _independent_ in performing the operation for which it is deployed, namely, blasting when a human or vehicle passes over it. However it possesses very limited cognitive skills.

INDEPENDENCE COGNITIVE CAPACITIES

- **A targeting system**

follows the target and calculates trajectories until an operator pushes the "fire" button. Such system is not independent with regard to the objective of hitting the target (it is up to the operator to push the bottom). However, _it performs highly complex discriminative functions_, distinguishing many possible input states, integrating many different features of such states to determine what circumstances most probably obtain, proposing the action that is most likely to produce the desired outcome under the given circumstances.

INDEPENDENCE **COGNITIVE CAPACITIES**

An autonomous system is normally just a component of a larger **sociotechnical system.**
Crucial point: is the human still in the loop?

Outline

A. **What is changing in robotics and law**
   a. From robotics to autonomous systems
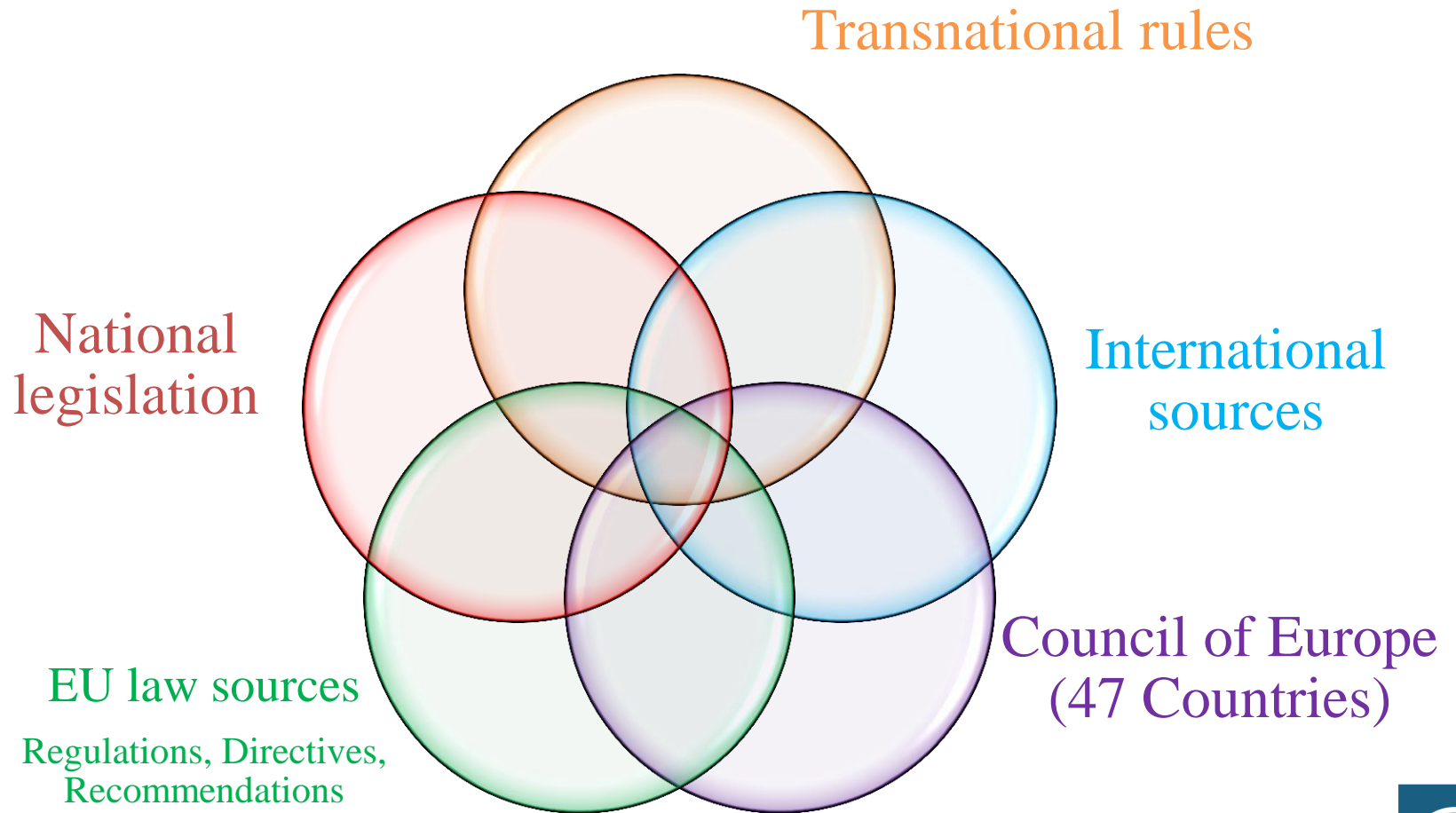   b. The increased role of Intelligence

B. **EU legislation: basic features**

C. **The case of autonomous systems and industry: Industry 4.0**.

D. **Conclusive remarks**
   a. European attitude toward regulations and technological innovation
   b. Autonomous Systems: Why Intelligence matters

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

The complexity of legislation in Europe

Transnational rules

International sources

National legislation

Council of Europe (47 Countries)

EU law sources

Regulations, Directives, Recommendations

Not only Europe and USA

Task 3.5 Standardisation

Practically all standard development related to robots takes place in ISO TC 184/ SC 2 committee and is organized in six working groups (see figure below). Nations that are currently actively participating in developing these standards are **China**, **France**, **Germany**, **Italy**, **Japan**, **Korea** and **UK**.

WG3 receives additional contributions from **Canada**, **Sweden** and **Switzerland** and the **USA.**
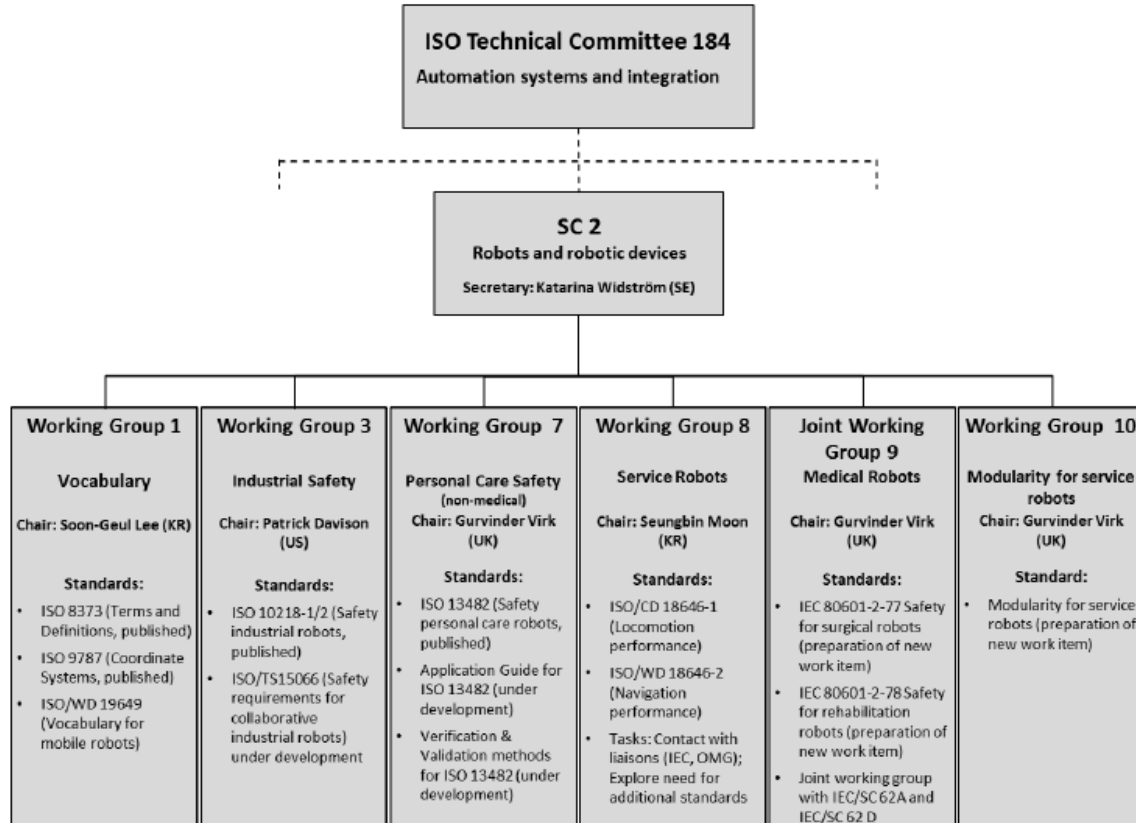
A MATTER OF DEFINITION

LEGALLY SPEAKING A ROBOT CAN BE

THING/PRODUCT

any tangible movable item, with the exception of:
- goods sold by way of execution or otherwise by authority of law,
- water and gas;
- electricity.

IPR

Market

Consumer protection

Security Standards

Data protection

NON-HUMAN AGENT

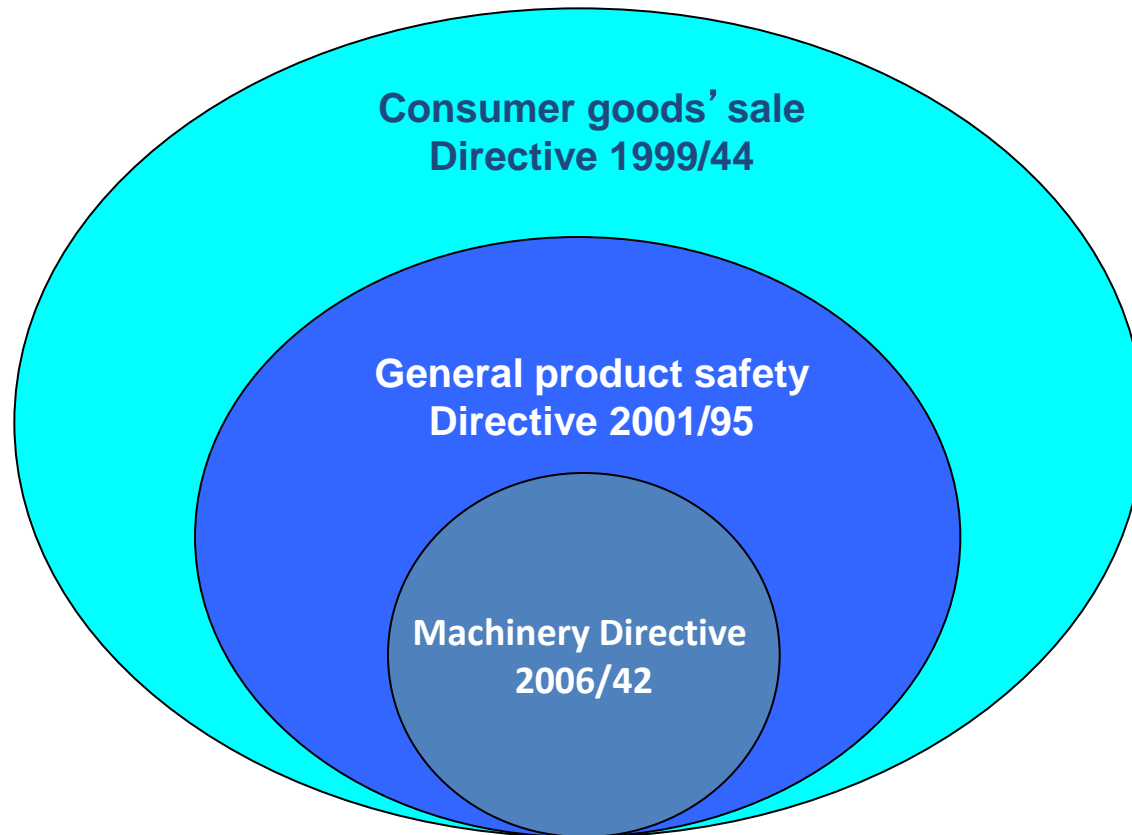entity able to ACT, considering its actions in the area of legal responsibility.
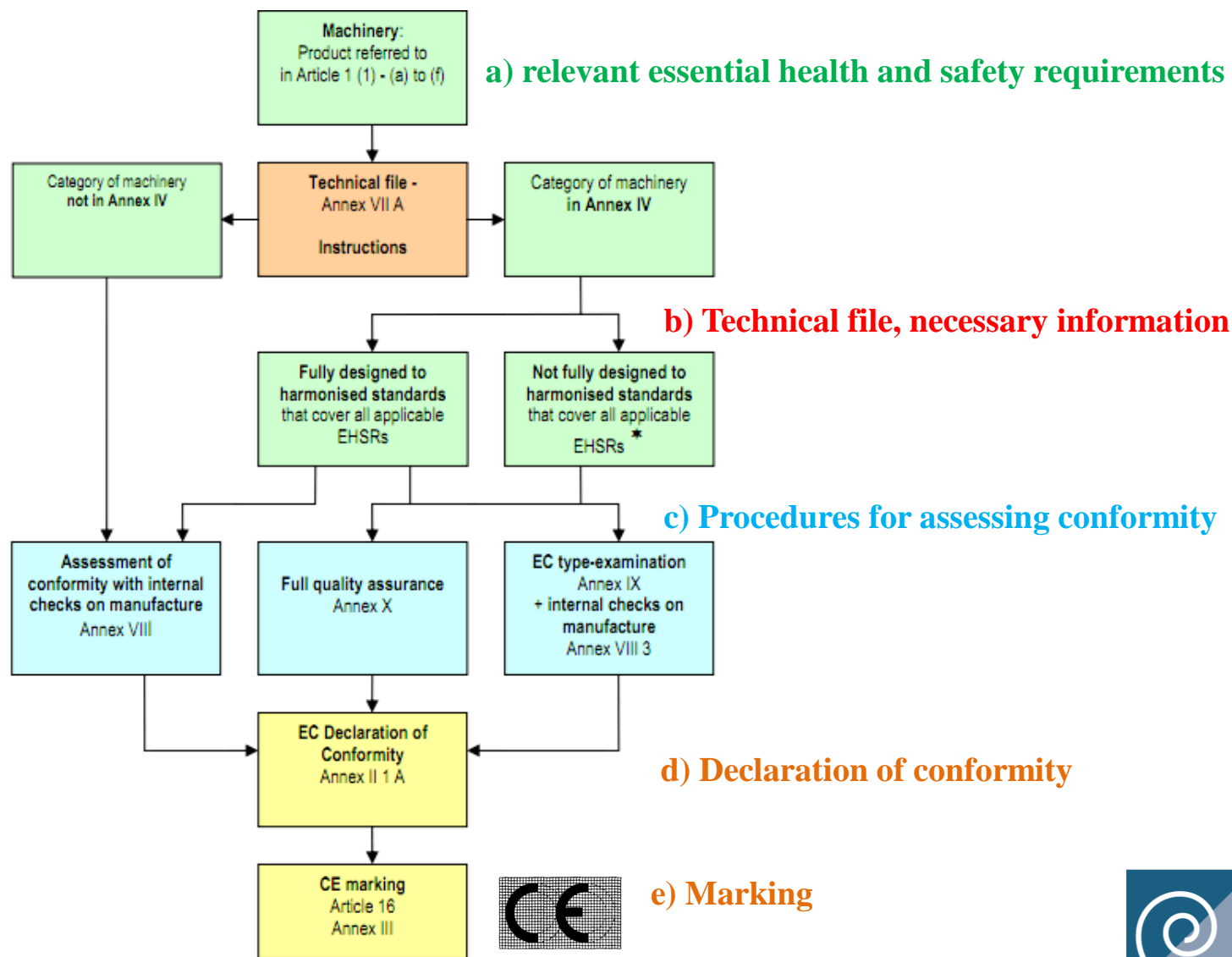
Non- contractual liability

Criminal Law

E-Personhood

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

ROBOTS AS PRODUCTS:
EU LAWS ON MARKET AND CONSUMER PROTECTION

Consumer goods' sale
Directive 1999/44

General product safety
Directive 2001/95

Machinery Directive
2006/42

THE DIRECTIVE 2006/42 ON MACHINERY

To place machinery on the market :

a) relevant essential health and safety requirements

Machinery:
Product referred to in Article 1 (1) - (a) to (f)

Category of machinery not in Annex IV

Technical file - Annex VII A

Instructions

Category of machinery in Annex IV

b) Technical file, necessary information

Fully designed to harmonised standards that cover all applicable EHSRs

Not fully designed to harmonised standards that cover all applicable EHSRs *

c) Procedures for assessing conformity

Assessment of conformity with internal checks on manufacture
Annex VIII

Full quality assurance
Annex X

EC type-examination
Annex IX
+ internal checks on manufacture
Annex VIII 3

EC Declaration of Conformity
Annex II 1 A

d) Declaration of conformity

CE marking
Article 16
Annex III

e) Marking

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

The case of Intellectual Property Rights

IPR & ROBOTS

ROBOTS AS OBJECTS OF IP'S PROTECTION

ROBOTS AS SUBJECTS OF IP'S PROTECTION

1. Copyrights
2. Database Rights
3. Patents
4. Trademark Rights
5. Industrial Design Rights
6. Semiconductor Topography Rights
7. Trade Secrets

*Utrecht University, Center of Intellectual Property Rights (CIER):
Overview of Intellectual Property Rights related to the Development of Robotics in Europe
M.de Cock Buning, L.Belder, R.de Bruin.

*Corinne Hueber-Saintot - CEA - DRT/VALO
Head of Contracts and Intellectual Property Department - Saclay Center

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

Copyrights

a) Every *literary, scientific or artistic work* is copyright protected, as long as it is *original* (not copied nor derived from other works).

b) The work must be an author's *own intellectual creation.*

c) The copyright holder has the exclusive right to produce reproductions of the work and to communicate the work to the public (copy, translate, distribute, broadcast, rent copies, etc.).

Robots

Many aspects of a robotic device can be copyright protected (programming codes, preparatory works, design of a robot).
Note: development of the programming software of a robotic device, requires permission of the original programmer/right holder.

Robot generated work's ownership

What happens when intelligent agents do not assist humans in the creation of works, but generate them autonomously? Are they capable of creativity?

The robot itself is in fact the author or the inventor: who will be entitled to the rights thereto?

1. Computer programmer?

2. User?

3. Intelligent agent itself?

4. Investor (owner or person who makes financial and logistical contributions for the development)?

Outline

A. **What is changing in robotics and law**
    a. From robotics to autonomous systems
    b. The increased role of Intelligence

B. **EU legislation: basic features**

C. The case of autonomous systems and industry: Industry 4.0.

D. Conclusive remarks
    a. European attitude toward regulations and technological innovation
    b. Autonomous Systems: Why Intelligence matters

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

Autonomous systems and regulation issues in Europe
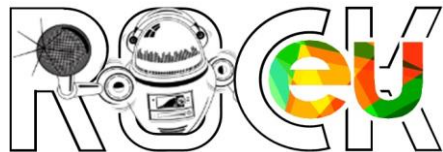
Research in progress

- what are the legal obstacles to put advanced robotics on the market?
- Are those obstacles due to national or European regulations?
- What specific changes are needed in regulation at national and European level?

Robots in the industry

Robots in the healthcare
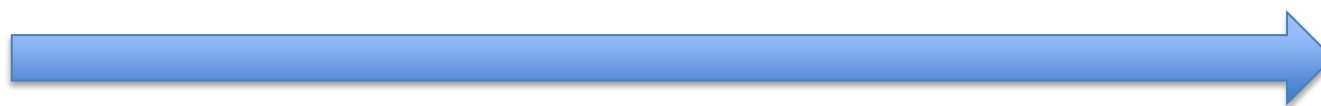
Self driving cars

Robots in the healthcare

Care robots

Telemedicine and e-health

Among the legal issues:
- Who is responsible in case of wrong indications?
- Who is responbile for damages caused to the user?

Robots in the industry

- Industry 4.0:
  - Internet of things
  - Big Data
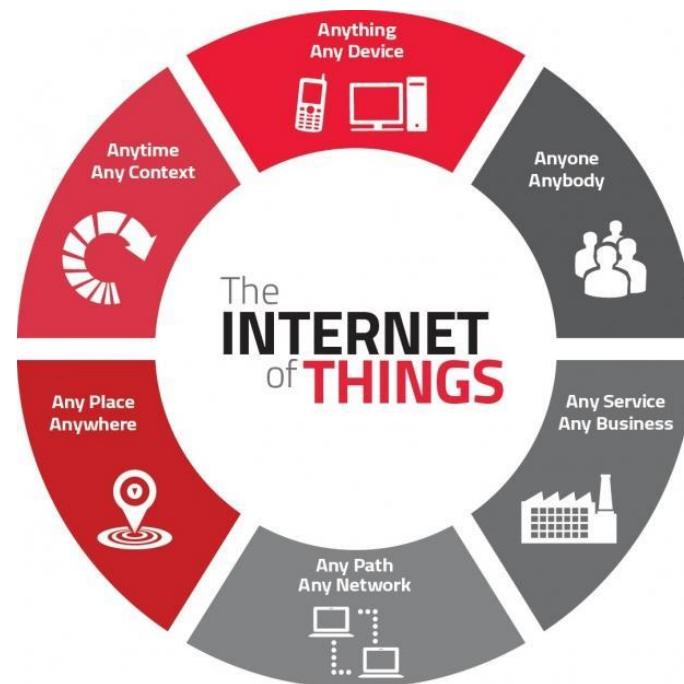 - Cloud robotics
  - Industrial robots

Image: http://www.dialoghannover.it/portfolio/industry-4-0-ce-ancora-molto-da-fare/

Robots in the industry
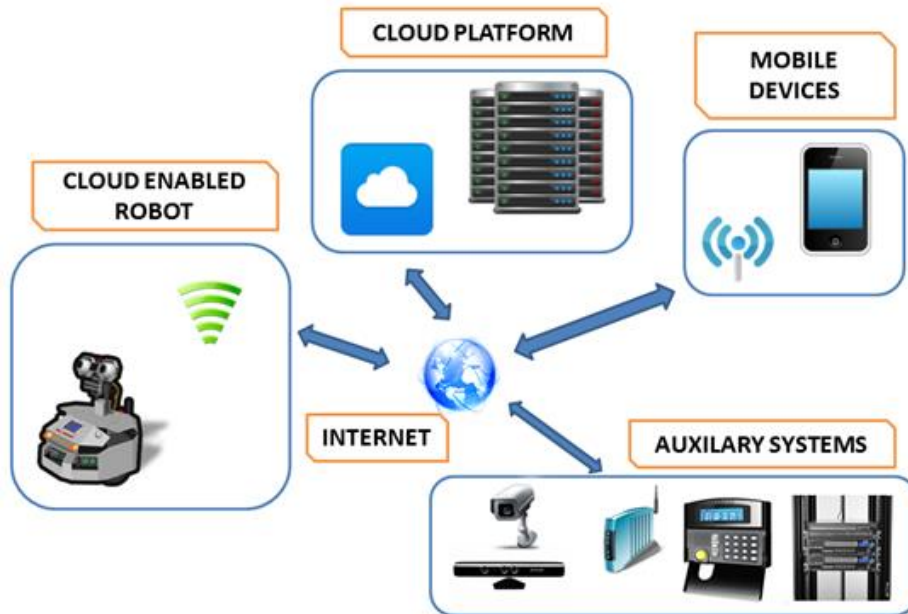

Human-robot interaction

- Safety issues
- Psychological issues
- New definition of job descriptions

Innovation in the workplace

CLOUD PLATFORM

CLOUD ENABLED ROBOT

MOBILE DEVICES

INTERNET

AUXILARY SYSTEMS

LEGAL ISSUES:

Privacy and survelliance on employees
- Recommendation CM/REC(2015)5 on the processing of personal data in the context of employment

- Italian Data Protection Authority for E-mail and Internet (2007) ["*In general, the employer's control must maintain a "human dimension", which should not be inflamed by the use of technologies that can exacerbate the employer's supervision of employees without any confidentiality and autonomy in the management of the employment relationship*"]

Data protection:

Personal data vs. medical data in the cloud

Outline

A. **What is changing in robotics and law**
   a. From robotics to autonomous systems
   b. The increased role of Intelligence

B. **EU legislation: basic features**

C. **The case of autonomous systems and industry: Industry 4.0.**

D. **Conclusive remarks**
   a. European attitude toward regulations and technological innovation
   b. Autonomous Systems: Why Intelligence matters

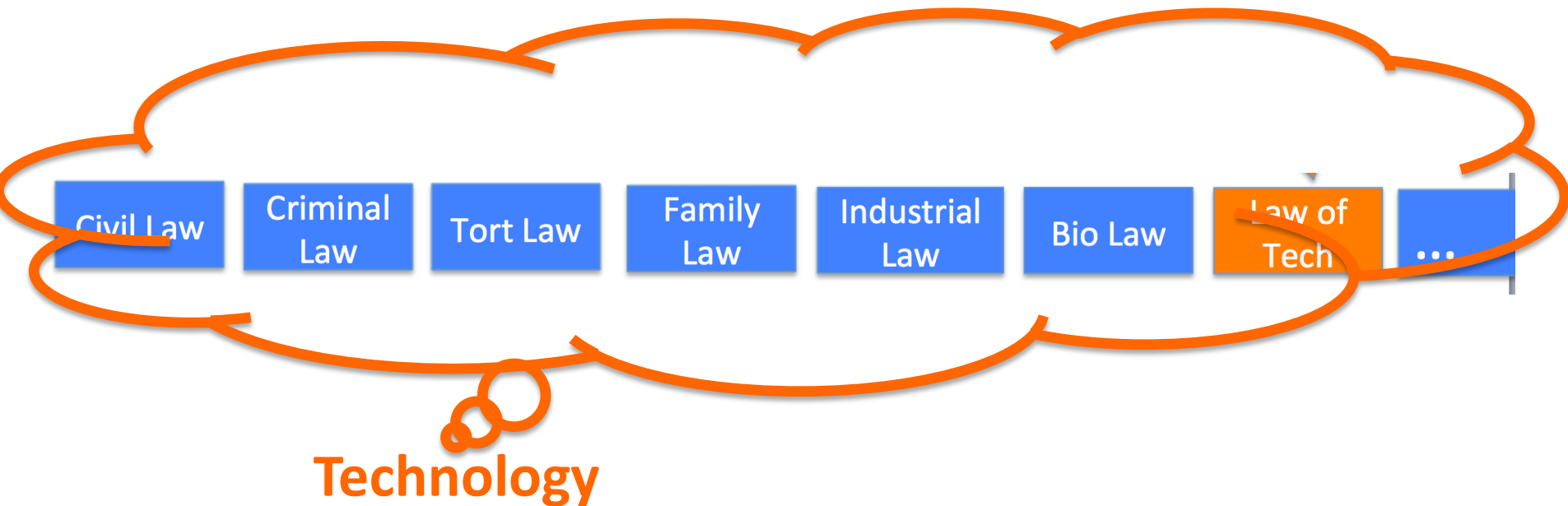| Civil Law | Criminal Law | Tort Law | Family Law | Industrial Law | Bio Law | Law of Tech | ... |

Technology

**Technology is NOT added to our social reality
And law is embedded in it already**

The crucial questions today:

- WHAT has really happened till now and what is happening?
- WHERE ? In which areas?
- HOW ? At what speed? What facilitating and hampering factors? And more…

Responsible research and innovation (RRI)
is an approach that anticipates and assesses potential implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and sustainable research and innovation.

RRI implies that societal actors (researchers, citizens, policy makers, business, third sector organizations, etc.) work together during the whole research and innovation process in order to better align both the process and its outcomes with the values, needs and expectations of society.

In practice, RRI is implemented as a package that includes multi-actor and public engagement in research and innovation, enabling easier access to scientific results, the take up of gender and ethics in the research and innovation content and process, and formal and informal science education.

Operational Objectives (of the HBP)

HBP research and technology development has numerous **social, ethical and philosophical** implications.

The project thus has an interest **in recognizing concerns <u>early</u>** and in addressing them in an open and transparent manner. In particular, **<u>early engagement</u>** can

provide scientists with opportunities to gauge public reaction to their work, and to <u>hone their research objectives and processes</u> in the light of these reactions.

The HBP will therefore launch **a major Ethics and Society Programme**, with the goal of exploring the project's social, ethical and philosophical implications, promoting engagement with decision-makers and the general public, promote responsible research and innovation by raising social and ethical awareness among project participants, and ensuring that the project is governed in a way that ensures full *compliance with relevant legal and ethical norms*. The programme will draw on the methods developed during empirical investigations of emerging technologies in genomics, neuroscience, synthetic biology, nanotechnology and information and communication technologies ….

1.2.4 SP14: The HBP Ethics and Society Programme

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

"a shift is perceived to be necessary towards defining at what society wants to get out of technology as well. This necessitates an assessment of the 'right impacts' of science and technology activities *on forehand*, rather than restricting these in hindsight.
The focus here is on **anticipating problems**, taking into account wider social, ethical issues, as a form of '**anticipatory governance**' ".

Governance does not restrict itself to the definition and implementation of regulation in the form of negative constraints for science and technology but also of **positive aims** in a societal setting.
... governance of science and as an incentive for **right** impact-innovations.

**from ELSI approach (anticipating problems)
to
'anticipatory governance'**

Overview of the SATORI project

Website: http://satoriproject.eu/

SATORI is a 45-month project, comprising 17 partners from 13 countries, including an intergovernmental organisation, the aim of which is to improve respect of ethics principles and laws in research and innovation, and to make sure that they are adequately adapted to the evolution of technologies and societal concerns. The partners will develop an ethics assessment framework based on thorough analysis, commonly accepted ethical principles, participatory processes and engagement with stakeholders, including the public, in Europe and beyond. The budget is € 4.7 million, and the running time is January 2014 – September 2017.

ORIGINAL PAPER

Anticipatory Ethics for Emerging Technologies

Philip A. E. Brey

Responsible research and innovation (RRI)

is an approach that **anticipates** and assesses **potential** implications and societal expectations with regard to research and innovation, with the aim to foster the design of inclusive and **sustainable research and innovation**.

RRI implies that **societal actors** (researchers, citizens, policy makers, business, third sector organizations, etc.) **work together** during the whole research and innovation process…

In practice, RRI is implemented as a package that includes multi-actor and **public engagement in research and innovation**, enabling easier access to scientific results, the **take up of gender and ethics in the research and innovation…**

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

Some questions about the anticipatory approach beyond its *prima facie* reasonableness

- **Anticipatory approach AND social development, economic growth and global interaction and competition**

- **Anticipatory approach, normative pressure over scientists AND freedom of scientific research?**

- **Anticipatory approach AND its theoretically foundation. What about the case of science and tech which take an unforeseen way?**

Outline

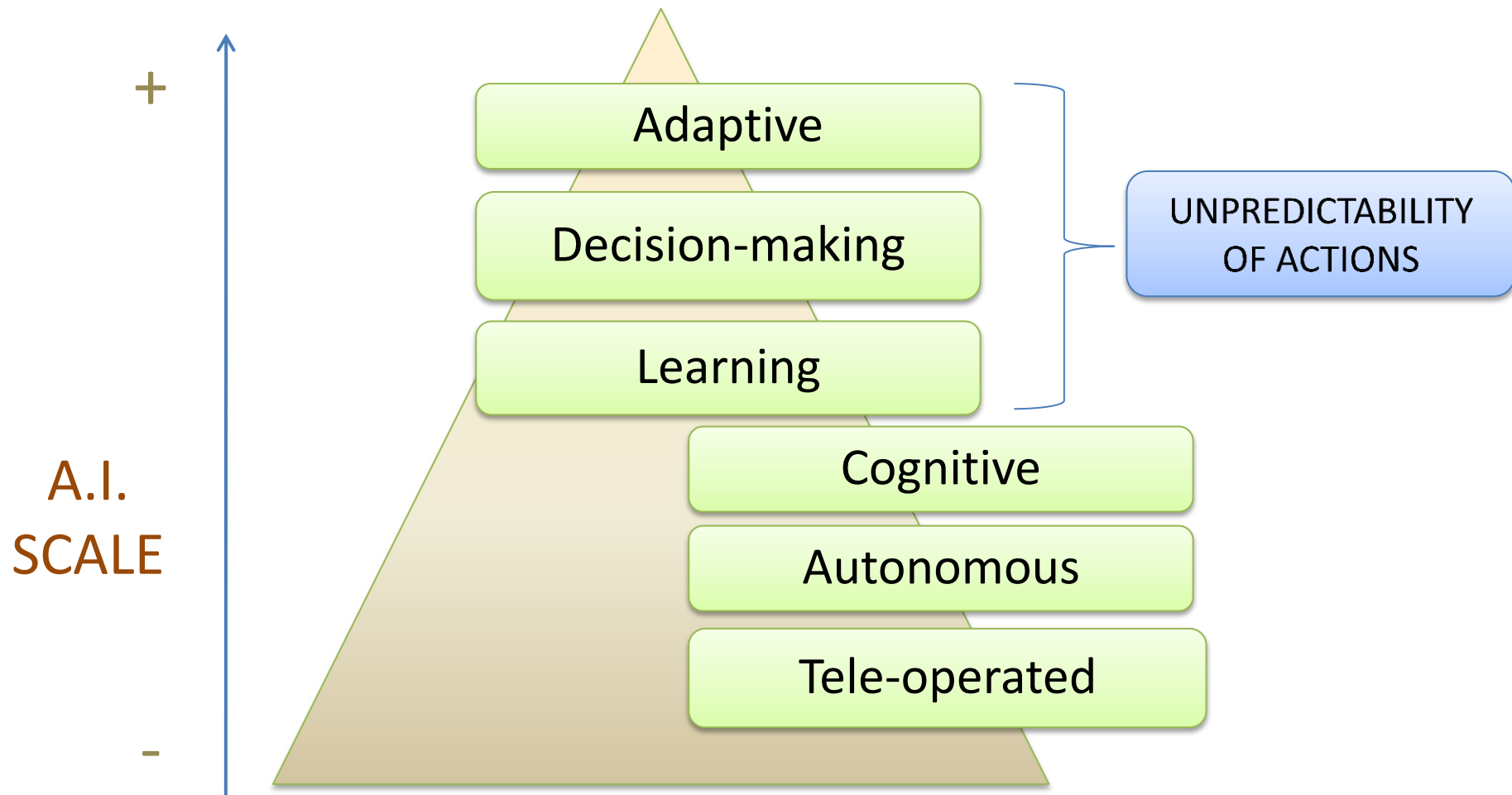A. **What is changing in robotics and law**
   a. From robotics to autonomous systems
   b. The increased role of Intelligence

B. **EU legislation: basic features**

C. **The case of autonomous systems and industry: Industry 4.0**.

D. **Conclusive remarks**
   a. European attitude toward regulations and technological innovation
   b. Autonomous Systems: Why Intelligence matters

A.I. SCALE

+

Adaptive

Decision-making

Learning

UNPREDICTABILITY OF ACTIONS

Cognitive

Autonomous

Tele-operated

−

SRA Technical Glossary and SRA ELS Glossary appendixes to:
The Strategic Research Agenda (SRA) for Robotics in Europe, 07/2009
Europ - http://www.robotics-platform.eu/cms/index.php

EUROPEAN CENTER
for LAW, SCIENCE
and new TECHNOLOGIES

Human Brain Project

HBP Vision

The goal of the Human Brain Project is to build a completely new information computing technology infrastructure for neuroscience and for brain-related research in medicine and computing, catalysing a global collaborative effort to understand the human brain and its diseases and ultimately to emulate its computational capabilities.

- to build a **completely new information computing technology infrastructure**
  - for **neuroscience** and for **brain-related research**
  - in **medicine** and **computing**

- catalysing a global collaborative effort
  - to **understand the human brain** and its **diseases** and
  - ultimately **to emulate its computational capabilities**.

.

Human Brain Project (HBP)

understanding the brain, its diseases & deriving future technologies

prof. Idan Segev, (Edmond and Lily Safra Center for Brain Science, Università ebraica di Gerusalemme, **Deputy Director of the HBP**)

Simulation

Supercomputing

Visualization

Analytics

Computation

Modeling

Neuromorphics

Diseasome

Neurorobotics

Brain Probes

Education

The Neuroscope

Informatics

Screening

Neuroscience

Coordination

Society

Big data analytics

The umbrella concept shifts

from **action**

to

information processing and analytics ability.

The ability to process information becomes the main essential point

Thank you !

European Center for Law, Science and New Technologies
University of Pavia, I

http://www.unipv-lawtech.eu/

a.santosuosso@unipv.it
barbara.bottalico@unipv-lawtech.eu