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Présentation par Madame Mady Delvaux-Stehres, membre du Parlement européen, du rapport contenant des recommandations à la Commission européenne concernant des règles de droit civil sur la robotique

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Présents : M. Marc Angel, Mme Anne Brasseur remplaçant Mme Simone Beissel, M. Alex Bodry, M. Franz Fayot, Mme Josée Lorsché, Mme Viviane Loschetter, Mme Octavie Modert, M. Laurent Mosar, M. Gilles Baum remplaçant Mme Lydie Polfer, M. Gilles Roth, membres de la Commission juridique

M. André Bauler, Mme Anne Brasseur remplaçant Mme Simone Beissel, Mme Tess Burton, M. Félix Eischen, Mme Joëlle Elvinger, M. Franz Fayot, M. Claude Haagen, Mme Françoise Hetto-Gaasch, M. Laurent Mosar, membres de la Commission de l'Economie

Mme Mady Delvaux-Stehres, membre du Parlement européen

M. Etienne Schneider, Ministre de l'Economie

M. Félix Braz, Ministre de la Justice

M. Luc Wilmes, du Ministère de l'Economie

Mme Dina Ramcilovic, du Ministère de la Justice

M. Christophe Li, de l'Administration parlementaire

Excusés : Mme Simone Beissel, M. Eugène Berger, M. Léon Gloden, M. Paul-Henri Meyers, Mme Lydie Polfer, M. Roy Reding, membres de la Commission juridique

Mme Diane Adehm, M. Gérard Anzia, M. Frank Arndt, Mme Simone Beissel,

M. Emile Eicher, M. Léon Gloden, M. Max Hahn, M. Roy Reding, membres de la Commission de l'Economie

*

Présidence : Mme Viviane Loschetter, Présidente de la Commission juridique
M. Franz Fayot, Président de la Commission de l'Economie

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Présentation par Madame Mady Delvaux-Stehres, membre du Parlement européen, du rapport contenant des recommandations à la Commission européenne concernant des règles de droit civil sur la robotique

L'auteure du rapport retrace l'historique et la procédure d'élaboration du rapport sous rubrique et explique que grâce aux progrès scientifiques réalisés en matière de robotique, d'algorithmes intelligents et d'intelligence artificielle, le monde se trouve à l'aube d'une nouvelle révolution industrielle, d'où la nécessité de créer une définition acceptée par tous des notions de robot et d'intelligence artificielle qui soit flexible et n'entrave pas l'innovation.

Le développement de machines intelligentes et autonomes, dotées de la capacité d'apprendre et de prendre des décisions de manière indépendante, ne crée pas seulement des avantages économiques, mais suscite également de multiples préoccupations de nature éthiques, philosophiques et juridiques. En effet, des questions liées à la responsabilité civile, la propriété intellectuelle et la circulation des données, ainsi qu'à la sûreté et la sécurité des machines intelligentes se posent.

L'oratrice donne à considérer qu'il n'existe pas un seul type de machines intelligentes, mais plusieurs types divers ayant des vocations fortement variées (moyens de transport à conduite automatique, drones intelligents, robots médicaux, robots de soins de personne...) et plaide en faveur de la mise en place d'un cadre légal à l'échelle européenne et de la création d'une agence européenne pour la robotique.

Il est proposé d'élaborer une définition européenne, reprenant l'ensemble des caractéristiques suivantes des robots intelligents :

- acquisition d'autonomie grâce à des capteurs et/ou à l'échange de données avec l'environnement (interconnectivité); échange et analyse de ces données;
- capacité d'auto-apprentissage à travers l'expérience et les interactions (critère facultatif);
- existence d'une enveloppe physique, même réduite;
- capacité d'adaptation de son comportement et de ses actes à son environnement;
- non vivant au sens biologique du terme.

Au vu des caractéristiques essentielles des robots intelligents, il y a lieu de s'interroger sur l'opportunité de créer, à moyen ou à long terme, une personnalité juridique propre en faveur des robots intelligents.

L'oratrice souligne l'importance du principe de transparence en matière de prise de décision par une machine intelligente et estime qu'il devrait toujours être possible de fournir la justification rationnelle de toute décision prise par une telle machine, susceptible d'avoir une incidence importante sur la vie d'une ou de plusieurs personnes. En outre, les futures règles en la matière devraient garantir à ce qu'il soit toujours possible de traduire les calculs d'un système d'intelligence artificielle dans une forme compréhensible pour l'être humain.

Quant à la problématique éventuelle de la responsabilité civile des dommages causés par un robot intelligent, la solution juridique à retenir dans le futur instrument législatif ne devrait en aucune manière limiter le type ou l'étendue des dommages qui peuvent faire l'objet d'un dédommagement et ne devrait pas non plus limiter la nature de ce dédommagement, au seul motif que les dommages sont causés par un acteur non humain.

En outre, l'opportunité de la mise en place d'une assurance de responsabilité civile spécifiquement dédiée aux robots intelligents ou la création d'un fonds d'indemnisation spécifique, consacré à l'indemnisation des dommages causés par un robot intelligent, devrait être envisagée.

Le rapport se focalise également sur l'impact de la robotique sur le marché du travail, dont notamment le risque d'une destruction progressive d'emplois dans les pays industrialisés, et il s'interroge également sur la question de savoir comment la société pourra faire face à des inégalités sociales qui en résultent. Les analyses des experts en la matière divergent fortement, cependant, il est envisageable que le progrès technologique rendra une partie des emplois existants superfétatoires.

L'oratrice estime que des concepts, tels que l'octroi d'un revenu universel à chaque personne, ou encore l'opportunité de la création d'une « *taxe robots* » mériteraient un débat approfondi, et ce, en vue garantir des conditions de vie décentes pour l'ensemble des citoyens.

Il est précisé que la Commission européenne soumettra dans les prochains mois au Parlement européen une première proposition en la matière.

Echange de vues

Monsieur le Ministre de l'Economie explique que de nombreuses questions soulevées dans le cadre du rapport sous rubrique se sont également posées aux auteurs de l'étude stratégique « *Troisième Révolution Industrielle* ». L'orateur souligne que le Luxembourg s'est doté d'infrastructures informatiques modernes pour pouvoir accueillir les évolutions technologiques futures. Cependant, la question de la répartition équitable des revenus et des gains de productivité se pose.

L'orateur signale que le Luxembourg vient de conclure un accord avec plusieurs Etats membres de l'Union européenne afin de développer la technologie du « *High Performance Computing* ». Le traitement des données et l'auto-apprentissage des machines intelligentes sont des éléments clés pour le développement de l'économie numérique.

Monsieur le Ministre de la Justice salue l'élaboration d'un rapport spécifique en la matière et donne à considérer qu'il s'agit d'un domaine nouveau pour le législateur. L'innovation technologique risque de rendre obsolète la législation actuelle dans certains domaines.

L'orateur appuie la proposition de créer un cadre législatif européen en la matière. Il estime qu'il y a lieu d'éviter un morcellement du marché intérieur par des législations différentes. En outre, un cadre législatif européen permettrait de garantir des standards élevés en matière de sécurité des produits et une protection accrue des consommateurs.

En outre, il préconise à ce que la future législation en la matière devrait garantir la possibilité d'exercer un contrôle humain à tout moment sur les machines intelligentes.

- ❖ Un membre du groupe politique LSAP s'interroge sur les points les plus controversés en la matière.

L'auteure du rapport explique que la question autour de l'opportunité de la création d'une personnalité juridique propre au bénéfice des machines intelligentes, ainsi que l'analyse des emplois les plus menacés par le progrès technologique et les questions éthiques liées à l'utilisation de prothèses intelligentes visant non seulement à réparer le corps humain, mais également à améliorer ce dernier, ont suscité de vifs débats au Parlement européen.

- ❖ Un membre du groupe politique LSAP donne à considérer que le recours à des robots intelligents dans l'industrie pourrait rendre plus attrayante la production de biens et de marchandises dans les pays industrialisés, grâce à une baisse considérable des coûts de production.

L'auteure du rapport confirme que le potentiel économique est considérable, notamment en matière de produits personnalisés. L'oratrice renvoie au fait que des imprimantes 3D se répandent de plus en plus, cependant, des questions liées à la propriété intellectuelle des produits créés se posent.

Monsieur le Ministre de l'Economie est d'avis que le procédé de l'impression 3D permet de relocaliser la production de nombreux biens dans les pays industrialisés. De plus, une production locale permet de raccourcir les trajets de transport, ce qui aura des effets positifs sur l'environnement et permettra également de réduire les frais de transport.

- ❖ Un membre du groupe politique CSV s'interroge sur la mise en place de normes internationales en matière de création de robots intelligents et l'opportunité de prévoir un contrôle technique obligatoire en la matière.

L'auteure du rapport est d'avis que la question de l'élaboration de normes harmonisées est primordiale pour la concurrence future dans le domaine des technologies de l'intelligence artificielle et de la robotique. L'oratrice préconise la création d'une agence européenne spécialisée, dotée de moyens appropriés et capable de fournir l'expertise technique, éthique et réglementaire nécessaire pour soutenir les acteurs publics concernés.

- ❖ Un membre du groupe politique DP s'interroge sur l'aspect de la cyber sécurité en la matière et renvoie aux risques de cyberattaques contre des machines intelligentes.

L'auteure du rapport donne à considérer qu'une sécurité absolue contre des cyberattaques ne peut pas être garantie, cependant, l'élaboration de normes harmonisées en la matière permet de garantir un niveau de protection élevé.

Monsieur le Ministre de l'Economie explique que le gouvernement lance régulièrement des campagnes de sensibilisation, visant à informer les utilisateurs d'internet sur les risques de la cybercriminalité. L'orateur renvoie également à la responsabilité individuelle de chaque utilisateur de faire preuve de vigilance et de ne pas communiquer des données confidentielles à des tiers.

- ❖ Un membre du groupe politique DP estime que les robots intelligents pourront effectuer des tâches jugées répétitives et pénibles. L'orateur ne croit pas que le travail humain sera superflu dans le futur.

- ❖ Monsieur le Ministre de l'Economie s'interroge sur l'opportunité et les modalités pratiques d'une « *taxe robots* ». L'orateur donne à considérer qu'il est difficile de déterminer quels robots intelligents devraient faire l'objet d'une taxation.

L'orateur estime que si une telle « *taxe robots* » devait être instaurée, elle devrait faire l'objet d'une harmonisation au niveau européen.

L'auteur du rapport explique qu'une taxation équitable en la matière est difficile à réaliser. Néanmoins, dans un scénario pessimiste, dans lequel l'Etat serait confronté à un chômage de masse suite à la destruction de nombreux emplois, la question du financement des services publics et celle du financement de la sécurité sociale se posent. Ainsi, des sources de revenus alternatives devront être envisagées.

Le secrétaire-administrateur,
Christophe Li

La Présidente de la Commission juridique,
Viviane Loschetter

Le Président de la Commission de
l'Economie,
Franz Fayot



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REPORT

with recommendations to the Commission on Civil Law Rules on Robotics
(2015/2103(INL))

Committee on Legal Affairs

Rapporteur: Mady Delvaux

(Initiative – Rule 46 of the Rules of Procedure)

Rapporteurs for the opinions (*):

Georg Mayer, Committee on Transport and Tourism

Michał Boni, Committee on Civil Liberties, Justice and Home Affairs

(*) Associated committees – Rule 54 of the Rules of Procedure

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(*) Associated committees – Rule 54 of the Rules of Procedure

MOTION FOR A EUROPEAN PARLIAMENT RESOLUTION

with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))

The European Parliament,

- having regard to Article 225 of the Treaty on the Functioning of the European Union,
- having regard to Rules 46 and 52 of its Rules of Procedure,
- having regard to the Product Liability Directive 85/374/EEC;
- having regard to the report of the Committee on Legal Affairs and the opinions of the Committee on Transport and Tourism, the Committee on Civil Liberties, Justice and Home Affairs, the Committee on Employment and Social Affairs, the Committee on the Environment, Public Health and Food Safety, the Committee on Industry, Research and Energy and the Committee on the Internal Market and Consumer Protection (A8-0000/2017),

Introduction

- A. whereas from Mary Shelley's *Frankenstein's Monster* to the classical myth of Pygmalion, through the story of Prague's Golem to the robot of Karel Čapek, who coined the word, people have fantasised about the possibility of building intelligent machines, more often than not androids with human features;
- B. whereas now that humankind stands on the threshold of an era when ever more sophisticated robots, bots, androids and other manifestations of artificial intelligence ("AI") seem to be poised to unleash a new industrial revolution, which is likely to leave no stratum of society untouched, it is vitally important for the legislature to consider its legal and ethical implications and effects, without stifling innovation;
- C. whereas there is a need to create a generally accepted definition of robot and AI that is flexible and is not hindering innovation;
- D. whereas between 2010 and 2014 the average increase in sales of robots stood at 17% per year and in 2014 sales rose by 29%, the highest year-on-year increase ever, with automotive parts suppliers and the electrical/electronics industry being the main drivers of the growth; whereas annual patent filings for robotics technology have tripled over the last decade;
- E. whereas, over the past 200 years employment figures had persistently increased due to the technological development; whereas the development of robotics and AI may have the potential to transform lives and work practices, raise efficiency, savings, and safety levels, provide enhanced level of services in the short to medium term robotics and AI promise to bring benefits of efficiency and savings, not only in production and commerce, but also in areas such as transport, medical care, rescue, education and farming, while making it possible to avoid exposing humans to dangerous conditions, such as those faced when cleaning up toxically polluted sites;

- F. whereas ageing is the result of an increased life expectancy due to progress in living conditions and in modern medicine, and is one of the greatest political, social, and economic challenges of the 21st century for European societies; whereas by 2025 more than 20 % of Europeans will be 65 or older, with a particularly rapid increase in numbers of people who are in their 80s or older, which will lead to a fundamentally different balance between generations within our societies, and whereas it is in the interest of society that older people remain healthy and active for as long as possible;
- G. whereas in the long-term, the current trend leans towards developing smart and autonomous machines, with the capacity to be trained and make decisions independently, holds not only economic advantages but also a variety of concerns regarding their direct and indirect effects on society as a whole;
- H. whereas machine learning offers enormous economic and innovative benefits for society by vastly improving the ability to analyse data, while also raising challenges to ensure non-discrimination, due process, transparency and understandability in decision-making processes;
- I. whereas similarly, assessments of economic shifts and the impact on employment as a result of robotics and machine learning need to be assessed; whereas, despite the undeniable advantages afforded by robotics, its implementation may entail a transformation of the labour market and a need to reflect on the future of education, employment, and social policies accordingly;
- J. whereas the widespread use of robots might not automatically lead to job replacement, but lower skilled jobs in labour-intensive sectors are likely to be more vulnerable to automation; whereas this trend could bring production processes back to the EU; whereas research has demonstrated that employment grows significantly faster in occupations that use computers more; whereas the automation of jobs has the potential to liberate people from manual monotone labour allowing them to shift direction towards more creative and meaningful tasks; whereas automation requires governments to invest in education and other reforms in order to improve reallocation in the types of skills that the workers of tomorrow will need;
- K. whereas at the same time the development of robotics and AI may result in a large part of the work now done by humans being taken over by robots without fully replenishing the lost jobs, so raising concerns about the future of employment, the viability of social welfare and security systems and the continued lag in pension contributions, if the current basis of taxation is maintained, creating the potential for increased inequality in the distribution of wealth and influence, while, for the preservation of social cohesion and prosperity, the likelihood of levying tax on the work performed by a robot or a fee for using and maintaining a robot should be examined in the context of funding the support and retraining of unemployed workers whose jobs have been reduced or eliminated;
- L. whereas in the face of increasing divisions in society, with a shrinking middle class, it is important to bear in mind that developing robotics may lead to a high concentration of wealth and influence in the hands of a minority;
- M. whereas the development of Robotics and AI will definitely influence the landscape of

the workplace what may create new liability concerns and eliminate others; whereas the legal responsibility need to be clarified from both business sight model, as well as the workers design pattern, in case emergencies or problems occur;

- N. whereas the trend towards automation requires that those involved in the development and commercialisation of artificial intelligence applications build in security and ethics at the outset, thereby recognizing that they must be prepared to accept legal liability for the quality of the technology they produce;
- O. whereas Regulation (EU) 2016/679 of the European Parliament and of the Council¹ (the General Data Protection Regulation) sets out a legal framework to protect personal data; whereas further aspects of data access and the protection of personal data and privacy might still need to be addressed, given that privacy concerns might still arise from applications and appliances communicating with each other and with databases without human intervention;
- P. whereas the developments in robotics and artificial intelligence can and should be designed in such a way that they preserve the dignity, autonomy and self-determination of the individual, especially in the fields of human care and companionship, and in the context of medical appliances, 'repairing' or enhancing human beings;
- Q. whereas ultimately there is a possibility that in the long-term, AI could surpass human intellectual capacity;
- R. whereas further development and increased use of automated and algorithmic decision-making undoubtedly has an impact on the choices that a private person (such as a business or an internet user) and an administrative, judicial or other public authority take in rendering their final decision of a consumer, business or authoritative nature; whereas safeguards and the possibility of human control and verification need to be built into the process of automated and algorithmic decision-making;
- S. whereas several foreign jurisdictions, such as the US, Japan, China and South Korea, are considering, and to a certain extent have already taken, regulatory action with respect to robotics and AI, and whereas some Member States have also started to reflect on possibly drawing up legal standards or carrying out legislative changes in order to take account of emerging applications of such technologies;
- T. whereas the European industry could benefit from an efficient, coherent and transparent approach to regulation at Union level, providing predictable and sufficiently clear conditions under which enterprises could develop applications and plan their business models on a European scale while ensuring that the Union and its Member States maintain control over the regulatory standards to be set, so as not to be forced to adopt and live with standards set by others, that is to say the third countries which are also at the forefront of the development of robotics and AI;

¹ Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (OJ L 119 4.5.2016, p. 1).

General principles

- U. whereas Asimov's Laws¹ must be regarded as being directed at the designers, producers and operators of robots, including robots assigned with built-in autonomy and self-learning, since those laws cannot be converted into machine code;
- V. whereas a series of rules, governing in particular liability, transparency and accountability, are useful, reflecting the intrinsically European and universal humanistic values that characterise Europe's contribution to society, are necessary; whereas those rules must not affect the process of research, innovation and development in robotics;
- W. whereas the Union could play an essential role in establishing basic ethical principles to be respected in the development, programming and use of robots and AI and in the incorporation of such principles into Union regulations and codes of conduct, with the aim of shaping the technological revolution so that it serves humanity and so that the benefits of advanced robotics and AI are broadly shared, while as far as possible avoiding potential pitfalls;
- X. whereas a gradualist, pragmatic and cautious approach of the type advocated by Jean Monnet² should be adopted for the Union with regard to future initiatives on robotics and AI so as to ensure that we do not stifle innovation;
- Y. whereas it is appropriate, in view of the stage reached in the development of robotics and AI, to start with civil liability issues;

Liability

- Z. whereas, thanks to the impressive technological advances of the last decade, not only are today's robots able to perform activities which used to be typically and exclusively human, but the development of certain autonomous and cognitive features – e.g. the ability to learn from experience and take quasi-independent decisions – has made them more and more similar to agents that interact with their environment and are able to alter it significantly; whereas, in such a context, the legal responsibility arising through a robot's harmful action becomes a crucial issue;
- AA. whereas a robot's autonomy can be defined as the ability to take decisions and implement them in the outside world, independently of external control or influence; whereas this autonomy is of a purely technological nature and its degree depends on how sophisticated a robot's interaction with its environment has been designed to be;
- AB. whereas the more autonomous robots are, the less they can be considered to be simple tools in the hands of other actors (such as the manufacturer, the operator, the owner, the

¹ (1) A robot may not injure a human being or, through inaction, allow a human being to come to harm. (2) A robot must obey the orders given it by human beings except where such orders would conflict with the First Law. (3) A robot must protect its own existence as long as such protection does not conflict with the First or Second Laws (See: I. Asimov, *Runaround*, 1943) and (0) A robot may not harm humanity, or, by inaction, allow humanity to come to harm.

² Cf. the Schuman Declaration (1950: "Europe will not be made all at once, or according to a single plan. It will be built through concrete achievements which first create a de facto solidarity."

user, etc.); whereas this, in turn, questions whether the ordinary rules on liability are sufficient or whether it calls for new principles and rules to provide clarity on the legal liability of various actors concerning responsibility for the acts and omissions of robots where the cause cannot be traced back to a specific human actor and whether the acts or omissions of robots which have caused harm could have been avoided;

- AC. whereas, ultimately, the autonomy of robots raises the question of their nature in the light of the existing legal categories or whether a new category should be created, with its own specific features and implications;
- AD. whereas under the current legal framework robots cannot be held liable per se for acts or omissions that cause damage to third parties; whereas the existing rules on liability cover cases where the cause of the robot's act or omission can be traced back to a specific human agent such as the manufacturer, the operator, the owner or the user and where that agent could have foreseen and avoided the robot's harmful behaviour; whereas, in addition, manufacturers, operators, owners or users could be held strictly liable for acts or omissions of a robot;
- AE. whereas according to the current legal framework product liability - where the producer of a product is liable for a malfunction- and rules governing liability for harmful actions -where the user of a product is liable for a behaviour that leads to harm- apply to damages caused by robots or AI;
- AF. whereas in the scenario where a robot can take autonomous decisions, the traditional rules will not suffice to give rise to legal liability for damage caused by a robot, since they would not make it possible to identify the party responsible for providing compensation and to require that party to make good the damage it has caused;
- AG. whereas the shortcomings of the current legal framework are also apparent in the area of contractual liability insofar as machines designed to choose their counterparts, negotiate contractual terms, conclude contracts and decide whether and how to implement them make the traditional rules inapplicable, which highlights the need for new, efficient and up-to-date ones, which should comply with the technological development and the innovations recently arisen and used on the market;
- AH. whereas, as regards non-contractual liability, Council Directive 85/374/EEC¹ can cover only damage caused by a robot's manufacturing defects and on condition that the injured person is able to prove the actual damage, the defect in the product and the causal relationship between damage and defect, therefore strict liability or liability without fault framework may not be sufficient;
- AI. whereas, notwithstanding the scope of the Directive 85/374/EEC, the current legal framework would not be sufficient to cover the damage caused by the new generation of robots, insofar as they can be equipped with adaptive and learning abilities entailing a certain degree of unpredictability in their behaviour, since those robots would autonomously learn from their own variable experience and interact with their

¹ Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (OJ L 210, 7.8.1985, p. 29).

environment in a unique and unforeseeable manner;

General principles concerning the development of robotics and artificial intelligence for civil use

1. Calls on the Commission to propose common Union definitions of cyber physical systems, autonomous systems, smart autonomous robots and their subcategories by taking into consideration the following characteristics of a smart robot:
 - the acquisition of autonomy through sensors and/or by exchanging data with its environment (inter-connectivity) and the trading and analysing of those data
 - self-learning from experience and by interaction (optional criterion)
 - at least a minor physical support
 - the adaptation of its behaviour and actions to the environment;
 - absence of life in the biological sense;
2. Considers that a comprehensive Union system of registration of advanced robots should be introduced within the Union's internal market where relevant and necessary for specific categories of robots, and calls on the Commission to establish criteria for the classification of robots that would need to be registered; in this context, calls on the Commission to investigate whether it would be desirable for the registration system and the register to be managed by a designated EU Agency for Robotics and Artificial Intelligence;
3. Stresses that the development of robot technology should focus on complementing human capabilities and not on replacing them; considers it essential, in the development of robotics and AI, to guarantee that humans have control over intelligent machines at all times; considers that special attention should be paid to the possible development of an emotional connection between humans and robots – particularly in vulnerable groups (children, the elderly and people with disabilities) – and highlights the issues raised by the serious emotional or physical impact that this emotional attachment could have on humans;
4. Emphasises that a Union-level approach can facilitate development by avoiding fragmentation in the internal market and at the same time underlines the importance of the principle of mutual recognition in the cross-border use of robots and robotic systems; recalls that testing, certification and market approval should only be required in a single Member State; stresses that this approach should be accompanied by effective market surveillance;
5. Stresses the importance of measures to help small and medium-sized enterprises and start-ups in the robotics sector that create new market segments in this sector or make use of robots;

Research and innovation

6. Underlines that many robotic applications are still in an experimental phase; welcomes the fact that more and more research projects are being funded by the Member States and the Union; considers it to be essential that the Union, together with the Member States by virtue of public funding, remains a leader in research in robotics and AI; calls on the Commission and the Member States to strengthen financial instruments for research projects in robotics and ICT, including public-private partnerships, and to implement in their research policies the principles of open science and responsible ethical innovation; emphasises that sufficient resources need to be devoted to the search for solutions to the social, ethical, legal and economic challenges that the technological development and its applications raise;
7. Calls on the Commission and the Member States to foster research programmes, to stimulate research into the possible long-term risks and opportunities of AI and robotics technologies and to encourage the initiation of a structured public dialogue on the consequences of developing those technologies as soon as possible; calls on the Commission to increase its support in the mid-term review of the Multiannual Financial Framework for the Horizon 2020 funded SPARC programme; calls on the Commission and the Member States to combine their efforts in order to carefully monitor and guarantee a smoother transition for these technologies from research to commercialisation and use on the market after appropriate safety evaluations in compliance with the precautionary principle;
8. Stresses that innovation in robotics and artificial intelligence and the integration of robotics and artificial intelligence technology within the economy and the society require digital infrastructure that provides ubiquitous connectivity; calls on the Commission to set a framework that will meet the connectivity requirements for the Union's digital future and to ensure that access to broadband and 5G networks is fully in line with the net neutrality principle;
9. Strongly believes that interoperability between systems, devices and cloud services, based on security and privacy by design is essential for real time data flows enabling robots and artificial intelligence to become more flexible and autonomous; asks the Commission to promote an open environment, from open standards and innovative licensing models, to open platforms and transparency, in order to avoid lock-in in proprietary systems that restrain interoperability;

Ethical principles

10. Notes that the potential for empowerment through the use of robotics is nuanced by a set of tensions or risks and should be seriously assessed from the point of view of human safety, health and security; freedom, privacy, integrity and dignity; self-determination and non-discrimination, and personal data protection;
11. Considers that the existing Union legal framework should be updated and complemented, where appropriate, by guiding ethical principles in line with the complexity of robotics and its many social, medical and bioethical implications; is of the view that a clear, strict and efficient guiding ethical framework for the development, design, production, use and modification of robots is needed to complement the legal recommendations of the report and the existing national and Union *acquis*; proposes, in

the annex to the resolution, a framework in the form of a charter consisting of a code of conduct for robotics engineers, of a code for research ethics committees when reviewing robotics protocols and of model licences for designers and users;

12. Highlights the principle of transparency, namely that it should always be possible to supply the rationale behind any decision taken with the aid of AI that can have a substantive impact on one or more persons' lives; considers that it must always be possible to reduce the AI system's computations to a form comprehensible by humans; considers that advanced robots should be equipped with a 'black box' which records data on every transaction carried out by the machine, including the logic that contributed to its decisions;
13. Points out that the guiding ethical framework should be based on the principles of beneficence, non-maleficence, autonomy and justice, on the principles and values enshrined in Article 2 of the Treaty on European Union and in the Charter of Fundamental Rights, such as human dignity, equality, justice and equity, non-discrimination, informed consent, private and family life and data protection, as well as on other underlying principles and values of the Union law, such as non-stigmatisation, transparency, autonomy, individual responsibility and social responsibility, and on existing ethical practices and codes;
14. Considers that special attention should be paid to robots that represent a significant threat to confidentiality owing to their placement in traditionally protected and private spheres and because they are able to extract and send personal and sensitive data;

A European Agency

15. Believes that enhanced cooperation between the Member States and the Commission is necessary in order to guarantee coherent cross-border rules in the Union which encourage the collaboration between European industries and allow the deployment in the whole Union of robots which are consistent with the required levels of safety and security, as well as the ethical principles enshrined in Union law;
16. Asks the Commission to consider the designation of a European Agency for robotics and artificial intelligence in order to provide the technical, ethical and regulatory expertise needed to support the relevant public actors, at both Union and Member State level, in their efforts to ensure a timely, ethical and well-informed response to the new opportunities and challenges, in particular those of a cross-border nature, arising from technological developments in robotics, such as in the transport sector;
17. Considers that the potential of and the problems linked to robotics use and the present investment dynamics justify providing the European Agency with a proper budget and staffing it with regulators and external technical and ethical experts dedicated to the cross-sectorial and multidisciplinary monitoring of robotics-based applications, identifying standards for best practice, and, where appropriate, recommending regulatory measures, defining new principles and addressing potential consumer protection issues and systematic challenges; asks the Commission (and the European Agency, if created) to report to the European Parliament on the latest developments in robotics and on any actions that need to be taken on an annual basis;

Intellectual property rights and the flow of data

18. Notes that there are no legal provisions that specifically apply to robotics, but that existing legal regimes and doctrines can be readily applied to robotics, although some aspects appear to call for specific consideration; calls on the Commission to support a horizontal and technologically neutral approach to intellectual property applicable to the various sectors in which robotics could be employed;
19. Calls on the Commission and the Member States to ensure that civil law regulations in the robotics sector are consistent with the General Data Protection Regulation and in line with the principles of necessity and proportionality; calls on the Commission and the Member States to take into account the rapid technological evolution in the field of robotics, including the advancement of cyber-physical systems, and to ensure that Union law does not stay behind the curve of technological development and deployment;
20. Emphasises that the right to the protection of private life and of personal data as enshrined in Article 7 and 8 of the Charter and in Article 16 of the Treaty on the Functioning of the European Union (TFEU) apply to all areas of robotics and that the Union legal framework for data protection must be fully complied with; asks in this regard for a review of rules and criteria regarding the use of cameras and sensors in robots; calls on the Commission to make sure that the data protection principles such as privacy by design and privacy by default, data minimisation, purpose limitation, as well as transparent control mechanisms for data subjects and appropriate remedies in compliance with Union data protection law and are followed and appropriate recommendations and standards are fostered and are integrated into Union policies;
21. Stresses that the free movement of data is paramount to the digital economy and development in the robotics and AI sector; stresses that a high level of security in robotics systems, including their internal data systems and data flows, is crucial to the appropriate use of robots and AI; emphasises that the protection of networks of interconnected robots and artificial intelligence has to be ensured to prevent potential security breaches; emphasises that a high level of security and protection of personal data together with due regard for privacy in communication between humans, robots and AI are fundamental; stresses the responsibility of designers of robotics and artificial intelligence to develop products to be safe, secure and fit for purpose; calls on the Commission and the Member States to support and incentivise the development of the necessary technology, including security by design;

Standardisation, safety and security

22. Highlights that the issue of setting standards and granting interoperability is key for future competition in the field of artificial intelligence and robotics technologies; calls on the Commission to continue to work on the international harmonisation of technical standards, in particular together with the European Standardisation Organisations and the International Standardisation Organisation, in order to foster innovation, to avoid fragmentation of the internal market and to guarantee a high level of product safety and consumer protection including where appropriate minimum safety standards in the work environment; stresses the importance of lawful reverse-engineering and open standards,

in order to maximise the value of innovation and to ensure that robots can communicate with each other; welcomes, in this respect, the setting up of special technical committees, such as ISO/TC 299 Robotics, dedicated exclusively to developing standards on robotics;

23. Emphasises that testing robots in real-life scenarios is essential for the identification and assessment of the risks they might entail, as well as of their technological development beyond a pure experimental laboratory phase; underlines, in this regard, that testing of robots in real-life scenarios, in particular in cities and on roads, raises a large number of issues, including barriers that slow down the development of those testing phases and requires an effective strategy and monitoring mechanism; calls on the Commission to draw up uniform criteria across all Member States which individual Member States should use in order to identify areas where experiments with robots are permitted, in compliance with the precautionary principle;

Autonomous means of transport

a) Autonomous vehicles

24. Underlines that autonomous transport covers all forms of remotely piloted, automated, connected and autonomous ways of road, rail, waterborne and air transport, including vehicles, trains, vessels, ferries, aircrafts, drones, as well as all future forms of developments and innovations in this sector;
25. Considers that the automotive sector is in most urgent need of efficient Union and global rules to ensure the cross-border development of automated and autonomous vehicles so as to fully exploit their economic potential and benefit from the positive effects of technological trends; emphasises that fragmented regulatory approaches would hinder implementation of autonomous transport systems and jeopardise European competitiveness;
26. Draws attention to the fact that driver reaction time in the event of an unplanned takeover of control of the vehicle is of vital importance and calls, therefore, on the stakeholders to provide for realistic values determining safety and liability issues;
27. Takes the view that the switch to autonomous vehicles will have an impact on the following aspects: civil responsibility (liability and insurance), road safety, all topics related to environment (e.g. energy efficiency, use of renewable technologies and energy sources), issues related to data (e.g. access to data, protection of data, privacy and sharing of data), issues related to ICT infrastructure (e.g. high density of efficient and reliable communication) and employment (e.g. creation and losses of jobs, training of heavy goods vehicles drivers for the use of automated vehicles); emphasises that substantial investments in roads, energy and ICT infrastructure will be required; calls on the Commission to consider the above-mentioned aspects in its work on autonomous vehicles;
28. Underlines the critical importance of reliable positioning and timing information provided by the European satellite navigation programmes Galileo and EGNOS for the implementation of autonomous vehicles, urges, in this regard, the finalisation and

launch of the satellites which are needed in order to complete the European Galileo positioning system;

29. Draws attention to the high added value provided by autonomous vehicles for persons with reduced mobility, as such vehicles allow them to participate more effectively in individual road transport and thereby facilitate their daily lives;

b) Drones (RPAS)

30. Acknowledges the positive advances in drone technology, particularly in the field of search and rescue; stresses the importance of a Union framework for drones to protect the safety, security and privacy of the citizens of the Union, and calls on the Commission to follow-up on the recommendations of Parliament's resolution of 29 October 2015 on safe use of remotely piloted aircraft systems (RPAS), commonly known as unmanned aerial vehicles (UAVs), in the field of civil aviation¹; urges the Commission to provide assessments of the safety issues connected with the widespread use of drones; calls on the Commission to examine the need to introduce an obligatory tracking and identification system for RPAS which enables aircraft's real-time positions during use to be determined; recalls, that the homogeneity and safety of unmanned aircrafts should be ensured by the measures set out in Regulation (EC) No 216/2008 of the European Parliament and of the Council²;

Care robots

31. Underlines that elder care robot research and development has, in time, become more mainstream and cheaper, producing products with greater functionality and broader consumer acceptance; notes the wide range of applications of such technologies providing prevention, assistance, monitoring, stimulation, and companionship to elderly people and people with disabilities as well as to people suffering from dementia, cognitive disorders, or memory loss;
32. Points out that human contact is one of the fundamental aspects of human care; believes that replacing the human factor with robots could dehumanise caring practices, on the other hand, recognises that robots could perform automated care tasks and could facilitate the work of care assistants, while augmenting human care and making the rehabilitation process more targeted, thereby enabling medical staff and caregivers to devote more time to diagnosis and better planned treatment options; stresses that despite the potential of robotics to enhance the mobility and integration of people with disabilities and elderly people, humans will still be needed in caregiving and will continue to provide an important source of social interaction that is not fully replaceable;

¹ Texts adopted, P8_TA(2015)0390.

² Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1).

Medical robots

33. Underlines the importance of appropriate education, training and preparation for health professionals, such as doctors and care assistants, in order to secure the highest degree of professional competence possible, as well as to safeguard and protect patients' health; underlines the need to define the minimum professional requirements that a surgeon must meet in order to operate and be allowed to use surgical robots; considers it vital to respect the principle of the supervised autonomy of robots, whereby the initial planning of treatment and the final decision regarding its execution will always remain with a human surgeon; emphasises the special importance of training for users to allow them to familiarise themselves with the technological requirements in this field; draws attention to the growing trend towards self-diagnosis using a mobile robot and, consequently, to the need for doctors to be trained in dealing with self-diagnosed cases; considers that the use of such technologies should not diminish or harm the doctor-patient relationship, but should provide doctors with assistance in diagnosing and/or treating patients with the aim of reducing the risk of human error and of increasing the quality of life and life expectancy;
34. Believes that medical robots continue to make inroads into the provision of high accuracy surgery and in performing repetitive procedures and that they have the potential to improve outcomes in rehabilitation, and provide highly effective logistical support within hospitals; notes that medical robots have the potential also to reduce healthcare costs by enabling medical professionals to shift their focus from treatment to prevention and by making more budgetary resources available for better adjustment to the diversity of patients' needs, continuous training of the healthcare professionals and research;
35. Calls on the Commission to ensure that the procedures for testing new medical robotic devices are safe, particularly in the case of devices that are implanted in the human body, before the date on which the Regulation on medical devices¹ becomes applicable;

Human repair and enhancement

36. Notes the great advances delivered by and further potential of robotics in the field of repairing and compensating for damaged organs and human functions, but also the complex questions raised in particular by the possibilities of human enhancement, as medical robots and particularly cyber physical systems (CPS) may change our concepts about the healthy human body since they can be worn directly on or implanted in the human body; underlines the importance of urgently establishing in hospitals and in other health care institutions appropriately staffed committees on robot ethics tasked with considering and assisting in resolving unusual, complicated ethical problems involving issues that affect the care and treatment of patients; calls on the Commission and the Member States to develop guidelines to aid in the establishment and functioning of such committees;

¹ See the European Parliament legislative resolution of 2 April 2014 on the proposal for a regulation of the European Parliament and of the Council on medical devices, and amending Directive 2001/83/EC, Regulation (EC) No 178/2002 and Regulation (EC) No 1223/2009 (COM(2012)0542 – C7-0318/2012 – 2012/0266(COD)).

37. Points out that for the field of vital medical applications such as robotic prostheses, continuous, sustainable access to maintenance, enhancement and, in particular, software updates that fix malfunctions and vulnerabilities needs to be ensured;
38. Recommends the creation of independent trusted entities to retain the means necessary to provide services to persons carrying vital and advanced medical appliances, such as maintenance, repairs and enhancements, including software updates, especially in the case where such services are no longer carried out by the original supplier; suggests creating an obligation for manufacturers to supply these independent trusted entities with comprehensive design instructions including source code, similar to the legal deposit of publications to a national library;
39. Draws attention to the risks associated with the possibility that CPS integrated into the human body may be hacked or switched off or have their memories wiped, because this could endanger human health, and in extreme cases even human life, and stresses therefore the priority that must be attached to protecting such systems;
40. Underlines the importance of guaranteeing equal access for all people to such technological innovations, tools and interventions; calls on the Commission and the Member States to promote the development of assistive technologies in order to facilitate the development and adoption of these technologies by those who need them, in accordance with Article 4 of the UN Convention on the Rights of Persons with Disabilities, to which the Union is party;

Education and employment

41. Draws attention to the Commission's forecast that by 2020 Europe might be facing a shortage of up to 825 000 ICT professionals and that 90 % of jobs will require at least basic digital skills; welcomes the Commission's initiative of proposing a roadmap for the possible use and revision of a Digital Competence framework and descriptors of Digital Competences for all levels of learners, and calls upon the Commission to provide significant support for the development of digital abilities in all age groups and irrespective of employment status, as a first step towards better aligning labour market shortages and demand; stresses that the growth in the robotics requires Member States to develop more flexible training and education systems so as to ensure that skill strategies match the needs of the robot economy;
42. Considers that getting more young women interested in a digital career and placing more women in digital jobs would benefit the digital industry, women themselves and Europe's economy; calls on the Commission and the Member States to launch initiatives in order to support women in ICT and to boost their e-skills;
43. Calls on the Commission to start analysing and monitoring medium- and long-term job trends more closely, with a special focus on the creation, displacement and loss of jobs in the different fields/areas of qualification in order to know in which fields jobs are being created and those in which jobs are being lost as a result of the increased use of robots;
44. Highlights the importance of foreseeing changes to society, bearing in mind the effect

that the development and deployment of robotics and AI might have; asks the Commission to analyse different possible scenarios and their consequences on the viability of the social security systems of the Member States; takes the view that an inclusive debate should be started on new employment models and on the sustainability of our tax and social systems on the basis of the existence of sufficient income, including the possible introduction of a general basic income; ;

45. Emphasises the importance of the flexibility of skills and of social, creative and digital skills in education; is certain that, in addition to schools imparting academic knowledge, lifelong learning needs to be achieved through lifelong activity;
46. Notes the great potential of robotics for the improvement of safety at work by transferring a number of hazardous and harmful tasks from humans to robots, but at the same time, notes their potential for creating a set of new risks owing to the increasing number of human-robot interactions at the workplace; underlines in this regard the importance of applying strict and forward-looking rules for human-robot interactions in order to guarantee health, safety and the respect of fundamental rights at the workplace;

Environmental impact

47. Notes that the development of robotics and artificial intelligence should be done in such a manner that the environmental impact is limited through effective energy consumption, energy efficiency by promoting the use of renewable energy and of scarce materials, and minimal waste, such as electric and electronic waste, and reparability; therefore encourages the Commission to incorporate the principles of a circular economy into any Union policy on robotics; notes that the use of robotics will also have a positive impact on the environment, especially in the fields of agriculture, food supply and transport, notably through the reduced size of machinery and the reduced use of fertilizers, energy and water, as well as through precision farming and route optimisation;
48. Stresses that CPS will lead to the creation of energy and infrastructure systems that are able to control the flow of electricity from producer to consumer, and will also result in the creation of energy ‘prosumers’, who both produce and consume energy; thus allowing for major environmental benefits;

Liability

49. Considers that the civil liability for damage caused by robots is a crucial issue which also needs to be analysed and addressed at Union level in order to ensure the same degree of efficiency, transparency and consistency in the implementation of legal certainty throughout the European Union for the benefit of citizens, consumers and businesses alike;
50. Notes that development of robotics technology will require more understanding for the common ground needed around joint human-robot activity, which should be based on two core interdependence relationships as predictability and directability; points out that these two interdependence relationships are crucial for determining what information

need to be shared between humans and robots and how a common basis between humans and robots can be achieved in order to enable smooth human-robot joint action;

51. Asks the Commission to submit, on the basis of Article 114 TFEU, a proposal for a legislative instrument on legal questions related to the development and use of robotics and artificial intelligence foreseeable in the next 10 to 15 years, combined with non-legislative instruments such as guidelines and codes of conduct as referred to in recommendations set out in the Annex;
52. Considers that, whatever legal solution it applies to the civil liability for damage caused by robots in cases other than those of damage to property, the future legislative instrument should in no way restrict the type or the extent of the damages which may be recovered, nor should it limit the forms of compensation which may be offered to the aggrieved party, on the sole grounds that damage is caused by a non-human agent;
53. Considers that the future legislative instrument should be based on an in-depth evaluation by the Commission determining whether the strict liability or the risk management approach should be applied;
54. Notes at the same time that strict liability requires only proof that damage has occurred and the establishment of a causal link between the harmful functioning of the robot and the damage suffered by the injured party;
55. Notes that the risk management approach does not focus on the person "who acted negligently" as individually liable but on the person who is able, under certain circumstances, to minimise risks and deal with negative impacts;
56. Considers that, in principle, once the parties bearing the ultimate responsibility have been identified, their liability should be proportional to the actual level of instructions given to the robot and of its degree of autonomy, so that the greater a robot's learning capability or autonomy, and the longer a robot's training, the greater the responsibility of its trainer should be; notes, in particular, that skills resulting from "training" given to a robot should be not confused with skills depending strictly on its self-learning abilities when seeking to identify the person to whom the robot's harmful behaviour is actually attributable; notes that at least at the present stage the responsibility must lie with a human and not a robot;
57. Points out that a possible solution to the complexity of allocating responsibility for damage caused by increasingly autonomous robots could be an obligatory insurance scheme, as is already the case, for instance, with cars; notes, nevertheless, that unlike the insurance system for road traffic, where the insurance covers human acts and failures, an insurance system for robotics should take into account all potential responsibilities in the chain;
58. Considers that, as is the case with the insurance of motor vehicles, such an insurance system could be supplemented by a fund in order to ensure that reparation can be made for damage in cases where no insurance cover exists; calls on the insurance industry to develop new products and types of offers that are in line with the advances in robotics;
59. Calls on the Commission, when carrying out an impact assessment of its future

legislative instrument, to explore, analyse and consider the implications of all possible legal solutions, such as:

- a) establishing a compulsory insurance scheme where relevant and necessary for specific categories of robots whereby, similarly to what already happens with cars, producers, or owners of robots would be required to take out insurance cover for the damage potentially caused by their robots;
- b) ensuring that a compensation fund would not only serve the purpose of guaranteeing compensation if the damage caused by a robot was not covered by insurance;
- c) allowing the manufacturer, the programmer, the owner or the user to benefit from limited liability if they contribute to a compensation fund, as well as if they jointly take out insurance to guarantee compensation where damage is caused by a robot;
- d) deciding whether to create a general fund for all smart autonomous robots or to create an individual fund for each and every robot category, and whether a contribution should be paid as a one-off fee when placing the robot on the market or whether periodic contributions should be paid during the lifetime of the robot;
- e) ensuring that the link between a robot and its fund would be made visible by an individual registration number appearing in a specific Union register, which would allow anyone interacting with the robot to be informed about the nature of the fund, the limits of its liability in case of damage to property, the names and the functions of the contributors and all other relevant details;
- f) creating a specific legal status for robots in the long run, so that at least the most sophisticated autonomous robots could be established as having the status of electronic persons responsible for making good any damage they may cause, and possibly applying electronic personality to cases where robots make autonomous decisions or otherwise interact with third parties independently;
- g) introducing a suitable instrument for consumers who wish to collectively claim compensation for damages deriving from the malfunction of intelligent machines from the manufacturing companies responsible;

International aspects

60. Notes that current general private international law rules on traffic accidents applicable within the Union do not urgently need substantive modification to accommodate the development of autonomous vehicles, however, simplifying the current dual system for defining applicable law (based on Regulation (EC) No 864/2007 of the European Parliament and of the Council¹ and the Hague Convention of 4 May 1971 on the law applicable to traffic accidents) would improve legal certainty and limit possibilities for forum shopping;

¹ Regulation (EC) No 864/2007 of the European Parliament and of the Council of 11 July 2007 on the law applicable to non-contractual obligations (Rome II) (OJ L 199, 31.7.2007, p. 40).

61. Notes the need to consider amendments to international agreements such as the Vienna Convention on Road Traffic of 8 November 1968 and the Hague Convention on the law applicable to traffic accidents;
62. Expects the Commission to ensure that Member States implement international law, such as the Vienna Convention on Road Traffic, which needs to be amended, in a uniform manner in order to make driverless driving possible, and calls on the Commission, the Member States and the industry to implement the objectives of the Amsterdam Declaration as soon as possible;
63. Strongly encourages international cooperation in the scrutiny of societal, ethical and legal challenges and thereafter setting regulatory standards under the auspices of the United Nations;
64. Points out that the restrictions and conditions laid down in Regulation (EC) No 428/2009 of the European Parliament and of the Council¹ on the trade in dual-use items – goods, software and technology that can be used for both civilian and military applications and/or can contribute to the proliferation of weapons of mass destruction – should apply to applications of robotics as well;

Final aspects

65. Requests, on the basis of Article 225 TFEU, the Commission to submit, on the basis of Article 114 TFEU, a proposal for a directive on civil law rules on robotics, following the detailed recommendations set out in the Annex hereto;
66. Confirms that the recommendations respect fundamental rights and the principle of subsidiarity;
67. Considers that the requested proposal would have financial implications if a new European agency is set up;
68. Instructs its President to forward this resolution and the accompanying detailed recommendations to the Commission and the Council.

¹ Council Regulation (EC) No 428/2009 setting up a Community regime for the control of exports, transfer, brokering and transit of dual-use items (OJ L 341, 29.5.2009, p. 1).

ANNEX TO THE MOTION FOR A RESOLUTION: DETAILED RECOMMENDATIONS AS TO THE CONTENT OF THE PROPOSAL REQUESTED

Definition and classification of 'smart robots'

A common European definition for smart autonomous robots should be established, where appropriate including definitions of its subcategories, taking into consideration the following characteristics:

- the capacity to acquire autonomy through sensors and/or by exchanging data with its environment (inter-connectivity) and the analysis of those data;
- the capacity to learn through experience and interaction;
- the form of the robot's physical support;
- the capacity to adapt its behaviour and actions to the environment.

Registration of smart robots

For the purposes of traceability and in order to facilitate the implementation of further recommendations, a system of registration of advanced robots should be introduced, based on the criteria established for the classification of robots. The system of registration and the register should be Union-wide, covering the internal market, and could be managed by a designated EU Agency for Robotics and Artificial Intelligence in case such an Agency is created.

Civil law liability

Any chosen legal solution applied to the liability of robots and of artificial intelligence in cases other than those of damage to property should in no way restrict the type or the extent of the damages which may be recovered, nor should it limit the forms of compensation which may be offered to the aggrieved party on the sole grounds that damage is caused by a non-human agent.

The future legislative instrument should be based on an in-depth evaluation by the Commission defining whether the strict liability or the risk management approach should be applied.

An obligatory insurance scheme, which could be based on the obligation of the producer to take out insurance for the autonomous robots it produces, should be established.

The insurance system should be supplemented by a fund in order to ensure that damages can be compensated for in cases where no insurance cover exists.

Any policy decision on the civil liability rules applicable to robots and artificial intelligence should be taken with due consultation of a European-wide research and development project dedicated to robotics and neuroscience, with scientists and experts able to assess all related risks and consequences;

Interoperability, access to code and intellectual property rights

The interoperability of network-connected autonomous robots that interact with each other should be ensured. Access to the source code, input data, and construction details should be available when needed, to investigate accidents and damage caused by smart robots, as well as in order to ensure their continued operation, availability, reliability, safety and security.

Charter on Robotics

The Commission, when proposing legal acts relating to robotics, should take into account the principles enshrined in the following Charter on Robotics.

CHARTER ON ROBOTICS

The proposed code of ethical conduct in the field of robotics will lay the groundwork for the identification, oversight and compliance with fundamental ethical principles from the design and development phase.

The framework, drafted in consultation with a European-wide research and development project dedicated to robotics and neuroscience, must be designed in a reflective manner that allows individual adjustments to be made on a case-by-case basis in order to assess whether a given behaviour is right or wrong in a given situation and to take decisions in accordance with a pre-set hierarchy of values.

The code should not replace the need to tackle all major legal challenges in this field, but should have a complementary function. It will, rather, facilitate the ethical categorisation of robotics, strengthen the responsible innovation efforts in this field and address public concerns.

Special emphasis should be placed on the research and development phases of the relevant technological trajectory (design process, ethics review, audit controls, etc.). It should aim to address the need for compliance by researchers, practitioners, users and designers with ethical standards, but also introduce a procedure for devising a way to resolve the relevant ethical dilemmas and to allow these systems to function in an ethically responsible manner.

CODE OF ETHICAL CONDUCT FOR ROBOTICS ENGINEERS

PREAMBLE

The Code of Conduct invites all researchers and designers to act responsibly and with absolute consideration for the need to respect the dignity, privacy and safety of humans.

The Code asks for close cooperation among all disciplines in order to ensure that robotics research is undertaken in the European Union in a safe, ethical and effective manner.

The Code of Conduct covers all research and development activities in the field of robotics.

The Code of Conduct is voluntary and offers a set of general principles and guidelines for actions to be taken by all stakeholders.

Robotics research funding bodies, research organisations, researchers and ethics committees are encouraged to consider, at the earliest stages, the future implications of the technologies or objects being researched and to develop a culture of responsibility with a view to the challenges and opportunities that may arise in the future.

Public and private robotics research funding bodies should request that a risk assessment be performed and presented along with each submission of a proposal for funding for robotics research. Such a code should consider humans, not robots, as the responsible agents.

Researchers in the field of robotics should commit themselves to the highest ethical and professional conduct and abide by the following principles:

Beneficence – robots should act in the best interests of humans;

Non-maleficence – the doctrine of ‘first, do no harm’, whereby robots should not harm a human;

Autonomy – the capacity to make an informed, un-coerced decision about the terms of interaction with robots;

Justice – fair distribution of the benefits associated with robotics and affordability of homecare and healthcare robots in particular.

Fundamental Rights

Robotics research activities should respect fundamental rights and be conducted in the interests of the well-being and self-determination of the individual and society at large in their design, implementation, dissemination and use. Human dignity and autonomy – both physical and psychological – is always to be respected.

Precaution

Robotics research activities should be conducted in accordance with the precautionary principle, anticipating potential safety impacts of outcomes and taking due precautions, proportional to the level of protection, while encouraging progress for the benefit of society and the environment.

Inclusiveness

Robotics engineers guarantee transparency and respect for the legitimate right of access to information by all stakeholders. Inclusiveness allows for participation in decision-making processes by all stakeholders involved in or concerned by robotics research activities.

Accountability

Robotics engineers should remain accountable for the social, environmental and human health impacts that robotics may impose on present and future generations.

Safety

Robot designers should consider and respect people’s physical wellbeing, safety, health and

rights. A robotics engineer must preserve human wellbeing, while also respecting human rights, and disclose promptly factors that might endanger the public or the environment.

Reversibility

Reversibility, being a necessary condition of controllability, is a fundamental concept when programming robots to behave safely and reliably. A reversibility model tells the robot which actions are reversible and how to reverse them if they are. The ability to undo the last action or a sequence of actions allows users to undo undesired actions and get back to the ‘good’ stage of their work.

Privacy

The right to privacy must always be respected. A robotics engineer should ensure that private information is kept secure and only used appropriately. Moreover, a robotics engineer should guarantee that individuals are not personally identifiable, aside from exceptional circumstances and then only with clear, unambiguous informed consent. Human informed consent should be pursued and obtained prior to any man-machine interaction. As such, robotics designers have a responsibility to develop and follow procedures for valid consent, confidentiality, anonymity, fair treatment and due process. Designers will comply with any requests that any related data be destroyed, and removed from any datasets.

Maximising benefit and minimising harm

Researchers should seek to maximise the benefits of their work at all stages, from inception through to dissemination. Harm to research participants/human subject/an experiment, trial, or study participant or subject must be avoided. Where risks arise as an unavoidable and integral element of the research, robust risk assessment and management protocols should be developed and complied with. Normally, the risk of harm should be no greater than that encountered in ordinary life, i.e. people should not be exposed to risks greater than or additional to those to which they are exposed in their normal lifestyles. The operation of a robotics system should always be based on a thorough risk assessment process, which should be informed by the precautionary and proportionality principles.

CODE FOR RESEARCH ETHICS COMMITTEES (REC)

Principles

Independence

The ethics review process should be independent of the research itself. This principle highlights the need to avoid conflicts of interest between researchers and those reviewing the ethics protocol, and between reviewers and organisational governance structures.

Competence

The ethics review process should be conducted by reviewers with appropriate expertise, taking into account the need for careful consideration of the range of membership and ethics-specific training of RECs.

Transparency and accountability

The review process should be accountable and open to scrutiny. RECs need to recognise their responsibilities and to be appropriately located within organisational structures that give transparency to the REC operation and procedures to maintain and review standards.

The role of a Research Ethics Committee

A REC is normally responsible for reviewing all research involving human participants conducted by individuals employed within or by the institution concerned; ensuring that ethics review is independent, competent and timely; protecting the dignity, rights and welfare of research participants; considering the safety of the researcher(s); considering the legitimate interests of other stakeholders; making informed judgements of the scientific merit of proposals; and making informed recommendations to the researcher if the proposal is found to be wanting in some respect.

The constitution of a Research Ethics Committee

A REC should normally be multidisciplinary; include both men and women; be comprised of members with a broad experience of and expertise in the area of robotics research. The appointment mechanism should ensure that the committee members provide an appropriate balance of scientific expertise, philosophical, legal or ethical backgrounds, and lay views, and that they include at least one member with specialist knowledge in ethics, users of specialist health, education or social services where these are the focus of research activities, and individuals with specific methodological expertise relevant to the research they review; and they must be so constituted that conflicts of interest are avoided.

Monitoring

All research organisations should establish appropriate procedures to monitor the conduct of research which has received ethics approval until it is completed, and to ensure continuing review where the research design anticipates possible changes over time that might need to be addressed. Monitoring should be proportionate to the nature and degree of risk associated with the research. Where a REC considers that a monitoring report raises significant concerns about the ethical conduct of the study, it should request a full and detailed account of the research for full ethics review. Where it is judged that a study is being conducted unethically, the withdrawal of its approval should be considered and its research should be suspended or discontinued.

LICENCE FOR DESIGNERS

- You should take into account the European values of dignity, autonomy and self-determination, freedom and justice before, during and after the process of design, development and delivery of such technologies including the need not to harm, injure, deceive or exploit (vulnerable) users.
- You should introduce trustworthy system design principles across all aspects of a robot's operation, for both hardware and software design, and for any data processing on or off the platform for security purposes.

- You should introduce privacy by design features so as to ensure that private information is kept secure and only used appropriately.
- You should integrate obvious opt-out mechanisms (kill switches) that should be consistent with reasonable design objectives.
- You should ensure that a robot operates in a way that is in accordance with local, national and international ethical and legal principles.
- You should ensure that the robot's decision-making steps are amenable to reconstruction and traceability.
- You should ensure that maximal transparency is required in the programming of robotic systems, as well as predictability of robotic behaviour.
- You should analyse the predictability of a human-robot system by considering uncertainty in interpretation and action and possible robotic or human failures.
- You should develop tracing tools at the robot's design stage. These tools will facilitate accounting and explanation of robotic behaviour, even if limited, at the various levels intended for experts, operators and users.
- You should draw up design and evaluation protocols and join with potential users and stakeholders when evaluating the benefits and risks of robotics, including cognitive, psychological and environmental ones.
- You should ensure that robots are identifiable as robots when interacting with humans.
- You should safeguard the safety and health of those interacting and coming in touch with robotics, given that robots as products should be designed using processes which ensure their safety and security. A robotics engineer must preserve human wellbeing while also respecting human rights and may not deploy a robot without safeguarding the safety, efficacy and reversibility of the operation of the system.
- You should obtain a positive opinion from a Research Ethics Committee before testing a robot in a real environment or involving humans in its design and development procedures.

LICENCE FOR USERS

- You are permitted to make use of a robot without risk or fear of physical or psychological harm.
- You should have the right to expect a robot to perform any task for which it has been explicitly designed.
- You should be aware that any robot may have perceptual, cognitive and actuation limitations.
- You should respect human frailty, both physical and psychological, and the emotional needs of humans.

- You should take the privacy rights of individuals into consideration, including the deactivation of video monitors during intimate procedures.
- You are not permitted to collect, use or disclose personal information without the explicit consent of the data subject.
- You are not permitted to use a robot in any way that contravenes ethical or legal principles and standards.
- You are not permitted to modify any robot to enable it to function as a weapon.

EXPLANATORY STATEMENT

Background

Under Annex VI to the Rules of Procedure, the Committee on Legal Affairs is responsible, inter alia, for civil and commercial law, company law, intellectual property law and the interpretation, application of international law, in so far as the European Union is affected, and ethical questions related to new technologies. The development of robotics and artificial intelligence raises legal and ethical issues that are clearly linked to all these areas and which require a prompt intervention at EU level. While it will be up to the Commission to eventually present one or more legislative proposals related to robotics and artificial intelligence, the European Parliament has decided to pave the way for such initiatives using its rights under Article 225 of the Treaty on the Functioning of the European Union and Rule 46 of its Rules of Procedure.

As a result, on the 20 January 2015 the JURI Committee decided to establish a Working Group (WG) on legal questions related to the development of Robotics and Artificial Intelligence (AI) in the European Union. The WG primarily aimed at drafting civil law rules linked to this subject-matter.

Besides Members of the Committee on Legal Affairs the Working Group also included Members representing the Committee on Industry, Research and Energy (ITRE), the Committee on the Internal Market and Consumer Protection (IMCO) and the Committee on Employment and Social Affairs (EMPL).

The WG consulted experts from very diverse backgrounds, receiving important contributions which are included in this resolution.

Generalities

Robotics and AI have become one of the most prominent technological trends of our century. The fast increase of their use and development brings new and difficult challenges to our society. The road from the industrial sector to the civil society environment obliges a different approach on these technologies, as robots and AI would increase their interaction with humans in very diverse fields.

The JURI Committee believes that the risks posed by these new interactions should be tackled urgently, ensuring that a set of core fundamental values is translated into every stage of contact between robots, AI and humans. In this process, special emphasis should be given to human safety, privacy, integrity, dignity and autonomy.

Other important aspects addressed in this resolution are: standardisation, intellectual property rights, data ownership, employment and liability. It is crucial that regulation provides predictable and sufficiently clear conditions to incentivise European innovation in the area of robotics and AI.

Legal basis and subsidiarity

The action by the Commission in order to adapt the existing legislation to the reality of robots and artificial intelligence should be based on Article 114 TFEU. According to Article 5 (3) TEU, the principle of subsidiarity provides that the Union shall act only if and in so far as the objectives of the proposed action cannot be sufficiently achieved by the Member States, either at central level or at regional and local level, but can rather, by reason of the scale or effects of the proposed action, be better achieved at Union level. The development of robotics is currently happening in the entire Union. In reaction to this innovation, Member States are developing different national legislations. These discrepancies are expected to create obstacles for an effective development of robotics. Due to the fact that this technology has cross-border implications, the best legislative option is a European one.

General and ethical principles

The resolution establishes general as well as ethical principles concerning the development of robotics and AI for civil use. First, in order to properly address this development, a common definition of smart autonomous robots is fundamental. Furthermore, research in robotics and ICT as well as in the implications of their dissemination should be strengthened.

Second, in order to address the ethical principles, a Charter on Robotics is annexed to this resolution. This Charter consists of a Code of Ethical Conduct for Robotics Engineers, a Code for Research Ethics Committees and Licenses for Designers and Users. The proposed framework is in full compliance with the EU Charter of Fundamental Rights.

Moreover, the creation of a European Agency for robotics and AI is suggested. This agency should provide the necessary technical, ethical and regulatory expertise to support the relevant public actors.

Intellectual property rights, data protection and data ownership

The resolution calls on the Commission to come forward with a balanced approach to intellectual property rights when applied to hardware and software standards and codes that protect innovation and at the same time foster innovation. Moreover, the elaboration of criteria for "own intellectual creation" for copyrightable works produced by computers or robots is demanded.

The current insufficient legal framework on data protection and ownership is of great concern due to the (expected massive) flow of data arising from the use of robotics and AI.

Standardisation, safety and security

The increasing use of robots and AI requires European standardisation in order to avoid discrepancies between Member States and fragmentation of the European Union internal market.

Moreover, consumer concerns over safety and security related to the use of robots and AI need to be addressed. This resolution specifically underlines that testing robots in real-life scenarios is essential for the identification and assessment of the risks they might entail.

Rules for specific use of robots and AI

The resolution includes provisions to be applied to specific types of robots. Individual rules should be adopted for autonomous vehicles, care robots, medical robots, human repair and enhancement, as well as drones (RPAS).

Rules on Liability

Risks that may occur are inherently linked to the use of autonomous machine in our society. A robot's behaviour potentially has civil law implications, both in terms of contractual and of non-contractual liability. Thus clarification of responsibility for the actions of robots and eventually of the legal capacity and/or status of robots an AI is needed in order to ensure transparency and legal certainty for producers and consumers across the European Union.

The Commission is called on to carry out an impact assessment of its future legislative instruments to explore the implications of all possible legal solutions, such as, among others, the establishment of a compulsory insurance scheme and a compensation fund.

Robotics and AI in the social context

Increasing communication and interaction with robots have the potential to profoundly impact physical and moral relations in our society. This is especially the case for care robots towards which particularly vulnerable people can develop emotional feelings and attachment, thus causing concerns over human dignity and other moral values.

Robots and AI already influence education and employment. Against this background a close monitoring of job trends is necessary in order to avoid undesirable repercussions on the employment market.

International aspects

In view of the development of robotics and AI all over the world, consideration should be given and initiatives taken to amend existing relevant international agreements when needed or to draft new instruments with the objective of introducing specific references to robotics and AI. International cooperation in this field is very much desirable.

16.11.2016

OPINION OF THE COMMITTEE ON TRANSPORT AND TOURISM (*)

for the Committee on Legal Affairs

with recommendations to the Commission on Civil Law Rules on Robotic

(2015/2103(INL))

Rapporteur: Georg Mayer

(Initiative – Rule 46 of the Rules of Procedure)

SUGGESTIONS

The Committee on Transport and Tourism calls on the Committee on Legal Affairs, as the committee responsible, to incorporate the following suggestions into its motion for a resolution:

- having regard to the Declaration of Amsterdam of the Council, of 14-15 April 2016, on cooperation in the field of connected and automated driving (“Amsterdam Declaration”),
- A. whereas the Commission recently established the High Level Group GEAR 2030 tasked with producing a roadmap for the proper deployment of autonomous vehicles;
- B. whereas, for the purpose of civil liability, a distinction should be drawn between automated vehicles (incorporating devices allowing the automatic execution of some driving operations) and autonomous vehicles (which perform all such operations); whereas in the former case, driving must still be continuously monitored by the driver and remains entirely his or her responsibility; and, in the latter case, driving no longer requires continuous monitoring or any intervention by the user; whereas in the former case the civil liability regime remains unchanged compared to that with conventional vehicles, while it needs to be adjusted in the latter case;
- 1. Underlines that autonomous transport covers all forms of remotely piloted, automated, connected and autonomous ways of road, rail, waterborne and air transport, including vehicles, trains, vessels, ferries, aircrafts, drones, as well as all future forms of developments and innovations in this sector (hereinafter referred as “autonomous means of transport”);
- 2. Calls on the Commission to consider the following aspects in its work on autonomous means of transport: civil responsibility (liability and insurance), all topics related to the

environment (e.g. energy efficiency, the use of renewable technologies and energy sources) and issues related to data (access to data, the protection of personal data and privacy, the sharing of accident and risk situation data, the financial value of data and its distribution);

3. Takes into account that autonomous means of transport might have a major impact on enhancing transport safety, since human errors are currently responsible for about 90% of road accidents; notes however that it will be impossible for autonomous vehicles to eliminate all accidents; this raises liability issues and questions of responsibility of the parties concerned and compensation for the victims in the event of accidents;
4. Recalls that the autonomous transport systems have long existed in the public transport sector (metro systems) and have proved their reliability and their high level of public acceptance;
5. Takes the view that the switch to autonomous vehicles, besides its positive impact on road safety, fuel consumption, the environment and the creation of new employment opportunities in the telecommunication and automotive sectors, might also lead to job losses in the transport sector as well as have consequences on the insurance sector;
6. Draws attention to the fact that driver reaction time in the event of an unplanned takeover of the control of the vehicle is of vital importance and calls, therefore, on the stakeholders to provide for realistic values determining safety and liability issues;
7. Emphasises the particular importance of the Committee on Legal Affairs' draft report on the transport sector, given technological progress and in view of the fact that semi-autonomous means of transport are already available on the market and fully autonomous means of transport will soon also be available;
8. Stresses the importance of supporting further innovation in robotics, such as connected and automated vehicles and drones, to strengthen the global market position of the Union industry;
9. Notes that autonomous means of transport play an important role in developing sustainable transport; notes that autonomous means of transport could help reduce traffic congestion and calls on the Commission and Member States to fully reflect technical progress in a timely manner, as well as environmental and safety impacts and the promotion of innovation;
10. Expects the Commission to ensure that the Member States adapt the existing legislation, such as the Vienna Convention on Road Traffic of 8 November 1968, in a uniform manner in order to make driverless driving possible, and calls on the Commission, the Member States and the industry to implement the objectives of the Amsterdam Declaration as soon as possible;
11. Urges the Commission to deliver assessments regarding the safety issues related to the widespread use of drones; calls on the Commission to deliver studies regarding the impact of autonomous means of transport on enhancing transport safety and sustainability;
12. Points out that through route optimisation, the fight against congestion, the optimisation

of the use of the propulsion system and their communication with flow control systems, autonomous vehicles will help improve environmental factors, particularly in urban nodes;

13. Underlines that the interaction among autonomous means of transport, traffic-management, infrastructure and its management will require a high density of efficient and reliable communication in order to securely transfer high volumes of data in real time; emphasises that substantial investments in roads, energy and ICT infrastructure will be required, while ensuring privacy and data protection;
14. Stresses the importance of smart and interconnected transport infrastructure and therefore calls on the Commission and the Member States to establish an appropriate comprehensive, cross-border and interoperable infrastructure;
15. Calls on the Commission to develop a civil liability regime, including on the burden of proof, adapted to the development of autonomous vehicles; stresses the importance of ensuring a clear division of responsibilities between the designers, the manufacturers of the various components and the assemblers of autonomous vehicles, the service providers (transport services or the services necessary for the operation of autonomous vehicles) and the end users in order to ensure the safety and rights of passengers, data protection and protection against piracy;
16. Underlines the critical importance of reliable positioning and timing information provided by the European satellite navigation programmes Galileo and EGNOS for the implementation of autonomous vehicles, particularly for navigation and safety systems in autonomous vehicles on the one hand and for intelligent transport systems and traffic management systems on the other hand;
17. Draws attention to the high added value provided by autonomous vehicles for persons with reduced mobility, as such vehicles allow them to participate more effectively in individual road transport and thereby facilitate their daily lives;
18. Calls on the Commission to propose by 2019 a shared European Strategy (including a single roadmap) for autonomous means of transport and for closer collaboration of all relevant stakeholders, including a careful analysis and recommendations regarding the dynamics and the development of the market; calls on the Commission to review and adapt where necessary the Union regulatory framework to support the development and use of autonomous means of transport; urges the finalisation and launch, as soon as possible, of the satellites which are needed in order to complete the European Galileo positioning system, so that such a system can be used as the default positioning system in autonomous means of transport;
19. Notes that the development of autonomous vehicles requires a proactive and committed institutional approach on the part of the Union and Member States as well as the involvement of technology centres and of the automotive industry;
20. Calls on the Commission to develop European infrastructural standards to allow the diffusion of autonomous vehicles and a road map to implement them;
21. Calls on the Commission and Member States to include the use of automated vehicles in

the initial and advanced training of heavy goods vehicle drivers and to make this part of the training needed to obtain a car driving licence;

22. Recalls, that the homogeneity and safety of unmanned aircrafts should be ensured by the measures set out in Regulation (EC) No 216/2008 of the European Parliament and of the Council¹;

¹ Regulation (EC) No 216/2008 of the European Parliament and of the Council of 20 February 2008 on common rules in the field of civil aviation and establishing a European Aviation Safety Agency, and repealing Council Directive 91/670/EEC, Regulation (EC) No 1592/2002 and Directive 2004/36/EC (OJ L 79, 19.3.2008, p. 1).

RESULT OF FINAL VOTE IN COMMITTEE ASKED FOR OPINION

Date adopted	10.11.2016
Result of final vote	+: 22 -: 5 0: 0
Members present for the final vote	Daniela Aiuto, Marie-Christine Arnautu, Georges Bach, Izaskun Bilbao Barandica, Deirdre Clune, Michael Cramer, Luis de Grandes Pascual, Andor Deli, Karima Delli, Jacqueline Foster, Bruno Gollnisch, Merja Kyllönen, Peter Lundgren, Marian-Jean Marinescu, Cláudia Monteiro de Aguiar, Renaud Muselier, Markus Pieper, Salvatore Domenico Pogliese, Massimiliano Salini, Claudia Schmidt, Jill Seymour, Pavel Telička, Wim van de Camp, Roberts Zīle, Elżbieta Katarzyna Łukacijewska
Substitutes present for the final vote	Ramona Nicole Mănescu, Matthijs van Miltenburg

17.11.2016

OPINION OF THE COMMITTEE ON CIVIL LIBERTIES, JUSTICE AND HOME AFFAIRS (*)

for the Committee on Legal Affairs

with recommendations to the Commission on Civil Law Rules on Robotics
(2015/2103(INL))

Rapporteur: Michał Boni

(Initiative – Rule 46 of the Rules of Procedure)

(*) Associated committee – Rule 54 of the Rules of Procedure

SUGGESTIONS

The Committee on Civil Liberties, Justice and Home Affairs calls on the Committee on Legal Affairs, as the committee responsible:

– to incorporate the following suggestions into its motion for a resolution:

A. Whereas the technological advancements in the area of robotics will bring positive effects for the Union economy and also for the daily life of individuals, but might also imply risks which need to be addressed; whereas the development of all new technological and production paradigms, within or outside of the framework of Horizon 2020, must respect ethical principles and have due regard to the fundamental rights enshrined in the Charter of Fundamental Rights (CFR);

B. Whereas a number of third-countries have adopted guidelines and legislation on robotics and some Member States have launched specific reflections in this area; whereas a regulatory framework that governs at Union level the development and the use of robotics and artificial intelligence and builds on existing rules such as the Union's General Data Protection Regulation¹ could prevent a fragmentation of rules in the single market and further safeguard the protection of the fundamental rights of all Union citizens to human dignity, privacy and family life, the protection of personal data and intellectual property, freedom of expression and information, equality and non-discrimination, solidarity, and citizens' rights and justice,

¹ Regulation (EU) 2016/679 of 27 April 2016 of the European Parliament and of the Council on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation) (OJ L 119, 04.05.2016, p. 1).

as well as security and safety, while being subject to the principle of proportionality;

Ethical principles

1. Considers that the existing Union legal framework should be updated and complemented, where appropriate, with guiding ethical principles for the design, engineering, testing and use of robots and artificial intelligence to ensure that such technologies can really improve the quality of human life; calls for the precautionary principle to always be taken into account in the development and use of such technologies;
2. Believes that robotics and artificial intelligence, especially those with built-in autonomy, including the capability to independently extract, collect and share sensitive information with various stakeholders, and the possibility of self-learning or even evolving to self-modify, should be subject to robust conceptual laws or principles, such as that a robot may not kill or harm a human being, that it must obey and be controlled by a human being and; that the process by which robots and AI collect, use and process personal data must be transparent and comprehensible; believes that these principles should be technology neutral and based on empirical research; supports the development of an ethics-by-default framework for researchers, academia and engineers which ensures that these technological solutions will not hinder research and technological developments but will be in compliance with existing Union and national ethical practices and codes as well as with the rights and principles enshrined in the CFR, in particular human dignity, the respect for and protection of private and family life, security and safety, the protection of personal data, protection of intellectual property, the freedom of expression and information, equality and non-discrimination, solidarity, and citizens' rights and justice, and should be subject to proportionality;
3. Acknowledges that the definition of such laws and principles and their practical implementation require more research in the field of ethics of artificial intelligence; considers that the European Group on Ethics in Science and New technologies could eventually play a role in the definition of ethical guidelines and standards which are both forward-looking and responsive to technological changes in the future;
4. Underlines the need to address the psychological and societal impact of human-robot-interaction as well as the dual character of the impact of technology on human capabilities, with special attention for vulnerable groups, in particular children, to avoid creating harmful dependence on robots, e.g. through evocation of emotional response, or isolation of these humans from reality;
5. Stresses that robotics and artificial intelligence, especially health, care and domestic robotics and medical cyber-physical systems, of which certain elements can be implanted in or worn on the human body, will have a significant impact on human life, in particular for people with disabilities; notes, therefore, that it is crucial to ensure inclusive and equal access to these technologies; points further to such robotics' impact on user privacy due to their access to traditionally protected spaces and sensitive personal information; believes that the respect of principles of medical ethics, safety of patients, and the integrity of care provided should be ensured;

Privacy and data protection

6. Reiterates that the right to the protection of private life and the right to the protection of

personal data as enshrined in Article 7 and 8 CFR and Article 16 TFEU apply to all areas of robotics and artificial intelligence and that the Union legal framework for data protection must be fully complied with; underlines the responsibility of designers of robotics and artificial intelligence to develop products in such a way that they are safe, secure and fit for purpose and follow procedures for data processing compliant with existing legislation, confidentiality, anonymity, fair treatment and due process;

7. Calls on the Commission to ensure that any Union legislation on robotics and artificial intelligence will include measures and rules which take into account the rapid technological evolution in this field, including in the development of cyber-physical systems, to ensure that Union legislation does not lag behind the curve of technological development and deployment; stresses the need for such legislation to be compliant with rules on privacy and data protection, i.e. concerning information obligations, the right to obtain an explanation of a decision based on automated processing, the requirement to follow the principles of privacy by design and by default, the principles of proportionality, necessity, data minimisation, purpose limitation, as well as transparent control mechanisms for data subjects and data protection authorities, and appropriate remedies in compliance with current legislation; calls for the review of rules, principles and criteria regarding the use of cameras and sensors in robots, artificial intelligence in accordance with the Union legal framework for data protection;

8. Highlights the importance of preventing mass-surveillance through robotics and artificial intelligence technologies;

9. Calls on the Commission and the Member States to promote strong and transparent cooperation between the public and private sectors and academia that would reinforce knowledge sharing, and to promote education and training for designers on ethical implications, safety and respect of fundamental rights as well as for consumers on the use of robotics and artificial intelligence, with particular focus on safety and data privacy;

Security of data and data systems and the flow of data

10. Underlines that the free flow of data is paramount to the digital economy and is essential for the development of robotics and artificial intelligence; highlights that a high level of security of robotics and artificial intelligence systems as a whole, including their internal data systems and data flows, is crucial for the adequate utilisation of robots and artificial intelligence; emphasises that the protection of networks of interconnected robots and artificial intelligence has to be ensured to prevent potential security breaches, cyber-attacks or misuse of personal data, especially when a large amount of data is collected and processed; stresses the need to design a mechanism that enables the user to stop the processing of his or her personal data in the event of a security breach; points to the importance of research and development activities in the area of data-securing techniques and underlines the joint responsibility of public and business to cooperate to guarantee a high level of safety, security and privacy of data used for the communication between people and robots and artificial intelligence, together with a high quality of voice and sign language recognition systems; believes that commercial hardware and software producers should be held responsible in case of serious breaches of data security caused by their negligence; calls on the Commission and Member States to support and incentivise the development of the necessary technology, including security by design and channels of communication;

Drones (Remotely piloted aircrafts systems, RPAS)

11. Underlines that when personal data are processed by RPAS, whether by public authorities for law enforcement purposes or by private or public entities for other purposes permitted by law, the right to liberty and security and the right to respect of private life as enshrined in Articles 6 and 7 CFR, the right to the protection of personal data stipulated in Articles 8 CFR and 16 TFEU apply and the Union legal framework for data protection must be fully complied with; calls on the Commission to examine the need to introduce an obligatory tracking and identification system for RPAS which enables aircraft's real-time positions during use to be determined.

12. Reiterates its call on the Council to develop a strict and effective common Union framework on the use of armed drones, giving the utmost importance to respect for ethical principles, human rights and international humanitarian law and addressing issues such as the legal framework, proportionality, accountability, transparency and the protection of civilians, including taking all feasible precautions to avoid erroneous targeting and the infliction of incidental civilian harm and ensuring that ultimate control and responsibility lies with a human being; repeats its demand for a ban on the production, development, and use of fully autonomous weapons which enable strikes to be carried out without human intervention; urges the Commission and the Member States to launch a broad international policy dialogue aiming to establish global legal standards on and legal and ethical limitations to the development, proliferation and use of increasingly autonomous weapon systems, e.g. in the form of a binding international agreement;

13. Acknowledges the positive advances in drone technology, particularly in the field of search and rescue, and maintains this is the direction the Union should be going in relation to advancing drone technology.

Code of conduct

14. Considers that, in specific areas where relevant studies show that the development of legislation would be premature, appropriate legislation should be accompanied by encouragement of a soft law framework, code of conduct or public-private partnerships, possibly Union-wide, in order to ensure the cooperation of the industry and robotic designers with public authorities and all other relevant stakeholders; believes that such instruments should focus on practical solutions to ensure privacy and data protection, human dignity, non-discrimination, the security and ethics of the robotics industry, and the proper use of robots and artificial intelligence on a daily basis.

RESULT OF FINAL VOTE IN COMMITTEE ASKED FOR OPINION

Date adopted	17.11.2016
Result of final vote	+: 47 -: 0 0: 2
Members present for the final vote	Heinz K. Becker, Malin Björk, Michał Boni, Caterina Chinnici, Ignazio Corrao, Frank Engel, Tanja Fajon, Lorenzo Fontana, Mariya Gabriel, Kinga Gál, Ana Gomes, Nathalie Griesbeck, Sylvie Guillaume, Jussi Halla-aho, Monika Hohlmeier, Filiz Hyusmenova, Sylvia-Yvonne Kaufmann, Cécile Kashetu Kyenge, Marju Lauristin, Juan Fernando López Aguilar, Monica Macovei, Roberta Metsola, Claude Moraes, József Nagy, Péter Niedermüller, Judith Sargentini, Birgit Sippel, Branislav Škripek, Csaba Sógor, Helga Stevens, Traian Ungureanu, Bodil Valero, Harald Vilimsky, Josef Weidenholzer, Tomáš Zdechovský
Substitutes present for the final vote	Daniel Dalton, Anna Hedh, Teresa Jiménez-Becerril Barrio, Ska Keller, Jeroen Lenaers, Andrejs Mamikins, Maite Pagazaurtundúa Ruiz, Christine Revault D'Allonnes Bonnefoy, Barbara Spinelli
Substitutes under Rule 200(2) present for the final vote	Lynn Boylan, Verónica Lope Fontagné, Mylène Troszczynski, Tom Vandenkendelaere, Rainer Wieland

9.11.2016

OPINION OF THE COMMITTEE ON EMPLOYMENT AND SOCIAL AFFAIRS

for the Committee on Legal Affairs

with recommendations to the Commission on Civil Law Rules on Robotics
(2015/2103(INL))

Rapporteur: Ádám Kósa

(Initiative - Rule 46 of the Rules of Procedure)

SUGGESTIONS

The Committee on Employment and Social Affairs calls on the Committee on Legal Affairs, as the committee responsible to incorporate the following suggestions into its motion for a resolution:

1. Calls on the Commission to undertake urgently a thorough assessment of the impact of robotics on the number and types of jobs and on the quality and competence profiles of existing jobs; to gather information on new forms of employment in order to anticipate as efficiently as possible, first, whether the spread of robotics bring welfare and progress per se, whether it renders human labour unnecessary within the traditional production and service structure and, if so, what conditions are needed in addition to financial security in order to ensure that people are healthy in terms of mental and physical wellbeing, happy, and active citizens and whether theoretical benefits of symbiosis between humans and machines contribute effectively to wellbeing and development; and, second, whether in the changing labour market Member States' law and practice can ensure a socially just, inclusive and sustainable way of reducing inequality, poverty and social exclusion and an environment in which all human beings have equal opportunities to develop their talents, skills and their sense of being an individual;
2. Stresses that while the development of robotics and artificial intelligence is accelerating, it is crucial to shape its course and to anticipate the possible consequences with respect to employment and social policy because the increased and global use of robotics in the production of goods and in services results in higher productivity that can be achieved with little manpower and, consequently, over the next decade some jobs will be completely eliminated and many others affected; therefore calls on the Commission to carry out an analysis of the challenges and opportunities in employment and to develop a method to enable monitoring of the number and nature of jobs lost and created by

robotisation and automation, and the impact of the phenomenon on income lost by social security systems; further calls on the Commission to assess regularly and in dialogue with the social partners to what extent weekly, annual and life working hours can be reduced without loss of income and to start exploring new financing options for future social protection systems and rethink how workers engage with their jobs and how digital labour platforms can better connect individuals, teams and projects;

3. Points out that many jobs will be lost as a result of robotisation, but that although individual working times will be shortened in many sectors of the economy, increased productivity could ensure that workers do not suffer any loss in wages;
4. Believes that robots should be designed using processes ensuring human control and the reversibility of robots' operations and that considering the increasing level of autonomy of robots, this should be accompanied by amending the rules on liability concerning the consequences associated with the actions or inaction of robots; is concerned by the lack of general framework and legal provisions with regard to work automation in this new and ongoing industrial revolution and considers it to be essential for the Union to specify a legal framework that reflects the complexity of robotics and its numerous social implications; therefore calls on the Commission to propose a common definition for smart autonomous robots and their subcategories in the workplace and to consider the pros and cons of a compulsory insurance scheme covering the potential damage and failures caused by its robots;
5. Stresses that education and training systems must adapt to changes in professions and modes of production, putting more focus on jobs with creative and non-repetitive content in order to preserve the value of human labour and to provide all generations with all the tools needed to offer them the best possible preparation for the job market in a world that is constantly changing due to robotisation and automation; stresses the importance of the flexibility of skills and emphasises the importance of life skills and social skills in education; is certain that, in addition to schools teaching academic knowledge, children need to acquire critical thinking skills to be able to question and take informed decisions, creative skills to be able to put ideas into action and develop a sense of initiative, and that lifelong learning needs to be realised through lifelong acting; underlines that digital competences are essential for today's fast-paced automation and digitalisation of work and services require digital skills and competences to be developed in order to ensure a high level of employment, eradicate growing digital illiteracy and the risk of social exclusion that is associated with it; stresses that particular attention should be paid to the digitalisation of teaching and exploiting robotisation in teaching and learning while education should also emphasise humanities, which bring benefit in the form of creative, inventive, artistic and cultured qualities in the changing labour market for humans to continue to have a comparative advantage over machines;
6. Admits that robotics offers great potential for the support and relief, in particular, of people with a disability and elderly people in their everyday lives and could make a major contribution to their self-determined life and their inclusion in the labour market, is of the opinion that thorough consideration must be given to the question of what employment provisions might be necessary in terms of the labour force if the artificial or genetic development or supplementing of existing human capabilities results in

people with extraordinary abilities, thereby fundamentally altering the meaning of the term 'disability' and conferring an unassailable advantage on people with access to such technological innovations, tools and interventions which will naturally raise ethical and moral questions that should be examined thoroughly;

7. Stresses that the individual decision to choose or reject an implant, prosthesis or extension to a human body must never lead to unfavourable treatment or threats with regard to employment, education, health care, social security or other benefits and stresses that all citizens must have equal and barrier-free access to benefiting from new technology; in this regard points out that, as human dignity is at the centre of Union and international human rights law, it is important to examine how to ensure that those who are not yet classified as disabled are not treated, in comparison to 'enhanced humans' at a disadvantage similar to people with intellectual disabilities and whether people living with intellectual disabilities will be able to take independent decisions by means of supported decision-making as outlined in the Convention on the Rights of Persons with Disabilities with the help of robots and how to divide responsibility among them;
8. Points out however, that there are risks from using robots which should be carefully weighed against the benefits they might bring; notes that work injuries caused by robots and related claims should be kept in mind; notes that, while wearable robot technology like exoskeletons aimed at protecting against workplace injuries might increase productivity, they could give rise to higher employer expectations of human workers and, in turn, to greater injury risks; points out that this must be taken into consideration, inter alia, by legislators, employers, unions and employees via internal rules, collective agreements and that other risks associated with robots might relate to anti-discrimination which could occur following a job interview in the event of data that was acquired leading to unintended analysis; notes that new challenges relating to trade and privacy may also arise as a consequence of the use of robotics;
9. Stresses that in the face of increasing divisions in society, with a shrinking middle class, it is important to bear in mind that developing robotics may lead to a high concentration of wealth and influence in the hands of a minority;
10. Notes that the impact on employment and social policy caused by technological progress and the ongoing robotisation has revolutionised the way in which people access and provide information, communicate, socialise and work, thereby creating new opportunities as well as challenges, opening up new prospects by possibly increasing the efficiency of activities, saving energy and materials; however, points out that, whilst robotics and artificial intelligence promise real advantages in the short and medium term in terms of effectiveness and economy not only for production and trade but also in areas where due to human interaction, intelligence and creativity, automation is difficult and hitherto meant there were only humans, such as in sectors in which large numbers of sometimes low-skilled people are employed, there may be a risk that the number of jobs in the field of robotics will not increase to match the number of jobs which are expected to be lost in areas such as transport, logistics and office work; therefore calls on the Commission and the Member States, in cooperation with the social partners and regional and local authorities where appropriate, to develop new mechanisms of protection which are suited to the working and career patterns shaped by digitalisation and the increased use of robotics and to provide suitable education and training for all

people;

11. Points out that due to the development and use of smart, collaborative robots and artificial intelligence, the differential between the creation and loss of jobs may have consequences on the financial sustainability of social security schemes, pension systems and unemployment insurance systems of the Member States and highlights that a loss in employment in the medium and long term as a consequence of robotisation could also be associated with the risk of a loss in consumption capacity; stresses that the majority of benefits coming from automatisisation and robotisation in employment should come not only from reducing labour costs but also from raising productivity through fewer errors, higher output and improved quality, safety and speed; calls on the Commission and the Member States to consult and involve the social partners regularly when adapting the regulatory framework for robotics and the digital economy, to identify potential occupational health and safety risks stemming from technological innovations and take appropriate measures to counter them and to explore the possibility of introducing a notification system prior to the establishment of robots and their relative participation to the companies turnover for the purpose of taxation and social security contributions;
12. Calls on the Commission to present guidelines on the ethical and social principles set to accompany future regulations in the field of robotics, in particular with regard to the objective of defining forward-looking standards suitable for future technological developments;
13. Points to so-called crowdworking; calls on the Commission to look into this new form of employment and to examine to what extent social security systems and applicable labour law will need to be adjusted to provide appropriate protection for crowdworkers;
14. Stresses that whilst it is impossible to hold back technological progress, the present generation has the opportunity as well as the responsibility to shape its course in order to benefit people and the planet; is of an opinion that the Union should contribute to an integrated strategy in the policy areas of welfare, economic growth and technology in order to be at the forefront of global development; calls on the Member States and the Commission to study in great detail the near-future consequences of the increased use of robotic systems on labour and to provide a framework for this development with legislation designed to make technological transition as smooth as possible for employees and firmly believes that, as a matter of urgency, an answer must be found to the question of whether, as the result of further developments in robotics and less expensive solutions, there will be jobs in which the ability for humans to work will be restricted by law due to the harmful or dangerous nature of the work vis-à-vis human health (as with rules currently applicable for pregnant women) or for other reasons, and to find an answer to the question of which areas potentially might be considered to be restrictions or a ban on partial or total automation in order to guarantee safety and respect of fundamental rights challenged by increased automation of entire industries, taking into account demographic changes and sustainability and to avoid any unintended social consequences;
15. Believes that given the pace of technological advance we should aim to legislate for robotics for the foreseeable future; believes also, that legislation should be fit for

purpose in order to react to scientific and technological changes; is of the opinion that it is necessary to anticipate the development of new business areas which could develop on the basis of the further development of robotics and artificial intelligence; however, points out that robots are not only tools for work but are increasingly acting autonomously in the production of goods and services therefore calls for comprehensive protection systems to ensure that the health and safety of workers is adequately protected when working with or alongside robotics and other forms of artificial intelligence and for liability rules that ensure that damage caused by autonomous robots can be clarified in favour of the employees; therefore calls on the Union and the Member States to encourage the initiation of a structured public dialogue on the consequences of developing those technologies as soon as possible and calls on the stakeholders involved in the research to develop a critical approach and to provide a constructive feed to the public dialogue;

16. Stresses that any processing activity carried out by robotics and artificial intelligence systems must be in full compliance with Union data protection law and must embed privacy by design and privacy by default principles;
17. Points out that robotisation offers considerable opportunities to bring the manufacturing industry back to the Union and thereby create new employment opportunities, in particular for low-skilled workers;
18. Believes that the use of robots in production comes with major challenges for health and safety in the workplace; points out that robotisation can, on the one hand, reduce the physical burden on workers, but that it can also result in higher mental strain given the increasing responsibility of the individual in more complex production processes; calls on the Commission and its agencies, in particular EU-OSHA, to examine the effects of digitalisation, robotics and artificial intelligence on mental strain and to make proposals for counter-measures; calls for employees to be given the opportunity play an active part in shaping their work environment at all times and for social partners and unions to be involved at all levels;
19. Points to scientific studies which have identified four major problems that arise when trying to legislate for the use of robots: discretion, with regard to the platforms and manufacturers involved in the development and research of artificial intelligence, which might not always be visible to regulators; diffuseness which arises when artificial intelligence systems are developed using teams of researchers that are organisationally, geographically and jurisdictionally separate; discretion refers to the fact that artificial intelligence systems could entail many separate, distinct pre-existing hardware and software components; points out that the effects of bringing all those components together may not be fully appreciated until after the fact and that opacity means that the way in which artificial intelligence systems work may be more opaque than previous technologies; notes that this might constitute a problem for regulators as there is a lack of clarity concerning the problems that may be posed by such systems and how those problems can be addressed.

RESULT OF FINAL VOTE IN COMMITTEE ASKED FOR OPINION

Date adopted	8.11.2016
Result of final vote	+: 36 -: 7 0: 9
Members present for the final vote	Laura Agea, Guillaume Balas, Brando Benifei, Vilija Blinkevičiūtė, Enrique Calvet Chambon, David Casa, Ole Christensen, Martina Dlabajová, Lampros Fountoulis, Arne Gericke, Sergio Gutiérrez Prieto, Marian Harkin, Danuta Jazłowiecka, Agnes Jongerius, Rina Ronja Kari, Jan Keller, Ádám Kósa, Jean Lambert, Patrick Le Hyaric, Jeroen Lenaers, Verónica Lope Fontagné, Javi López, Morten Løkkegaard, Thomas Mann, Dominique Martin, Anthea McIntyre, Joëlle Mélin, Elisabeth Morin-Chartier, Emilian Pavel, João Pimenta Lopes, Georgi Pirinski, Marek Plura, Terry Reintke, Sofia Ribeiro, Maria João Rodrigues, Claude Rolin, Sven Schulze, Siôn Simon, Jutta Steinruck, Yana Toom, Renate Weber, Tatjana Ždanoka, Jana Žitňanská
Substitutes present for the final vote	Daniela Aiuto, Georges Bach, Amjad Bashir, Heinz K. Becker, Csaba Sógor, Helga Stevens, Neoklis Sylikiotis, Flavio Zanonato
Substitutes under Rule 200(2) present for the final vote	David Coburn

14.10.2016

OPINION OF THE COMMITTEE ON THE ENVIRONMENT, PUBLIC HEALTH AND FOOD SAFETY

for the Committee on Legal Affairs

with recommendations to the Commission on Civil Law Rules on Robotics
(2015/2103(INL))

Rapporteur: Cristian-Silviu Buşoi

(Initiative – Rule 46 of the Rules of Procedure)

SUGGESTIONS

The Committee on the Environment, Public Health and Food Safety calls on the Committee on Legal Affairs, as the committee responsible:

- to incorporate the following suggestions into its motion for a resolution:
- A. whereas ageing is the result of an increased life expectancy due to progress in living conditions and in modern medicine, and is one of the greatest political, social, and economic challenges of the 21st century for European societies; whereas by 2025 more than 20 % of Europeans will be 65 or over, with a particularly rapid increase in numbers of people who are in their 80s or older, which will lead to a fundamentally different balance between generations within our societies, and whereas it is in the interest of society that older people remain healthy and active for as long as possible;
- B. whereas the sale and production of robots rose significantly between 2010 and 2014, with an increase of almost 30 % in 2014 alone, particularly in the health sector and in the care sector;
- C. whereas in an ageing society the prevalence and incident rate of disabilities, chronic diseases, the risk of stroke, brain injuries and diminished abilities is increasing;
- D. whereas societies and health systems will need to adapt to the ageing process and elderly healthcare requirements, so they can provide adequate care and remain financially sustainable;
- E. whereas cyber-physical systems (CPS) are technical systems of network computers, robots, and artificial intelligence that interact with the physical world and have

numerous applications in the healthcare sector;

- F. whereas, given the nature of CPS, there is a need to achieve specific, more detailed standards that are the same throughout the Union;
 - G. whereas such systems will provide the foundation and the basis of emerging and future smart services, and will bring advances in personalised healthcare, emergency response and telemedicine;
 - H. whereas under no circumstances should the use of robotic or high-technology diagnostic or treatment instruments result in increased liability for the doctors or healthcare personnel who are required to use them; whereas it is therefore considered advisable to increase the liability of the healthcare facilities or manufacturers involved;
 - I. whereas the economic and societal potential of CPS is vastly greater than what has been previously imagined, and major investments are being made worldwide to develop the technology;
 - J. whereas the use of such technology should not diminish or harm the doctor-patient relationship, but should provide doctors with assistance in diagnosing and/or treating patients;
 - K. whereas CPS raise many high expectations and have much potential, the effects of newly introduced technologies will never be completely predicted and can only be successfully integrated if society can adjust to a new way of interacting with technology;
- 1. acknowledges that the adoption of new technologies in the field of healthcare, assuming that the emphasis is laid on the doctor-patient relationship and free will, is likely to bring major benefits in terms of patient care and effectiveness and precision of treatment, and with the aim of reducing the risk of human error, thereby leading to an increased quality of life and longer life expectancy;
 - 2. considers that although robotics can bring societal benefits, they can at the same time dramatically change the ways people interact with each other and therefore have a real impact on current societal structures; therefore, underlines the urgent need for extensive and informed public debate around this new technological revolution;
 - 3. considers it essential for the Union to develop a regulatory framework based on ethical principles in line with the complexity of robotics and its many social, medical and bioethical implications;
 - 4. underlines that innovation providing better diagnoses and better insights into treatment, care and rehabilitation options leads to more accurate medical decisions and quicker recovery times, and could therefore alleviate shortages of healthcare professionals in care and rehabilitation processes;
 - 5. stresses that the increase in demand in CPS units has the potential to create a large number of high-skilled jobs in the Union;

6. considers it useful for robots to be present to support the work of doctors or healthcare assistants, in order to improve the human experience of diagnosis and treatment, without, however, disregarding the need to ensure that medical practice and patient care practices are not dehumanised;

Care robots

7. notes that CPS are able to change for the better the life of people suffering from a disability, as smart technologies can be used for prevention, assistance, monitoring and companionship;
8. notes that CPS are likely to have a profound impact on the healthcare sector, with the potential to lower the overall costs of healthcare by enabling medical professionals to shift their focus from treatment to prevention;
9. underlines that elder care robot research and development has, in time, grown more mainstream and cheaper, producing products with greater functionality and broader consumer acceptance; notes the wide range of applications of such technologies providing prevention, assistance, monitoring, stimulation, and companionship to elderly people as well as people suffering from dementia, cognitive disorders, or memory loss;
10. stresses that although CPS has the potential to enhance the mobility and sociability of people with disabilities and elderly people, human caregivers will still be needed and will continue to provide an important source of social interaction for them that is not totally replaceable; notes that CPS technologies or robots can only considerably augment human care and make the rehabilitation process more targeted, so that medical staff and caregivers can allocate more quality time for diagnosis and better treatment options;

Medical robots

11. notes that early forms of robots and smart CPS devices are already used in healthcare, such as e-Health devices and surgical robots and that in the near future this technology will continue to develop, having the potential to also reduce healthcare costs, by enabling medical professionals to shift their focus from treatment to prevention and by making more budgetary resources available for better adjustment to the diversity of patients' needs, continuous training of the healthcare professionals and research;
12. underlines that the increased use of CPS could result in a healthier society as procedures become less invasive, leading to quicker recovery times, and reducing healthcare-related absenteeism;
13. notes that medical robotic devices continue to evolve and will likely become more frequently used in surgical procedures, moving the boundaries of medicine forward;
14. acknowledges that surgical robots have been envisaged to extend the capabilities of human surgeons beyond the limits of conventional laparoscopy, and that the development of surgical robots is rooted in the desire to overcome such limitations and to expand the benefits of minimally invasive surgery, fine movements and accuracy;

15. underlines that CPS allow for telesurgery, with numerous advantages such as increased precision of hand motion, removing tremor from hand motion, magnified view, which they can analyse and assess immediately, improved dexterity and remote surgery, while it must be a fundamental requirement for doctors to acquire skills and accreditation for the performance of medical intervention with individual CPS devices;
16. notes that recent years have seen significant changes in the medical education and training sector; further notes that, as medical care has become increasingly complex, the climate in academic health centres provides an opportunity to enhance a holistic approach to health, rethink the way medical education and lifelong learning is delivered, while preserving the core competence of doctors to retain their expertise and authority over robots; calls on the Commission and the Member States to promote high training and specialisation standards for medical and paramedical personnel who use or are planning to use new robotic technologies, and encourage the free movement of surgeons who intend to use such technologies to carry out their operations;
17. calls on the Commission and the Member States to strengthen the financial instruments for research projects in robotics for social and health emergencies;
18. considers it vital to respect the principle of supervised autonomy of robots, whereby the initial planning of treatment and the final decision regarding its execution will always remain the decision of a human surgeon;

Clinical evaluation and clinical investigations

19. stresses that medical CPS should meet the high standards set for medical equipment, through effective verification and certification procedures which allow assessment by adequately trained staff of the safety and effectiveness of the proposed technology, even at the design stage;
20. stresses the importance of distinguishing surgical robots from prostheses and exoskeletons from robot companions whose function is to assist persons with disabilities or those who are temporarily incapacitated; stresses the importance of subjecting both types to checks to be carried out in accordance with standards that are as precise and detailed as possible;
21. welcomes the political agreement on the Regulation on medical devices (2012/0266(COD)) reached by the co-legislators in June 2016; calls on the Commission to ensure that the procedures for testing new medical robotic devices are safe, particularly in the case of devices that are implanted in the human body, before the date on which that Regulation becomes applicable; further notes that there must be full transparency for patients concerning their own data and for the public concerning failed and successful trials, and that the responsibility for failed trials and CPS must be clear to patients and the public;

Ethics

22. emphasises that while the development of technology is increasing exponentially, social systems in the Union cannot respond as quickly, and healthcare systems have an even slower response; stresses that those developments have a significant impact on

civilisation as we know it, and that it is therefore imperative for technological advances to go hand in hand with assessments of the long term moral and ethical implications of new technologies before and throughout their development;

23. stresses the importance, as regards ethical standards, of ensuring that robotic products respect the fundamental rights of individuals and society, which should be protected at Union level, by providing for any necessary technical measures which ensure such respect from the design stage, in accordance with the so-called privacy by design approach;
24. draws attention to the risks associated with the possibility that CPS integrated into the human body may be hacked or switched off or have their memories wiped, because this could endanger human health, and in extreme cases even human life, and stresses therefore the priority that must be attached to protecting such systems;
25. acknowledges the vulnerability of patients with special needs, including children, elderly and people suffering from disabilities, and stresses that any user may develop an emotional connection with CPS and robots; underlines the ethical considerations posed by their possible attachment; encourages the Commission to start a reflection on how to ensure that CPS will not negatively impact the autonomy and independence of vulnerable persons;
26. calls on the Commission and on the Member States to promote the development of assistive technologies, also through liability schemes that are different from those currently applicable, in order to facilitate the development and adoption of these technologies by those who need them, in accordance with Article 4 of the UN Convention on the Rights of Persons with Disabilities, to which the Union is party;
27. highlights the importance of preserving the patient-doctor care relationship, in particular as regards communication of the medical diagnosis and treatment;
28. notes that the use of CPS raises the issue of human enhancement, which is defined as the enhancement of existing natural human skills or the conferral of new skills, allowing individuals to overcome disability;

Environmental impact

29. acknowledges the need to minimise the possible environmental or ecological footprint of robotics, as the use of CPS and robots is expected to increase overall energy consumption and the amount of electric and electronic waste; emphasises the need to maximise the potential to make processes more resource-efficient, to increase energy efficiency by promoting the use of renewable technologies for robotics, to promote the use and reuse of secondary raw materials and to reduce waste; therefore encourages the Commission to incorporate the principles of a circular economy into any Union policy on robotics;
30. notes also that the use of CPS will have a positive impact on the environment, especially in the fields of agriculture and food supply, notably through the reduced size of machinery and the reduced use of fertilizers, energy and water, as well as through precision farming;

31. stresses that CPS will lead to the creation of energy and infrastructure systems that are able to control the flow of electricity from producer to consumer, and will also result in the creation of energy 'prosumers', who both produce and consume energy; thus allowing for major environmental benefits;

- to incorporate the following recommendations in the Annex to its motion for a resolution:

Safety

Safety of medical robotic devices is a precondition for their introduction in the healthcare sector. The effectiveness and safety of care and medical robots should be assessed against specific, very detailed, safety safeguards and standard certification procedures, with special attention given to their use by impaired users or in emergency situations; calls on the Commission to adopt detailed common specifications for robotic medical devices; particular attention should be paid to the security of CPS networks so as to remove any possibility of hacking into them and stealing sensitive personal data.

The safety of CPS systems implanted in the human body is a fundamental requirement, because any fault in them may be fatal, and in this context it is important to provide information and to unambiguously regulate issues of liability, including whose property these implanted CPS are, who has rights over them and who may change their implantation, strictly prohibiting any experimentation on people without their consent.

Privacy

Medical CPS and the use of a robot as an "electronic health record" raise questions concerning laws on patient privacy, medical professional secrecy, and data protection in the area of public health. Union data protection rules should be adapted to take into account the increasing complexity and interconnectivity of care and medical robots possibly handling highly sensitive personal information and health data; they should comply with the concept of privacy by design, as laid down in Regulation (EU) No 2016/679 on data protection. The codes of conduct on medical professional secrecy should be enhanced concerning the health data stored on CPS that can be accessed by third parties.

Insurance companies or any other service provider should not be allowed to use e-health data to introduce discrimination in the setting of prices, as this would contradict the fundamental right to the highest attainable standard of health.

Research Ethics Committees

Research Ethics Committees (RECs) should take into account the ethical questions raised by the development of medical robotic devices and CPS in many areas of healthcare and assistance provision to disabled and elderly people. Issues such as equality of access to robotic preventive health care, the privileged patient-doctor care relationship, and the susceptibility, in particular, of patients with special needs (for example people with disabilities), but not only them (for example children, lonely people, etc.), to developing an emotional attachment to robots should be given due

consideration.

RECs and the Commission are encouraged to start a reflection in order to develop a code of conduct for researchers/designers and users of medical CPS, that should be based on the principles enshrined in the Union's Charter of Fundamental Rights (such as human dignity and human rights, equality, justice and equity, benefit and harm, dignity, non-discrimination and non-stigmatisation, autonomy and individual responsibility, informed consent, privacy and social responsibility as well as the rights of the elderly, the integration of persons with disabilities, the right to healthcare, and the right to consumer protection) and on existing ethical practices and codes.

It is noteworthy that robotics can introduce a high level of uncertainty regarding responsibility and liability issues.

RESULT OF FINAL VOTE IN COMMITTEE ASKED FOR OPINION

Date adopted	13.10.2016
Result of final vote	+: 61 -: 0 0: 0
Members present for the final vote	Marco Affronte, Margrete Auken, Pilar Ayuso, Zoltán Balczó, Catherine Bearder, Ivo Belet, Nessa Childers, Birgit Collin-Langen, Mireille D'Ornano, Miriam Dalli, Angélique Delahaye, Stefan Eck, Bas Eickhout, Eleonora Evi, José Inácio Faria, Elisabetta Gardini, Gerben-Jan Gerbrandy, Jens Gieseke, Julie Girling, Sylvie Goddyn, Françoise Grossetête, Anneli Jäätteenmäki, Jean-François Jalkh, Josu Juaristi Abaunz, Karin Kadenbach, Kateřina Konečná, Giovanni La Via, Peter Liese, Norbert Lins, Susanne Melior, Miroslav Mikolášik, Massimo Paolucci, Bolesław G. Piecha, Frédérique Ries, Michèle Rivasi, Daciana Octavia Sârbu, Annie Schreijer-Pierik, Davor Škrlec, Dubravka Šuica, Tibor Szanyi, Claudiu Ciprian Tănăsescu, Jadwiga Wiśniewska, Damiano Zoffoli
Substitutes present for the final vote	Guillaume Balas, Paul Brannen, Nicola Caputo, Michel Dantin, Mark Demesmaeker, Luke Ming Flanagan, Elena Gentile, Martin Häusling, Krzysztof Hetman, Gesine Meissner, James Nicholson, Marijana Petir, Gabriele Preuß, Christel Schaldemose, Jasenko Selimovic, Mihai Turcanu
Substitutes under Rule 200(2) present for the final vote	Nicola Danti, Anna Hedh

15.11.2016

OPINION OF THE COMMITTEE ON INDUSTRY, RESEARCH AND ENERGY

for the Committee on Legal Affairs

with recommendations to the Commission on Civil Law Rules on Robotics
(2015/2103(INL))

Rapporteur: Kaja Kallas

(Initiative – Rule 46 of the Rules of Procedure)

SUGGESTIONS

The Committee on Industry, Research and Energy calls on the Committee on Legal Affairs, as the committee responsible:

- to incorporate the following suggestions into its motion for a resolution:
 - A. whereas robot-human teams could be 85 %¹ more productive than either robots or humans on their own; whereas, by enhancing capabilities of humans, robots will reduce the risk of human error,
 - B. whereas the Union holds a leading position in industrial robotics, with a share of more than 25 %² of supply and use and growth in the market is estimated to be 8 to 9% per annum, thereby making the sector an industrial strategy priority,
- 1. Believes that robotics and artificial intelligence play a major role in improving the competitiveness and productivity of the European economy and could, in the medium term, have more impact on the competitiveness of non-manufacturing industries such as agriculture, transport, healthcare, security and utilities; calls on the Commission to promote an ambitious and cross-sectorial pro-innovation policy in robotics and artificial intelligence, facilitating integration of technologies in value chains, development of innovative business models, and shortening the time passed from innovation to industrialisation; asks the Commission to assess the need to modernise legislation or develop European guidelines to ensure a joint approach in robotics and artificial intelligence, essential for companies to scale up in the Union;
- 2. Notes that third countries have recognised the strategic importance of robotics and are

¹ According to research from MIT following joint experience with Carmakers BMW and Mercedes-Benz.

² <http://ec.europa.eu/programmes/horizon2020/en/h2020-section/robotics>.

challenging the Union's global market leadership, for example through takeovers of Union manufacturers; calls on the Commission to devise an industrial strategy that addresses the role of strategically significant sectors such as robotics and sets out how the Union can retain jobs, growth, know-how and much of the value chain;

3. Stresses that innovation in robotics and artificial intelligence and the integration of robotics and artificial intelligence technology within the economy and the society require digital infrastructure that provides ubiquitous connectivity; calls on the Commission to set a framework that will meet the connectivity requirements for the Union's digital future and to ensure that access to broadband and 5G networks is fully in line with the net neutrality principle;
4. Strongly believes that interoperability between systems, devices and cloud services, based on security and privacy by design is essential for real time data flows enabling robots and artificial intelligence to become more flexible and autonomous; asks the Commission to promote an open environment, from open standards and innovative licensing models, to open platforms and transparency, in order to avoid lock-in in proprietary systems that restrain interoperability; stresses, in addition, that a high level of safety, security and privacy of data used for the communication of people with robots and artificial intelligence has to be ensured ; therefore calls on the Commission and Member States to integrate the security and privacy by design principles in their policies related to robotics and artificial intelligence, in the Union cybersecurity strategy and to include robotics and artificial intelligence in the discussions of the high-level advisory group on cybersecurity that will be established by the Commission;
5. Notes that data access is key to innovation in machine learning algorithms; calls on the Commission to implement an ambitious framework and strategy on open and free flow of data in particular with the "free-flow-of-data" initiative, in line with data protection legislation and a reformed intellectual property law; stresses that the "free-flow-of-data" initiative should clarify issues of data ownership, usability and access, which are important for the further development and use of robotics technology;
6. Calls on the Commission to increase its support in the mid-term review of the MFF for the Horizon 2020 funded SPARC programme, conduct forecast studies, promote open innovation as a strategic objective, and a collaborative environment between national and European institutions, the research community, standardisation bodies which attract talent, but also the private sector, between global companies, SMEs and start-ups which are key to innovation and opening up new markets in robotic technology on a global scale; stresses the role that private-public partnerships can play in this respect;
7. Stresses that the development of robot technology should focus on complementing human capabilities and not on replacing them; Stresses that growth in robotics and artificial intelligence will automate a significant number of jobs, reducing human exposure to harmful and hazardous conditions and transform lives and work practices, thereby requiring a long-term assessment and measures to ensure that social, environmental, ethical, liability and education aspects are properly addressed; considers in particular the need for digital skills, including coding, to be included in all the teaching and training from the early school years to life-long learning;
8. Believes that medicine robots continue to make inroads into the provision of high

accuracy surgery and in performing repetitive procedures; considers that they have the potential to improve outcomes in rehabilitation, and provide highly effective logistics support within hospitals;

– to incorporate the following recommendations in the annex to its motion for a resolution:

9. Considers that any future legislative initiatives covering on robotics and artificial intelligence after consultation with a diverse range of relevant stakeholders and based on a continuous dialogue, should provide legal certainty without stifling innovation in this fast-evolving technology field;
10. Believes that, together with end-users robotics engineers, the research community and other stakeholders the Commission should develop a code of ethical conduct aimed at guiding robotics and artificial intelligence development activities;
11. Considers that recommendations regarding licences should respect contractual freedom and leave room for innovative licensing regimes; cautions against the introduction of new intellectual property rights in the field of robotics and artificial intelligence that could hamper innovation and the exchange of expertise;

RESULT OF FINAL VOTE IN COMMITTEE ASKED FOR OPINION

Date adopted	13.10.2016
Result of final vote	+: 54 -: 1 0: 3
Members present for the final vote	Bendt Bendtsen, Xabier Benito Ziluaga, José Blanco López, David Borrelli, Jerzy Buzek, Angelo Ciocca, Edward Czesak, Jakop Dalunde, Pilar del Castillo Vera, Christian Ehler, Fredrick Federley, Ashley Fox, Adam Gierek, Theresa Griffin, Hans-Olaf Henkel, Eva Kaili, Kaja Kallas, Barbara Kappel, Krišjānis Kariņš, Seán Kelly, Jaromír Kohlíček, Zdzisław Krasnodębski, Miapetra Kumpula-Natri, Janusz Lewandowski, Ernest Maragall, Edouard Martin, Angelika Mlinar, Nadine Morano, Dan Nica, Carolina Punset, Herbert Reul, Paul Rübig, Algirdas Saudargas, Sergei Stanishev, Neoklis Sylikiotis, Dario Tamburrano, Patrizia Toia, Evžen Tošenovský, Claude Turmes, Vladimir Urutchev, Henna Virkkunen, Martina Werner, Lieve Wierinck, Anna Záborská, Flavio Zanonato, Carlos Zorrinho
Substitutes present for the final vote	Michał Boni, Rosa D'Amato, Esther de Lange, Jens Geier, Benedek Jávor, Olle Ludvigsson, Vladimír Maňka, Marian-Jean Marinescu, Clare Moody, Maria Spyrali
Substitutes under Rule 200(2) present for the final vote	Salvatore Cicu, Albert Deß

OPINION OF THE COMMITTEE ON THE INTERNAL MARKET AND CONSUMER PROTECTION

for the Committee on Legal Affairs

Civil Law Rules on Robotics
(2015/2103(INL))

Rapporteur: Dita Charanzová

(Initiative – Rule 46 of the Rules of Procedure)

SUGGESTIONS

The Committee on the Internal Market and Consumer Protection calls on the Committee on Legal Affairs, as the committee responsible, to incorporate the following suggestions into its motion for a resolution:

- A. whereas robotics is not new; whereas robotics can, and does, play a role in transforming our society for the better; whereas robotics and artificial intelligence can play an active part in the digitisation of the economy in many sectors, such as industry, healthcare, construction and transport, and lead to innovations, less exposure to hazardous work conditions, and new business models, and the Union must actively embrace developments in this area to advance the digital single market;
- B. whereas robots increasingly operate in close proximity to humans and, in particular, the market for robotic services is constantly expanding, allowing new benefits to be brought to society, without neglecting safety and liability issues;
- C. whereas, despite the undeniable advantages afforded by robotics, its implementation may entail a transformation of the labour market and a need to reflect on the future of education, employment, and social policies accordingly;
- D. whereas the sale and production of robots rose significantly between 2010 and 2014, with an increase of almost 30 % in 2014 alone, particularly in the electronics industry;
- E. whereas the digital transformation of European manufacturing industry, which accounts for 15 % of the GDP of the Union, could have a value-added potential of EUR 1,25 trillion in 2025¹, and the adoption of autonomous and robotic technologies could

¹ STOA, Ethical Aspects of Cyber-Physical Systems, Scientific Foresight Study (May 2016), Annex

contribute to boosting European industrial output and result in a significant competitive advantage for Europe;

- F. whereas machine learning offers enormous economic and innovative benefits for society by vastly improving the ability to analyse data, while also raising challenges to ensure non-discrimination, due process, access to information and comprehensibility in decision-making processes;
 - G. whereas developments in the field of medical applications, such as robotic prostheses and implants, make persons carrying them vitally reliant on the availability of maintenance, repairs, and enhancements;
 - H. whereas data protection and respect for intellectual property must be taken into account in the development of all new technological and production prototypes;
 - I. whereas many third countries have adopted suitable guidelines and legislation in the field of robotics, while a number of Member States have also begun to give the matter serious consideration;
1. Stresses that a Union-level approach can facilitate development by avoiding fragmentation in the internal market and at the same time underlines the importance of the principle of mutual recognition in the cross-border use of robots and robotic systems; recalls that testing, certification and market approval should only be required in a single Member State;
 2. Stresses that this approach should be accompanied by effective market surveillance, as well as legal remedies and powers for the Member States to impose recalls and sanction infringements;
 3. Stresses the importance of measures to help small and medium-sized enterprises and start-ups in the robotics sector that create new market segments in this sector or make use of robots;
 4. Encourages the development of an ambitious European strategy for research and innovation in robotics in order to fully develop its potential for growth and jobs in Europe;
 5. While recognising that significant numbers of international standards, addressing issues such as interoperability and safety, already exist and are applied across the industry, believes that further harmonised standardisation for robotics and artificial intelligence is necessary and should be part of the Union's standardisation priorities in order to foster innovation and to guarantee a high level of consumer protection; stresses that it is essential for common, safe and high-level standards to be developed in this future-oriented area;
 6. Calls on the Commission, in cooperation with European standardisation bodies, to continue to engage pro-actively with international standardisation bodies and to improve cooperation with international partners to work further on improving standards

1, p. 37.

in this field; welcomes, in this respect, the setting up of special technical committees, such as ISO/TC 299 Robotics, dedicated exclusively to developing standards on robotics;

7. Reiterates that the vast majority of standards are developed in response to an industry-identified need and encourages European and international standardisation bodies to continually review their own standards to ensure that they meet these needs;
8. Considers that robots developed for both manufacturing and individual use should be subject to product safety and consumer protection rules ensuring, where appropriate, minimum safety standards and addressing the risk of accidents resulting from interaction with, or working in proximity to, humans; believes that ethical issues and issues of data protection, including third-party and personal data, civil liability, education and training and cybersecurity should be addressed in any policy on robotics;
9. Highlights the importance of privacy and security by design in the development of robots and the importance of rules for testing robot responses for the purposes of consumer protection;
10. Stresses that, wherever the use of robots is proposed, there is a need to focus on the dignity of the human being, especially in the field of health care;
11. Points out that for the field of vital medical applications such as robotic prostheses, continuous, sustainable access to maintenance, enhancement and, in particular, software updates that fix malfunctions and vulnerabilities needs to be ensured;
12. Considers that better account of the impact of robotisation needs to be taken in Member States' employment, education and social policies; asks the Commission to help seek a uniform regulatory framework and greater cooperation between the Member States; asks the Member States to put in place redesigned training frameworks to prevent a shortage of information and communications technology professionals;
13. Recognises that robotics and artificial intelligence technologies are increasingly used in autonomous vehicles, such as autonomous cars and civilian drones; notes that some Member States are already enacting or considering legislation in this area in particular, which could result in a patchwork of national legislations hampering the development of autonomous vehicles; calls, therefore, for a single set of Union rules striking the right balance between the interests of users, businesses and other concerned parties, while avoiding overregulation in robotics and robotic systems;
14. Calls for regulatory cooperation in order to amend certain international agreements, such as the Vienna Convention on Road Traffic of 8 November 1968 and the Hague Traffic Accident Convention of 4 May 1971;
15. Believes that, in the case of autonomous vehicles, there may not necessarily be a need to alter the legal situation relating to insurance, as current practices and relationships between operators, manufacturers and insurers may adequately cope with the introduction of new technologies, as has been the case in the past;
16. Underlines that the use of robotics in healthcare is already a growing market, especially

in telerobotic surgical procedures, in which Europe leads; asks the Commission to ensure conditions to allow the increased use of such practices;

17. Calls on the Commission to increase funding for interdisciplinary studies of the societal impacts of artificial intelligence and machine learning processes.

RESULT OF FINAL VOTE IN COMMITTEE ASKED FOR OPINION

Date adopted	11.10.2016
Result of final vote	+: 35 -: 1 0: 1
Members present for the final vote	Catherine Bearder, Dita Charanzová, Carlos Coelho, Lara Comi, Anna Maria Corazza Bildt, Daniel Dalton, Nicola Danti, Dennis de Jong, Vicky Ford, Ildikó Gáll-Pelcz, Evelyne Gebhardt, Maria Grapini, Sergio Gutiérrez Prieto, Robert Jarosław Iwaszkiewicz, Liisa Jaakonsaari, Antonio López-Istúriz White, Marlene Mizzi, Eva Paunova, Jiří Pospíšil, Virginie Rozière, Christel Schaldemose, Andreas Schwab, Olga Sehnalová, Igor Šoltes, Ivan Štefanec, Catherine Stihler, Richard Sulík, Róza Gräfin von Thun und Hohenstein, Mylène Troszczynski, Mihai Țurcanu, Anneleen Van Bossuyt, Marco Zullo
Substitutes present for the final vote	Birgit Collin-Langen, Morten Løkkegaard, Julia Reda, Marc Tarabella
Substitutes under Rule 200(2) present for the final vote	John Stuart Agnew

RESULT OF FINAL VOTE IN COMMITTEE RESPONSIBLE

Date adopted	12.1.2017
Result of final vote	+: 17 -: 2 0: 2
Members present for the final vote	Max Andersson, Joëlle Bergeron, Marie-Christine Boutonnet, Jean-Marie Cavada, Therese Comodini Cachia, Mady Delvaux, Lidia Joanna Geringer de Oedenberg, Mary Honeyball, Gilles Lebreton, António Marinho e Pinto, Julia Reda, Evelyn Regner, József Szájer, Tadeusz Zwiefka
Substitutes present for the final vote	Daniel Buda, Sergio Gaetano Cofferati, Angel Dzhambazki, Heidi Hautala, Constance Le Grip, Victor Negrescu
Substitutes under Rule 200(2) present for the final vote	Eleonora Evi, Andrey Novakov