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CEA LIST

A green paper on legal issues in robotics

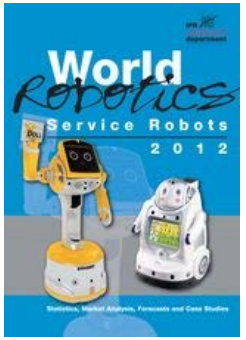
International workshop on autonomics and legal implications,
Berlin, 2nd November 2012

Title

- Introduction: economic context
  - Robot create jobs, Robotics market, International Competition, Robotics a chance for European industry and research activity
- euRobotics
  - What is it? Objectives: study ELS issues Specific to robotics,
- Green paper
  - What is a green paper? Methodology, Issues with case studies, Top down approach
  - What is a robot? What are its abilities?
  - Laws and legislation in Europe, robot market and consumer laws, IPR, labor laws and robotics, data protection, criminal law, conflicts and litigation involving robots, non human agents and electronic personhood
- Conclusions and future actions
  - White paper

Robots create jobs

- Martech report highlights three critical areas of growth in robotics:
- robots carry out work in **areas unsafe for humans**
  - Marlin Steel, USA, increased workforce by 25% in 15 years and increased payment of an hour by 4 times (6$/hour to 25$/hour).
- robots carry out work **not economically viable in a high wage economy**
  - Odense Steel Shipyard increased productivity by factor six with a robotic arc welding system, made quality improvements, whilst protecting jobs of qualified welders.
- robots carry out work that would be **impossible for humans**
  - Robots contributed significantly to growth and employment within high tech industries (electronics, semiconductor and pharmaceutical sectors) providing required quality, precision, speed and traceability unachievable manually.
- **3 million jobs** today are enabled by use of 1 million robots.
- **1 more million jobs in the next 5 years** due to adoption of robotics technology (consumer electronics, solar & wind, and advanced fuel cell technology, …)



Robotics an economic sector in growth

- A technological revolution similar to computer technology
- According to Japan Robotics Association global market estimated to
  - US$ 11 billion in 2005,
  - Possibly US$ 30 billion in 2015,
  - US$ 60 billion in 2025
- Growth of demand in 5 years-time stimulated by service robotics, defence, co-working, intervention in hazardous environment, space, agriculture, health, ageing,
- according to ABI Research study in 2011
  - Personal Robotics Market to Top $19 Billion in 2017,
  - Growth of market for military robotics from $5.8 billion in 2010 to more than $8 billion in 2016

Robotics in Europe

- **Many trumps in Europe**: world leaders and high quality of research labs and industries,
- EC swaps **from a project to a program logic** for financing research in Robotics in Europe: **robotics 2020 PPP**
- Ambitious research program: **ROBOCOM Flagship**
- Robotics is **a major opportunity for European economy**

Some issues

Many cooperative projects financed by EC

- Little impact in European economy
- Industries and academia do not see the level of maturity the same way
- Few measures to favour and achieve technology transfer

Reluctances and fears in the public about robotics

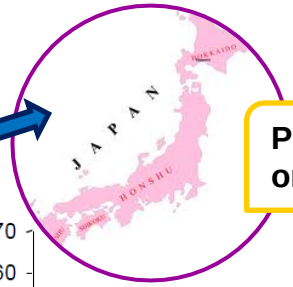
Companies willing to develop platforms for mass market meet some serious Hindrances

- Security standards **too tight to norms for industrial machines**. These norms, too restrictive, seem to be an obstacle to the development of robotics sector (increasing costs and making developments slow)
- Civil liability when using robot is not clarified.

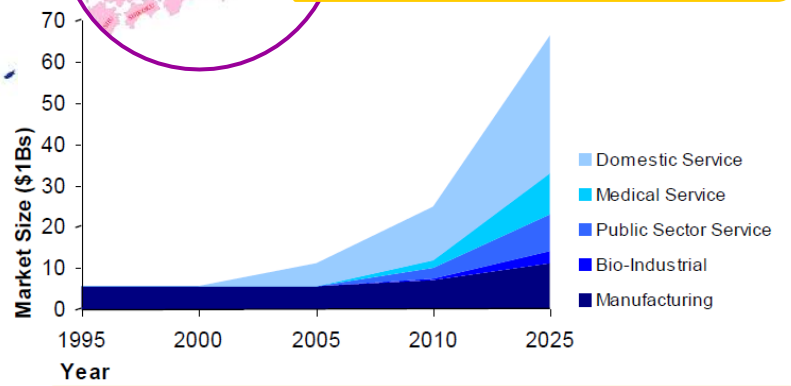
International competition

Huge force, and vast expertise in service robotics, defence, mining, agriculture, health
Important effort to **impose American standards**
Multiple financing sources: market, private funding (1billion US$), large projects
Most important service robotics market in the world (250M€ of income for iRobot)

750 M$ to make Korea to be 3rd robotics nation
Plan to be **leader of service robotics in 2018** and hold 20% of world market
One robot in each household in 2020
Large public investments



Projections of the JP METI on robotics world market



Industry of the new generation for Taiwan
50M€ financing aiming at making Taiwan world leader in service robotics
5.6% of world market in 2007

National funding increasing

Robotics is a key priority for JP in METI roadmap
Interdepartmental financing
Huge force in R&D

Challenges

- Robots were a long time limited to stationary, **industry-related usage**
- Such robots assumed strict precautionary measures that required to protect workers from injury **within the robot's sphere of movement**
- Technological development are changing this with the introduction of complex industrial **robots that can work with humans**
- Same with the development of mobile service robots, operating in **spaces shared with humans**
- Applications with **fully-automated robots** that can learn, make decisions, determine appropriate actions, perceive their surroundings, and react with flexibility are becoming **a reality**.

euRobotics coordination action

- **Favor the development of European robotics**
  - Interested in issues **specific to robotics**
  - Propose **actions to maintain and improve quality level, performances** of European robotics research and industry
  - **Understand the obstacles** hindering the development of robotics
  - **Propose solutions** to overcome these obstacles
  - Facilitate robotics activity in Europe in terms of research, development, innovation, market or usage.
- **Examples**
  - Stimulate the participation to **standardization** effort,
  - Bridge the gaps between **academia and industry**
  - Identify the obstacles hindering the development of robotics in terms of **Ethical, Legal and Societal issues**
  - euRobotics organizes **the elaboration of a Green paper on legal issues in robotics**

Green paper

- Terminology used by EC to define
  - "*a discussion document intended to **stimulate debate** and **launch a process of consultation**, at European level, on a particular topic*".
- It may be **preparatory to** a *"white paper"*.
- A White paper (EC terminology) is
  - "*a document containing **proposals for European Union action** in a specific area"*.
  - It gathers **proposition to be presented** to Europe political instances
  - It can be a set of **recommendations** to change a legal framework
- The green paper does not pretend to provide a complete overview on legal issues in robotics and to provide an exhaustive list of actions to undertake

Methodology

- Gather a community of **legists, philosophers,** specialists in **ethics, sociology,** together with experts in robotics
- Experts from different countries to take into account the differences between different jurisdictions and practices
- Organization of meetings in order
  - To make the jurist and robotics communities know each other,
  - To “share” common language, vision and objective
  - and finally to organize the work on the green paper focusing on robotics specificities
- In order to circumscribe the issue, we tried at first stage to organise the work on a set of **case studies**

Weaknesses of case study approach

- **Time demanding**
  - There is a *large number of case studies in robotics:* co-working, autonomous transport, aerial, surgical and assistive robotics, etc.
  - inhomogeneous in legal terms.
  - Analysing legal issues for each case study would be time demanding, needing to *understand whether current legislation is in line with each specific case*, in *all* European countries,.
- **Risk to forget some legal issues**
  - Concentrating on case studies would lead to highlight a reduced set of legal issues.
  - The risk is to leave aside and forget important matters and finally to show only a limited and restricted impact of legal issues on robotics activity
- **Fragmentation of the problem**
  - Considering legal issues from specific case studies (surgical robotics, autonomous transport or co-working for example) would lead to reduce the impact of legal issues, thus limiting the interest to change the existing legislations.
- **Risk to miss commonalities within robotics and with other technological disciplines**

A top down approach

- Starting from existing legislations to analyse the impact on case studies
- Expecting to propose more impacting solutions,
  - transverse to robotics applications
  - possibly linking issues to other economic sectors emphasizing this way the importance of challenges to tackle
- For example
  - to consider legal issues in autonomous transport as the same topic as legal issues in automotive
  - to consider privacy issues in robotics as a particular case of privacy issues with computers

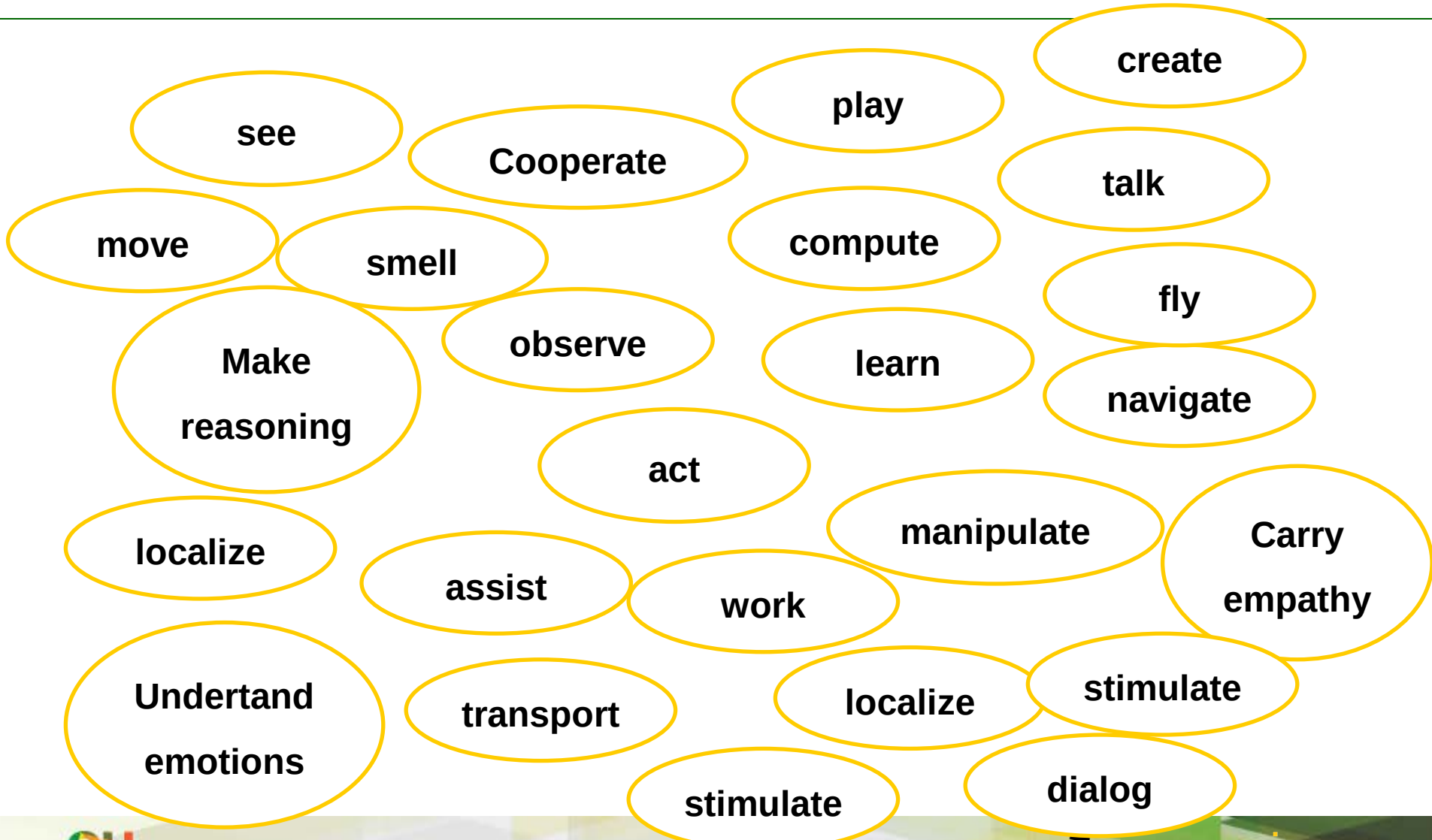
What the green paper does not deal with?

- The green paper deals with short or mid-term visions of robotics
- We excluded too futuristic visions like considerations about post-humans
- The analysis on ethical and societal issues is part of the report on Ethical Legal and Societal issues in robotics from euRobotics project

What is a robot?

- **Wikipedia**,
- "*a robot is a mechanical or virtual intelligent agent which can perform tasks on its own, or with guidance. In practice a robot is usually an electro-mechanical machine which is guided by computer and electronic programming*".
- **Encyclopaedia Britannica**, a sociological definition:
- "*any automatically operated machine that replaces human effort, though it may not resemble human beings in appearance or perform functions in a humanlike manner*".
- **Merriam-Webster** three different (and perhaps misleading) definitions:
- a) a machine that looks like a human being and performs various complex acts of a human being (as walking or talking);
- b) a device that automatically performs complicated often repetitive tasks;
- c) a mechanism guided by automatic controls.
- **ISO 8373**,
- "an *actuated mechanism programmable in two or more axes* (directions used to specify the robot motion in a linear or rotary mode) *with a degree of autonomy, moving within its environment, to perform intended tasks*"
- It is easier to understand *what a robot is* by looking at *what it can do*, its characteristics and tasks

Abilities of a robots



Robots and laws

- Robots are *artefacts, instruments* in the hands of manufacturer, programmer, owner and user.
- Legal issues raised can be traced to different macro-areas, such as

- safety of new technologies, especially for their use in workplaces or by carrying out dangerous activities;
- placing of the product "robot" on the market
- intellectual property rights: who has the intellectual property rights when a robot makes a new invention?.
- if autonomous and cognitive, robots are seen as agents, as entity, which act and react in the environment the liability for robot's action may become a crucial point.

Existing laws and legislation in Europe a multilayered reality

- in EU, laws are the result of a multifaceted law-making process with several law-makers
- International sources: treaties and conventions involving also non-European countries: e.g. World Intellectual Property Organization - WIPO, The World Trade Organization - WTO.
- Conventions and agreements signed within Council of Europe (i.e. European Convention on Human Rights).
- European Union law sources:
  - *Regulations*: a legislative act of the EU which immediately becomes enforceable as law in all Member States simultaneously.
  - *Directives:* legislative acts of the EU requiring Member States to achieve a particular result without dictating the means of achieving that result. Directives leave member states with a certain leeway as to the exact rules to be adopted.
  - *Recommendations* and *Opinions* (without binding force).
- Transnational rules**:** legal concepts and standards which flow horizontally across national borders
- National legislations and law sources (including local legislations)
  - Strictly national
  - National legislation that transpose international and/or EU sources and rules (such as Directives) into the laws of a State.

ROBOTS' MARKET LAW AND ROBOTS' CONSUMER LAW

- EU laws in the field of robotics can be described as a series of circles having a common centre:

- the *inner circle*: EU Directive 2006/42/EC, which **regulates the specific sector of machinery** that can encompass the category of robots considered as mechanical artefacts
- the *wider circle:* general measures governing policies to **protect health, public safety and consumer interests** (EU Directive 2001/95/EC, EU Decision 768/2008/EC and EU Decision 765/2008/EC, which settle the rules on the product safety)
- the *external circle:* encompassing rights and guarantees recognized by EU Directive 1999/44/EC on **sale of any kind of consumer goods**

Robots' market law and robots' consumer law

- Machinery Directive's large scope allows considering that robots can easily be included in the categories of machinery or partly completed machinery
- Robots' production and placing on the market have to respect procedures for assessing conformity manufacturer has to satisfy all relevant essential requirements and conditions set out by the Directive (declaration of conformity, CE marking, instructions, technical file)

=> **No specificities on market and consumer laws for robotics**

Intellectual property right and robotics

- Current legal IPR schemes are based on the fact that computers are inert tools
- IP regimes apply to **creation from humans or legal persons** and not to creations from computers or inert tools
- However, **artificial technologies have advanced rapidly** to the point that intelligent agents do not assist humans in the creation of works, but generate them autonomously
- Thus, **intelligent agents are being capable of creativity**.
- Questions arise about **possibility to protect "robot generated works" by IPR**, on conditions of protection, on ownership of creations and on limits of the current rules
- **Protection and exploitation of robot-generated works is an open issue**

- **Can robot creation be patented ?** Today, inventor must be designated by his name and his address. That implies that the inventor must be a physical person, even if the applicant can be a corporation
- An invention must not be obvious to a person skilled in the domain. **Is this “non-obviousness” applicable to a robot?**
- **Can copyright be applied to robot-generated works?** Currently, copyright must be attached to the person who created it
- **Who will be vested of the ownership** of these creations: the programmer, the user, the intelligent agent, the investor?

Labour law and robotics

- Labour laws is not fully harmonized in Europe yet
- Labour law in Europe is still influenced by national legislation or case law to a high degree
- It makes references to proceedings, liability, safety norms and relationship to the employers' Liability insurance
- Particular duties appear in labour law in the area of collaboration of employees with robots.

- **Proper information has to be provided by the employer** to the operator about the danger arising from the machine and the reasonable use of it
- **Regular technical check** could be made to guarantee a correct behaviour of sensors and nominal and safe operation of the machine in its whole
- As discussed in liability law a **blackbox** could be implemented in the robot in order to provide information on circumstances of an accident

Labor safety law

- Robots besides humans at work is a reality
- **Employer is required to make legal assessment of risk** for robot used in workplace
- **Current limits**

- Employer's **compliance with safety requirements can only be an indication** that he has acted with care
- Current **standards are insufficient:** ISO and safe-regulation norms do not have legal character
- Compliance with **safety measures does not provide protection from risk**.
- **Residual risk always exist** because a malfunction can never be eliminated
- The more autonomous a robot is, the more his actions are unpredictable, which raises **concerns about the foreseeability of robot's behaviour** in certain situations and dangers arising from it.
- Danger is difficult to estimate, which **hinders development of safety standards and requirements for producers and employers** that wish to use autonomous robot

- **Suggestions**

- Legal options for employees require a better examination (refusal to work or right for hazard pay)
- Development of autonomous robots must go with new methods for the protection of workers
- **Investigation still needed in this domain**: clarify issues, investigate deeper current regulation, find solutions

Data protection

- Protection of Personal Data established as a right in the **Charter of Fundamental Rights** of the European Union
- Basic principle of privacy: personal data should be
  - processed fairly and lawfully,
  - collected for specified, explicit and legitimate purposes and not for further process incompatible with purposes as originally specified,
  - adequate, relevant and not excessive in relation to the purposes for which they are collected or further process
  - accurate and, where necessary, kept complete and up to date,
  - not be kept in a personally identifiable form for longer than necessary
- Possibility of a code of conduct
  - European directive 95/46/EC **encourages definition of code of conduct** taking into account the sectorial specific features
  - However code of conduct are not binding
- Necessity of special regulation for robotics is not obvious; **exploitation of personal data is not specific to robotics**

Criminal law

- There is **no common substantive criminal law in the EU**: criminal law is seen as a protected area of national law
- A **harmonized European criminal law is still a long way off,** even though the Lisbon Treaty led to an inversion regarding the legislative competencies
- A robotic system **cannot be the perpetrator** who has to be punished (yet).
- However, **other persons can be considered as perpetrator**: the producer, the programmer, the seller or the user of the robot
- Assuming that none of these persons intentionally causes damage to someone, there is still a risk of **criminal liability arising from negligence**
- The more autonomous and potentially dangerous a machine is, the more it can be foreseen during the research phase, that it may later bring harm to humans.
- The use of robots for military purposes or the use of autonomous cars are reasonable examples.
- Because a harmonized European criminal law is currently not possible, **only national regulations can be analyzed** and compared.

Conflicts and litigations involving robots

Robots as agents in a human environment – civil liability

- Purpose of *civil liability* is to identify the party responsible for reparation of the infringement of another party's right or interest.
- It could be a matter of "contractual" or "non-contractual" liability.
- **Contractual liability** arises when, even though damage does not occur, *a robot does not conform to contractual obligations*, e.g. does not have the promised features.
- **Non-contractual liability** arises when an agent, in this case a robot, *causes damage due to the violation of a right*, which is legally protected regardless the existence of a contract (e.g. physical integrity)
- As these fields are mostly regulated by national legislations, it is helpful to make reference two texts can be taken as useful legal tools to start a discussion at European level
  - Principles of European Contract Law (PECL)
  - European Civil Code project "Commission on European Contract Law" (Lando Commission)

Contractual liability

- The robot is considered as a simple product
  - the robot is the *object* of the contract of sale between the seller/manufacturer and the buyer/user.
  - The seller must comply with legal rules governing this institution.
- Furthermore, the robot can be regarded as "consumer goods"
  - The buyer is protected by various provisions on commercial guarantees and remedies in case of lack of conformity seen above.
  - The robot looks like a mere object of exchange, a product or a commodity.
  - The application of traditional rules on liability for breach of contract does not seem to cause any problem.
- In conclusion, the **existing legislation,** both at European and (presumably) national level, **does not seem to require any addition** or modification in relation to the fact that the object of a contract is a robot.

Non contractual liability

- Non-contractual liability arises, when a person suffers a “legally relevant damage” due to the action of a robot regardless the existence of a contract.
- Two situations can be considered.

- In the first, a robot causes damage because of its manufacturing defects.
- In the second, a robot causes damage simply by acting or reacting with humans in an open environment.

- *First case: the robot causes damage because of its manufacturing defects*

- The product liability Directive 85/374 **establishes the principle of objective liability** (liability without fault) of the producer in cases of damage caused by a defective product. If more than one person (manufacturer, supplier or importer) is liable for the same damage, this is joint liability.
- ECC provides a similar general rule in case of defective product

Non contractual liability

- *Second case:* the robot **causes damage simply by acting** or reacting with humans in an open environment
- New generation of robots are equipped with adaptive and **learning ability** implying a degree of **unpredictability in the robot's behaviour**.
- Considering the robot as a mere product, as an object as in the Directive on manufacturer's liability is be inadequate
- The **robot's conduct**, although attributable at the program set by the programmer or the manufacturer, **could not entirely been planned** in its specific details because of the increase of experience made by the robot on its own.
- What happens if damage is not derived from a defect of the robot, but **from its behaviour**?
- **An open issue**

- There are currently no ad hoc tort rules for cognitive robots.
- The legal framework should be traced to the traditional categories of liability.
- **Analogy between an animal** and a moving object (has already been used in the US Courts)
- The **parental model** might be assumed, assimilating cognitive robots to children
- Another solution may be to equip cognitive robots with an **ethical code of conduct**

Electronic personhood

- **Machines cannot and should not, at least for the moment, have the legal status of humans.**
- It is still possible to establish a **special legal category for robots: electronic personhood**.
- Inspired from the successful concept, of **“legal person”**.
- Legal personhood, e.g. of companies or corporations, ultimately **means bundle of capacities, material and financial responsibilities**.
- Legal persons **experience the same treatment that humans receive under the law**, while they are not given the same legal status as humans in other respects.
- Concept is **quite successful for dealing with corporations,** holding at least the legal person liable as well as ensuring that not one person (e.g. the owner) is liable for all harm caused by the corporation. In some countries, even criminal liability of corporations has been established.
- **Legal personhood for robots would be the bundle of all the legal responsibilities** of the various parties (users, sellers, producers, etc…).
- This bundle is the main reason why a new classification for these machines is necessary.
- In practice, this would mean that each such machine would be entered in a public register (similar to the commercial register) and would obtain their legal status at the moment of this registration.

Artificial Humans

- This currently discussed concept is **still vague** and it is very likely that it would only be important **in a distant future**.
- It is **based on ontological and moral considerations** on “status” questions.
- In contrast to the attribution of legal personhood, in these discussion **one tries to define the characteristics an entity should have** to be seen as artificial human.
- Proposals for such criteria include
- Moral authority/entitlement, social capacity/reality, and legal convenience/expediency.
- Others require mobility, at least three of the five senses (taste, smell, touch, sight, hearing), autonomous intelligence (ability to learn), and consciousness (intentionality, identity, room for reasoning).
- Another opinion demands intentionality, responsiveness for reasoning, ability to have 2nd order wishes, sanity, distinction between intended and foreseeable consequences of actions as requirement to see artificial entities as being entitled to personhood.

Conclusion

- Green paper represents a **set of propositions on legal issues in robotics**
- Many issues are **still open**: labour safety law, no contractual liability,
- All propositions deserve debates
- An **harmonisation of European legislation** would favour the solutions
- Green paper in circulation for approval: **final version in December**
- **One of the first effort on laws and robotics issues in Europe**
- **Positive and constructive** contact between communities

Green paper co-authors

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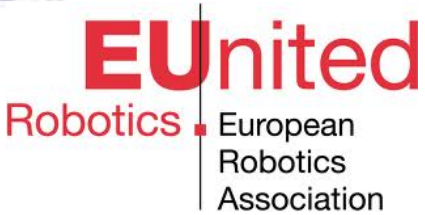
euRobotics partnership



Thank you for your attention

Références

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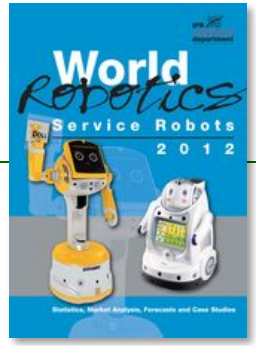

Economical trends

- close to 3 million jobs today are enabled by use of 1 million robots.
- expect 1 more million jobs in the next 5 years due to adoption of robotics (consumer electronics, solar & wind, and advanced fuel cell technology, …)
- saving manufacturing jobs also results in saving jobs throughout the community. This means that restaurants, shops and the service economy also benefit from this valuable ripple effect.
- Japan and Germany are leaders in use of robotics this resulted in increased employment in sectors such as automotive,
- robots will continue to be major players in automation of factories, and new application areas will include elderly care and medical applications. In addition homeland security and defense will maintain its position as a high value market.
- **Industrial Robots save production locations and millions of jobs**
- **Robotics is a major challenge for robotics industry**

Economic trends in robotics for defense

- 50 to 80 countries utilize defense robotic unmanned aerial vehicles (UAVs), unmanned ground vehicles (UGVs), and unmanned underwater vehicles (UUVs),
- global market for military robotics will grow from $5.8 billion in 2010 to more than $8 billion in 2016 according to ABI Research study in 2011)
- The key drivers for the defense robotics market include
  - the strong desire to reduce or prevent military casualties in the field of operations;
  - changes in the tactics of warfare requiring new reconnaissance, combat and task machinery, and tools;
  - the need to reduce military spending;
  - developments in materials science, computer programming and sensing technology to create advanced robots.
- Among the forces working against the growth of defense robotics are
  - continuing weak economic conditions that negatively impact spending on defense systems;
  - dearth of active military conflicts for most of the world,
  - ethical concerns involving the use of robots for war-fighting operations.
- In developed countries, military spending is often “recession-proof,” so weak economic conditions are unlikely to impact defense robot spending greatly, since even the most expensive robot systems are far less expensive than equivalent manned systems.
- ABI Research projects that the market for military robots will remain healthy throughout the forecast period and beyond, with even greater opportunities opening up by the end of the decade, driven by technological advances and a growing, real-world track record of tangible benefits offered by these systems.