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**Civil Liability and Autonomous Robotic  
Machines: Approaches in the EU and US**

**Paul Opitz**

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# TTLF Working Papers

**Editors: Siegfried Fina, Mark Lemley, and Roland Vogl**

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## **Abstract**

More and more machines, from medical robots and self-driving cars to industrial robots and consumer devices, are highly automatized or even fully autonomous. But since even the best technology is not error-free, domestic robots, self-driving cars, and other autonomous systems will inevitably cause harm to other people or property. In order for society to accept these new technologies and to foster innovation, clear rules on civil liability are required.

In the past, certain technological advancements have led to special statutes in individual member states of the European Union and also in the US. Such statutes have introduced a kind of strict liability, replacing the ordinary requirement of negligence. Will that trend extend to fully autonomous robots? Who will be civilly liable if domestic robots or other autonomous systems cause injuries?

This project addresses possible approaches that new statutes or other solutions could use to determine liability rules in the EU and US, especially concentrating on liability regimes for the user of autonomous robotic machines. In 2017, the European Parliament (2015/2103(INL)) argued that the existing laws might not be capable of handling every aspect of autonomous systems, since these systems are more than mere tools in the hands of their users. The Parliament emphasized the importance of new regulations at the European level in order to ensure an equal and transparent legal environment across member states. The legal challenges posed by autonomous machines, as well as possible solutions, have also been widely discussed by scholars in the United States. This paper aims to analyze, compare, and discuss approaches in the EU and the US.

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## **A. Introduction**

The development of autonomous robots challenges the legal systems around the world. Since machines are becoming highly automatized or even fully autonomous, the range of possible applications is staggering. However, since even the best technology is not error-free and as the interaction between humans and robots increases, domestic robots, self-driving cars, and other autonomous systems will inevitably cause harm to people and property. In order for society to accept the new technologies and to foster innovation, clear rules on civil liability are required. This paper discusses how traditional civil liability theory in both the EU and the US can be applied to autonomous machines and also compares current legal approaches to this issue in both jurisdictions.

Part A (I) of this paper will summarize the regulatory discussions in the EU and the US. Part A (II) includes some general background on the interplay between technology and the law. Part B will then give a short overview of the basic principles of traditional civil liability theory in the EU and US and will analyze how these theories might be insufficient when determining liability for autonomous robots. Part C discusses possible solutions advanced by the European Parliament and by legal scholars in the EU and the US. Finally, the paper will compare suggested solutions in Part D.

### **I. A Short Recap of Past Regulatory Discussion**

In light of multi-layered legal, ethical, and regulatory problems, countries in the European Union started a transnational debate on robotics around 2010. This debate resulted in a number of initiatives and frameworks focused on legal issues in robotics.<sup>1</sup> Most recently, the European Parliament issued a report with recommendations to the Commission on civil law

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<sup>1</sup> See for more details of this development *Santosouso/Bottalico*, *Autonomous Systems and the Law: Why Intelligence Matters*, in: Hilgendorf/Seidel, *Robotics, Autonomics, and the Law*, 27, 44 (2017).

rules on robotics in 2017.<sup>2</sup> It argued that existing laws were not capable of handling every aspect of autonomous systems, since these robots cease to be “simple tools” in the hands of their users.<sup>3</sup> The higher the level of autonomy, the more independent decisions robots might make, diminishing the human sphere of influence. Also, the Parliament emphasized the necessity of new regulations on a European level in order to ensure an equal and transparent legal environment across member states.<sup>4</sup> In response to this paper, the Commission announced various regulatory initiatives.<sup>5</sup> Along with the widely discussed approach of manufacturer liability, risk-based liability regimes are considered to be a possible solution, creating liability for the persons who benefit from the use of such systems.<sup>6</sup>

Furthermore, the regulation of AI is not only a relevant topic in the EU. Scholars in the United States have also discussed the challenges posed by autonomous machines to the legal system, as well as possible solutions.<sup>7</sup> Because of the increasing autonomy of many different machines, the application of traditional civil liability doctrine is seen as a major challenge for courts and legal scholars.<sup>8</sup> Additionally, the US Chamber Institute for Legal Reform has

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<sup>2</sup> European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051.

<sup>3</sup> European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, AB.

<sup>4</sup> European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, Nr. 49, 16.

<sup>5</sup> European Commission, Follow up to the European Parliament resolution of 16 February 2017 on civil law rules on robotics, 2015/2103 (INL), Reference Number: A8-0005/2017 / P8\_TA-PROV(2017)0051; see also *Molyneux*, What is a Robot under EU Law?, available at <https://www.globalpolicywatch.com/2017/08/what-is-a-robot-under-eu-law/> (last visited 23 October 2018).

<sup>6</sup> European Commission, Follow up to the European Parliament resolution of 16 February 2017 on civil law rules on robotics, 2015/2103 (INL), Reference Number: A8-0005/2017 / P8\_TA-PROV(2017)0051, 2.

<sup>7</sup> *Calo*, Robotics and the Lessons of Cyberlaw, 103 Calif. L. Rev. 513 (2015); *Calo*, Open Robotics, 70 Md. L. Rev. 571 (2011); *Chopra/White*, A Legal Theory for Autonomous Artificial Agents (2011); *Hubbard*, Allocating the Risk of Physical Injury from “Sophisticated Robots”: Efficiency, Fairness, and Innovation, in: *Calo et al.*, Robot Law, 3 (2016); *Richards/Smart*, How Should the Law Think About Robots, in: *Calo et al.*, Robot Law, 3 (2016); *Scherer*, Regulating Artificial Intelligence Systems: Risks, Challenges, Competences, and Strategies, Harv. J. L. & Tech. 354 (2016); *Weaver*, Robots Are People Too: How Siri, Google Car, and Artificial Intelligence Will Force Us to Change Our Laws (2014); *Calo et al.*, Robot Law (2016).

<sup>8</sup> *White/Baum*, in: Lin et al., Robot Ethics 2.0, 66, 69 (2017); see also *Wallach*, in: Wallach/Allen, Moral Machines: Teaching Robots Right from Wrong, 189 (2014).

released two documents (Torts of the Future I<sup>9</sup> and Torts of the Future II<sup>10</sup>), in which regulatory problems concerning autonomous systems are explored and analyzed. The Institute similarly reaches the conclusion that the rapid development of autonomous technologies entails problems for the legal systems and that the underlying question of liability must be discussed.<sup>11</sup>

Since there are no general laws specifically regulating autonomous systems, legal scholars and institutions try to approach the question of liability through the comparison to and the extension of traditional legal doctrines. Various possible frameworks for the liability of robot owners are discussed, treating robots variably as agents, employees,<sup>12</sup> children, animals,<sup>13</sup> or as abnormally dangerous activities. In fact, the underlying strategy of searching for analogies is similar to past regulatory developments; for example, in the United States, strict liability for defective products initially resulted from an analogy to dangerous animals.<sup>14</sup>

## II. Technology and the Law

Generally, the challenge of regulating new technologies is characterized by uncertainty and the desire to keep up to date with fast-moving technological advances.<sup>15</sup> There have been

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<sup>9</sup> US Chamber Institute for Legal Reform, Torts of the Future: Addressing the Liability and Regulatory Implications of Emerging Technologies (March 2017).

<sup>10</sup> US Chamber Institute for Legal Reform, Torts of the Future II: Addressing the Liability and Regulatory Implications of Emerging Technologies (April 2018).

<sup>11</sup> Concerning autonomous vehicles see US Chamber Institute for Legal Reform, Torts of the Future: Addressing the Liability and Regulatory Implications of Emerging Technologies (March 2017), 5.

<sup>12</sup> US Chamber Institute for Legal Reform, Torts of the Future II: Addressing the Liability and Regulatory Implications of Emerging Technologies (April 2018), 14-16.

<sup>13</sup> *Calo*, Robotics and the Lessons of Cyberlaw, 103 Calif. L. Rev. 513, 542 (2015); *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 120 (2001); *Weaver*, Robots Are People Too, 27 (2014).

<sup>14</sup> Bernstein, *How Can a Product be Liable?*, 45 Duke Law Journal, 9 (1995); see also *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 120 (2001).

<sup>15</sup> *Graeme et al.*, Foresighting Futures: Law, New Technologies, and the Challenges of Regulating for Uncertainty, 4 Law, Innovation and Technology, 1 (2012); for the relationship of innovation and uncertainty see *De Jong*, Regulating Uncertain Risks, in: Hilgendorf/Günther, Robotik und Gesetzgebung, 163 et seq. (2013); *Del Castillo*, A law on robotics and artificial intelligence in the EU? ETUI Foresight Brief, Nr. 2 (2017), 2, available at <https://www.etui.org/Publications2/Foresight-briefs/Artificial-intelligence-a-game-changer-for-the-world-of-work>; see also *Leenes et al.*, Regulatory challenges of robotics: Some guidelines for addressing legal and ethical issues, Law, 9 Innovation and Technology, 1, 7 (2017).

many changes in tort law from 1850 to 2000.<sup>16</sup> Throughout this span of time, liability for fault has been a central issue for private law and, specifically, the compensation determination for accidents.<sup>17</sup> However, in the past, the development of technology has also led to various special statutes in individual member states of the European Union. Such statutes introduced a form of strict liability and thereby replaced the ordinary standard of negligence in certain circumstances involving advanced technologies.<sup>18</sup>

The development of the railroad and motor-powered automobiles brought the first strict liability regimes to European jurisdictions.<sup>19</sup> Strict liability regimes have been introduced for railway operators,<sup>20</sup> cars, nuclear power plants, airplanes, and facilities that are hazardous to the environment.<sup>21</sup> The most widespread strict liability regime across Europe is the liability of keepers of motorcars.<sup>22</sup> However, the list is being extended as technology creates new risks and dangers.<sup>23</sup> In France, there is a more general doctrine of strict custodians' liability, according to which the liability is not limited to dangerous objects, but applies to all kind of items.<sup>24</sup>

In the US, the most prominent regime of strict liability is arguably that of products liability.<sup>25</sup>

In regard to technological development, another relevant theory of strict liability is the

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<sup>16</sup> *Martin-Casals*, The Development of Liability in Relation to Technological Change, Volume 4, vii-viii (2010).

<sup>17</sup> *Martin-Casals*, The Development of Liability in Relation to Technological Change, Volume 4, viii (2010).

<sup>18</sup> *Kirn/Müller-Hengstenberg*, Rechtliche Risiken autonomer und vernetzter Systeme, 134 et seq. (2016).

<sup>19</sup> *Wagner*, Robot Liability, 1 (2018) with more literature references for German law.

<sup>20</sup> Prussian Railway Operators Act; see *Wagner*, Strict Liability in European Private Law, 4 (2011); this rule was also followed by France, *Martin-Casals*, The Development of Liability in Relation to Technological Change, Volume 4, 7 (2010).

<sup>21</sup> *Wagner*, Strict Liability in European Private Law, 4 (2011).

<sup>22</sup> The prominent exception to this rule is the United Kingdom, which applies fault-based liability to motor vehicle accidents, *Wagner*, Robot Liability, 16 (2018); see also *Wagner*, Strict Liability in European Private Law, 5 (2011).

<sup>23</sup> *Wagner*, Strict Liability in European Private Law, 4 (2011).

<sup>24</sup> This kind of liability is called *responsabilité du fait des choses*, see *Wagner*, Strict Liability in European Private Law, 2 (2011).

<sup>25</sup> The European Products Liability Directive Nr. 85/374/EEC is very similar to the North American Restatement Third of Torts: Product Liability, *Palmerini et al.*, RoboLaw: Towards a European framework for robotics regulation, 86 Robotics and Autonomous Systems, 78, 83 (2016); see also *Abbott*, The Reasonable Computer: Disrupting the Paradigm of Tort Liability, 86 Geo. Wash. L. Rev. 1, 14 (2018).

liability for abnormally dangerous activities, which has been applied to the processing, storage, or disposal of explosives and other toxic substances.<sup>26</sup> This paper explores the possibility of following the trend of introducing new strict liability regimes for regulating autonomous robots.

## **B. Basic Principles of Liability and Arising Challenges**

Liability law normally divides up into contractual liability and non-contractual liability. This paper focuses on non-contractual liability, especially the law of torts. In tort law, civil liability systems are based on different concepts. On the one hand, a legal system might base liability on improper conduct itself and require human fault.<sup>27</sup> Fault-based liability is the “central pillar of the liability system” of the European member states.<sup>28</sup> The user is liable if he or she misused an autonomous robot and caused damages to others.<sup>29</sup> On the other hand, liability can be strict, meaning that a person can be held liable without the requirement of specific wrongdoing or fault.<sup>30</sup> This kind of liability is based on the causation of a certain risk rather than on a specific action itself.<sup>31</sup> Outside of product liability law (which is strict), extra-contractual liability legislation is not entirely harmonized in the EU.<sup>32</sup>

Overall, our liability laws assume a human actor.<sup>33</sup> Therefore, robots and other machines are mostly seen as mere tools. This concept has been applied to electronic communications,

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<sup>26</sup> *Dobbs*, The Law of Torts, 3; *Abbott*, The Reasonable Computer: Disrupting the Paradigm of Tort Liability, 86 *Geo. Wash. L. Rev.* 1, 13-14 (2018).

<sup>27</sup> *De Jong*, Regulating Uncertain Risks, in: Hilgendorf/Günther, Robotik und Gesetzgebung, 163, 172 (2013).

<sup>28</sup> *Wagner*, Robot Liability, 16 (2018); see also *Giliker*, Vicarious Liability in Tort: A Comparative Perspective, 2 (2010); *De Jong*, Regulating Uncertain Risks, in: Hilgendorf/Günther, Robotik und Gesetzgebung, 163, 172 (2013).

<sup>29</sup> *Wagner*, Robot Liability, 16 (2018).

<sup>30</sup> In Germany, the term “Gefährdungshaftung” is used, whereas in common law this kind of liability is called “strict liability”; *Wagner*, Strict Liability in European Private Law, 2 (2011); see also *Dietz*, Technische Risiken und Gefährdungshaftung, 35 (2006).

<sup>31</sup> *De Jong*, Regulating Uncertain Risks, in: Hilgendorf/Günther, Robotik und Gesetzgebung, 163, 172 (2013); see also *Dietz*, Technische Risiken und Gefährdungshaftung, 35 (2006).

<sup>32</sup> *European Commission*, Study on emerging issues of data ownership, interoperability, (re-) usability and access to data, and liability, 2017, SMART number 2016/0030, 117.

<sup>33</sup> *Weaver*, Robots Are People Too, 18 (2014); see also *Eidenmüller*: The Rise of Robots and the Law of Humans, *ZEuP* 2017, 765, 766.

where automated message systems are attributed to the person on whose behalf the computer was programmed (Article 12 United Nations Convention of the Use of Electronic Communications in International Contracts).<sup>34</sup> This evaluation corresponds to the general principle that the employer of a tool should be responsible for the results of its use, seeing as the tool has no will of its own.<sup>35</sup> However, the more autonomous robots are, the less they may be seen as mere tools in the hands of the user.<sup>36</sup>

There are certain characteristics of autonomous systems that separate them from “normal” machines and create specific problems for determining liability.<sup>37</sup> The most crucial factors are deep learning (especially reinforcement learning),<sup>38</sup> mobility,<sup>39</sup> interconnectedness,<sup>40</sup> and the (un)foreseeability<sup>41</sup> of the intelligent machines. Robot learning describes the robot’s ability to improve its performance through practice.<sup>42</sup> The relevant information for learning processes stems from existing data, but also from experiences and other new information.<sup>43</sup> The relevant aspect of this technological development is the decrease of human control, seeing as deep learning can function solely by relying on training by algorithms without human intervention

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<sup>34</sup> See also *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 384 (2015).

<sup>35</sup> Cited after *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 98 (2013); see also *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 384 (2015).

<sup>36</sup> *European Parliament*, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, AB.

<sup>37</sup> *Eidenmüller*: The Rise of Robots and the Law of Humans, *ZEuP* 2017, 765, 768 et seq.

<sup>38</sup> *Zech*, Zivilrechtliche Haftung für den Einsatz von Robotern – Zuweisung von Automatisierungs- und Autonomierisiken, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 163, 170 et seq. (2016); for a description of deep learning see *Pratt*, Is a Cambrian Explosion Coming for Robotics?, 29 *JEP* 51, 52 (2015).

<sup>39</sup> *Zech*, Zivilrechtliche Haftung für den Einsatz von Robotern – Zuweisung von Automatisierungs- und Autonomierisiken, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 163, 169 (2016).

<sup>40</sup> See *Christaller/Wehner*, in: *Autonome Maschinen*, 9 (20); *Zech*, Zivilrechtliche Haftung für den Einsatz von Robotern – Zuweisung von Automatisierungs- und Autonomierisiken, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 163, 169 (2016).

<sup>41</sup> *Zech*, Zivilrechtliche Haftung für den Einsatz von Robotern – Zuweisung von Automatisierungs- und Autonomierisiken, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 163, 175 (2016).

<sup>42</sup> *Bekey*, *Autonomous Robots*, 125 (2005).

<sup>43</sup> *Alpaydin*, *Machine Learning*, 3 *Wiley Interdisciplinary Reviews: Computational Statistics*, 195, 195 (2011); see also with more references *Eidenmüller*: The Rise of Robots and the Law of Humans, *ZEuP* 2017, 765, 769.

(“unsupervised learning”).<sup>44</sup> In addition, the rising interconnectedness of machines can cause problems, since they are capable of simultaneously developing a connected infrastructure, making the isolated treatment of a single system more complicated.<sup>45</sup> Lastly, the unforeseeable actions of autonomous systems might constitute the greatest challenge for traditional liability systems.<sup>46</sup> The more intelligent systems learn independently and from other connected systems, the more difficult it can be for the human user to foresee robot behavior.

Whereas autonomous acts by a robot could possibly be handled by a regime of strict liability, no member state in the EU nor any state in the US has enacted a statute specifically for damage done by intelligent robots. According to an EU study, liability for damages caused by objects is generally attributed to the persons who have the object under their care or custody (listing Belgium, the Czech Republic, Estonia, Luxembourg as examples).<sup>47</sup> One exception is France, where the custodian’s liability without fault is explicitly applicable to any kind of object that causes damage.<sup>48</sup>

In the US, the regime of strict liability governs products liability, the liability of the owner of wild animals and the liability for abnormally dangerous activities.<sup>49</sup> In light of this framework, scholars and institutions have made suggestions for future adjustments of the

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<sup>44</sup> *Russell/Norvig*, Artificial Intelligence, A Modern Approach, 694; see also *Surden*, Machine Learning and Law, 89 Wash. L. Rev. 87, 94 (2014); *Goodfellow et al.*, Deep Learning, 102 (2016); *Denga*, Deliktische Haftung für künstliche Intelligenz, CR 2018, 69 (70).

<sup>45</sup> See *Zech*, Zivilrechtliche Haftung für den Einsatz von Robotern – Zuweisung von Automatisierungs- und Autonomierisiken, in: Gless/Seelmann, Intelligente Agenten und das Recht, 163, 169 (2016); *Christaller/Wehner*, in: Autonome Maschinen, 9 (20);

<sup>46</sup> *Calo*, Robotics and the Lessons of Cyberlaw, 103 Calif. L. Rev. 513, 531, 554 (2015); *Scherer*, Regulating Artificial Intelligence Systems: Risks, Challenges, Competences, and Strategies, Harv. J. L. & Tech. 354, 363, 366 (2016); *Asaro*, The Liability Problem for Autonomous Artificial Agents, 1; *Karnow*, The Application of Traditional Tort Theory to Embodied Machine Intelligence, in: Calo/Froomkin/Kerr, Robot Law, 51, 63 (2016); *Balkin*, The Path of Robotics Law, 6 Calif. L. Rev. Circuit 45, 52 (2015).

<sup>47</sup> European Commission, Study on emerging issues of data ownership, interoperability, (re-) usability and access to data, and liability, 2017, SMART number 2016/0030, 129.

<sup>48</sup> Article 1242 of the French Code Civil; see also *Wagner*, Strict Liability in European Private Law, 2 (2011).

<sup>49</sup> *Dobbs*, The Law of Torts, 3 (2001); *Abbott*, *The Reasonable Computer: Disrupting the Paradigm of Tort Liability*, 86 Geo. Wash. L. Rev. 1, 14 (2018); *Hay*, US-Amerikanisches Recht, 150 (2015); *Reimann*, Einführung in das US-amerikanische Privatrecht, 108 et seq. (2014).

liability systems, including but not limited to the introduction of a completely new strict liability statute for the owners or users of the intelligent robotic machines.

### C. Possible Solutions & New Approaches

In its report from 16 February 2017, the European Parliament considers two possible approaches: (1) a strict liability regime or (2) a risk management approach.<sup>50</sup> The strict liability approach would help the injured party, since it only requires proof that damage has occurred and that a causal link existed between the robot's action and the injury.<sup>51</sup> A risk-management approach would, on the other hand, find liable the person who would have been able to minimize the risk, which is not necessarily the person "who acted negligently".<sup>52</sup> Overall, the responsible party should only be liable "proportional to the actual level of instructions given to the robot"<sup>53</sup> - the higher the robot's learning capabilities are, or the longer the duration of the robot's education, the greater the responsibility of the user/owner.<sup>54</sup> Not only would such a liability regime ensure compensation for future victims, it would also create legal certainty. Seeing that the influence of the user becomes more important for always-learning-robots,<sup>55</sup> the liability only for the manufacturer is no longer sufficient or

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<sup>50</sup> European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, para 53.

<sup>51</sup> European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, para 54.

<sup>52</sup> European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, para 55.

<sup>53</sup> European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, para 56.

<sup>54</sup> *Leroux et al.*, euRobotics, Suggestion For A Green Paper on Legal Issues in Robotics, Grant Agreement Number: 248552, public report, Dec 2012, 55.

<sup>55</sup> *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, ZRP 2017, 168, 169; even the European Parliament elaborates, that „manufacturers, operators, owners or users could be held strictly liable for acts or omissions of a robot“, European Parliament, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, P8\_TA-PROV(2017)0051, AD; see also *Günther*, Roboter und rechtliche Verantwortung, 237 (2016); *Hanisch*, Zivilrechtliche Haftungskonzepte für Roboter, in Hilgendorf/Günther, Robotik und Gesetzgebung, 109, 113 et seq. (2013).

appropriate.<sup>56</sup> The user selects his robots and benefits from their application.<sup>57</sup> Moreover, he might even be in the best position to understand the robot,<sup>58</sup> especially if the owner is involved in the learning processes.

## I. Robots as Animals, Kids or Employees

Possible analogies concerning the liability of the user exist in the EU as well as in the US. Among the most popular theories are the liability of owners for their animals, the liability of parents for their children, the liability of employers for their employees, and the liability for persons carrying out abnormally dangerous activities. Any possible framework must balance various related concerns, such as the specific risks of robots, present legal standards, and consumer protection goals.<sup>59</sup> The focus lies on liability without fault, since the standard of care in the realm of negligence might become unfulfillable if the courts continuously create new duties of care and obligations for supervision and control.<sup>60</sup> At some point, such a development would be tantamount to a strict liability statute.<sup>61</sup> In sum, the analogy to existing theories or the implementation of a new strict liability regime might be favorable and would at least create a degree of legal certainty.<sup>62</sup>

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<sup>56</sup> *Leroux/Labruto et al.*, euRobotics, Suggestion For A Green Paper on Legal Issues in Robotics, Grant Agreement Number: 248552, public report, Dec 2012, 55; see also *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, ZRP 2017, 168, 169.

<sup>57</sup> *Hanisch*, Zivilrechtliche Haftungskonzepte für Roboter, in Hilgendorf/Günther, Robotik und Gesetzgebung, 109, 114 (2013); *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, ZRP 2017, 168, 169.

<sup>58</sup> *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 126 (2013).

<sup>59</sup> *Schaerer et al.*, Robots as Animals: A Framework for Liability and Responsibility in Human-Robot Interactions, 18<sup>th</sup> IEEE Proc. Int. Symp. on Robot and Human Interactive Communication, Toyama, 72 (2009); see also *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1862 (2010).

<sup>60</sup> *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, ZRP 2017, 168, 169.

<sup>61</sup> *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, ZRP 2017, 168, 169.

<sup>62</sup> *Schirmer*, Rechtsfähige Roboter?, JZ 2016, 660, 665; *Gruber*, Zumutung und Zumutbarkeit von Verantwortung in Mensch-Maschine-Assoziationen, in Hilgendorf/Günther, Robotik und Gesetzgebung, 123, 157-158 (2013); see also *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, ZRP 2017, 168, 169; in this direction also *Hanisch*, Zivilrechtliche Haftungskonzepte für Robotik, in: Hilgendorf, Robotik im Kontext von Recht und Moral, 27, 60-61 (2014).

## 1. Robots as Animals

### a) Law in the US and the EU

First of all, liability rules governing wild and domestic animals could be applied to robots and their owners as proposed by various legal scholars in the US.<sup>63</sup> While the owner of domestic animals is normally subject to the standard of negligence, the owner of wild animals is governed by strict liability due to the “erratic” behavior of such animals. In contrast, domestic animals are considered more predictable.<sup>64</sup> Wild animals include, inter alia, lions, tigers, and bears, while dogs, cats, and horses are usually seen as domesticated animals.<sup>65</sup> However, even the owner of domestic animals might be subject to strict liability, if the animal causes damages while trespassing on the land of another<sup>66</sup> or if the keeper has knowledge of the animal’s dangerous tendencies.<sup>67</sup> In these cases, the owner is strictly liable even if there is no specific negligent behavior.<sup>68</sup> Furthermore, a growing number of statutes impose strict liability for dog owners.<sup>69</sup>

The analogy of robots as animals has also been suggested at the EU and member state

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<sup>63</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1862 (2010); *Schaerer et al.*, Robots as Animals: A Framework for Liability and Responsibility in Human-Robot Interactions, 18<sup>th</sup> IEEE Proc. Int. Symp. on Robot and Human Interactive Communication, Toyama, 72 (2009); see for artificial agents also *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 120-121 (2011); see also *Asaro*, A Body to Kick, but Still No Soul to Damn, Lin et al., *Robot Ethics*, 169, 176 (2012); see for an early analogy also *Lehmann-Wilzig*, Frankenstein Unbound – Towards a legal definition of Artificial Intelligence, in: *Futures*, 442, 448 (1981).

<sup>64</sup> See *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1864 (2010); *Schaerer et al.*, Robots as Animals: A Framework for Liability and Responsibility in Human-Robot Interactions, 18<sup>th</sup> IEEE Proc. Int. Symp. on Robot and Human Interactive Communication, Toyama, 72, 74-75 (2009).

<sup>65</sup> *Schaerer et al.*, Robots as Animals: A Framework for Liability and Responsibility in Human-Robot Interactions, 18<sup>th</sup> IEEE Proc. Int. Symp. on Robot and Human Interactive Communication, Toyama, 72, 74 (2009).

<sup>66</sup> *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 *Fla. L. Rev.* 1803, 1864 (2014).

<sup>67</sup> This is the so-called “scienter action”, see *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 130 (2011).

<sup>68</sup> *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 130-131 (2011).

<sup>69</sup> *Duffy/Hopkins*, Sit, Stay, Drive: The Future of Autonomous Car Liability, 16 *SMU Sci & Tech L. Rev.* 453, 468-469 (2013) with more references.

levels.<sup>70</sup> In contrast to US tort liability, Italian law, for example, creates strict liability for domestic pets as well as for wild animals.<sup>71</sup> This means that, in Italy, owners of pets are strictly liable for any injury to third persons regardless of the owner's awareness of any particular danger posed by his or her animal.<sup>72</sup> Similarly, the French civil code contains a strict liability statute for the keeper of animals.<sup>73</sup> In Germany, the keeper of animals is also generally strictly liable for injuries to third persons.<sup>74</sup> However, there is an exception for pets that serve the keeper in his work or occupation (livestock or working animals), in which case the fault of the keeper is only presumed.<sup>75</sup>

In addition to the above discussed liability theories, several European countries (Denmark, Germany, Portugal) have banned specific dog breeds that are recognized as particularly dangerous to people, while other countries (Spain, Poland, France) have enforced significant restrictions, such as microchip implantation.<sup>76</sup> The underlying principle remains that owners must take appropriate measures to prevent harm to others.<sup>77</sup> In general, the European laws seem somewhat stricter than those in the United States.<sup>78</sup>

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<sup>70</sup> For the EU see *Leroux et al.*, euRobotics, Suggestion For A Green Paper on Legal Issues in Robotics, Grant Agreement Number: 248552, public report, Dec 2012, 55; for Germany see *Janal*, Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen, in: Gless/Seelmann, Intelligente Agenten und das Recht, 141, 144 et seq. (2016); *Schweighofer*, Rechtliche Aspekte der Robotik, in: Christaller, Robotik: Perspektiven für menschliches Handeln in der zukünftigen Gesellschaft, 144 (2001); *Günther*, in: Autonome Automaten, 155, 167 (2015); *Hanisch*, Haftung für Automation, 47 (2010); *Günther*, Roboter und rechtliche Verantwortung, 138 et seq. (2016); *Schulz*, Verantwortlichkeit bei autonom agierenden Systemen, 148 (2015); with an international approach see *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 121 et seq. (2013); for Swiss law see *Lohmann*, Roboter als Wundertüten – eine zivilrechtliche Haftungsanalyse, AJP 2017, 152, 160.

<sup>71</sup> *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 127 (2013).

<sup>72</sup> *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 127 (2013), who refers to Articles 2048 and 2052 of the Italian Civil Code.

<sup>73</sup> Art. 1242, 1243 Code Civil; see also *Wagner*, Strict Liability in European Private Law, 5 (2011).

<sup>74</sup> § 833 par. 1 S. 1 BGB.

<sup>75</sup> § 833 par. 1 S. 2 BGB.

<sup>76</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1865-1866 (2010).

<sup>77</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1867 (2010).

<sup>78</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1866 (2010).

## b) Application to Autonomous Robots

The analogy to animals seems plausible, since both animals and robots are entities that are “neither human, nor totally without responsibility”.<sup>79</sup> Animals and autonomous robots similarly “think and act independently from their human owners”,<sup>80</sup> and can learn by using the “trial and error” methodology.<sup>81</sup> Interestingly, American courts have already compared animals to moving objects, for example, by deciding the ownership of a baseball through analogizing to wild game possession rules.<sup>82</sup>

Hence, Kelley et al. propose that the robot owner should be subject to negligence liability by comparing (non-defective) robots to domesticated animals.<sup>83</sup> Because the robot is a programmed machine, the range of behavior is set and does not resemble a case of strict liability for unpredictable behavior. Therefore, harmless robots (like “normal” household robots) would not be subject to special regulations; rather owners would be subject to pure negligence liability.<sup>84</sup> In contrast, a stricter approach could be applied when a robot is known to be dangerous or poses a greater risk to third parties.<sup>85</sup> As an example, armed security robots

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<sup>79</sup> *Wilks*, Responsible Computers? 1279, 1279 (1985), available at <https://www.ijcai.org/Proceedings/85-2/Papers/117.pdf> (last visited 16.11.2018); see also *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 120 (2011).

<sup>80</sup> Comparing dogs to autonomous cars *Duffy/Hopkins*, Sit, Stay, Drive: The Future of Autonomous Car Liability, 16 SMU Sci & Tech L. Rev. 453, 467 (2013).

<sup>81</sup> *Hanisch*, Haftung für Automation, 47 (2010); see also *Lohmann*, Roboter als Wundertüten – eine zivilrechtliche Haftungsanalyse, AJP 2017, 152, 160.

<sup>82</sup> In *Popov v. Hayashi*, 2002 WL 31833731 (Cal. Superior, Dec. 18, 2002) the court compared the possession of a baseball to case law concerning the hunting and fishing of wild animals, cited after *Walton*, Similarity, precedent and argument from analogy, in 18 Artificial Intelligence and Law, 217-246 (2010) with a discussion of this case and doctrinal explorations of analogies; see also *Leroux et al.*, euRobotics, Suggestion For A Green Paper on Legal Issues in Robotics, Grant Agreement Number: 248552, public report, Dec 2012, 55.

<sup>83</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 Advanced Robotics 1861, 1864-1865 (2010); *Schaerer/Kelley/Nicolescu*, Robots as Animals: A Framework for Liability and Responsibility in Human-Robot Interactions, 18<sup>th</sup> IEEE Proc. Int. Symp. on Robot and Human Interactive Communication, Toyama, 72, 75 (2009).

<sup>84</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 Advanced Robotics 1861, 1864 (2010).

<sup>85</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 Advanced Robotics 1861, 1865 (2010); see also *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 130-131 (2011).

could fall under the requirement of specific registration and entail a strict liability standard.<sup>86</sup> Moreover, if a robot is evaluated as too dangerous, it could be banned from use (e.g. armed military robots).

However, if the law were to focus on a certain degree of dangerousness, it must be determinable in a reliable manner. According to Kelley et al.,<sup>87</sup> a robot's dangerousness can result from various factors, such as manufacturing defects, the owner's failure to perform regular maintenance, or the alteration of the robot.<sup>88</sup> Also, the place wherein a robot operates or its size and function should also be taken into account when classifying robots. In this sense, a care robot that helps elderly persons can be considered dangerous, however in a different way than an armed robot in the military.<sup>89</sup> Furthermore, if a normally harmless robot has shown dangerous tendencies in past instances and the keeper is aware of this, a strict liability theory might be appropriate.<sup>90</sup>

One fundamental argument against the application of liability theories governing animals to robots is that animals act according to natural instincts, while autonomous systems are governed by algorithmic processes "similar to rational human thinking".<sup>91</sup> Therefore, the underlying reasons for the application of strict liability might be incomparable. Also, thirst, hunger, or sicknesses can play an important role for erratic behavior of an animal, while robots cannot have feelings or biological diseases.<sup>92</sup> These arguments focus on the specific biological reasons for risks caused by animals, which justify the owner's strict liability.

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<sup>86</sup> Kelley et al., Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1864-1865 (2010).

<sup>87</sup> Kelley et al., Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1869-1870 (2010).

<sup>88</sup> See also Asaro, A Body to Kick, but Still No Soul to Damn, in: Lin et al., *Robot Ethics*, 169, 177 (2012).

<sup>89</sup> Kelley et al., Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1868 (2010).

<sup>90</sup> Chopra/White, A Legal Theory for Autonomous Artificial Agents, 131 (2011).

<sup>91</sup> Cerka et al., Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 385 (2015); see also Günther, *Roboter und rechtliche Verantwortung*, 139.

<sup>92</sup> Hanisch, *Haftung für Automation*, 202 (2010).

However, the goal of analogizing robots to animals is not the complete equation of robots and animals. Notwithstanding the fact that robots are mechanical and cannot have biological features, from the user perspective the actions of robots and animals might be similarly unpredictable and unforeseeable.

Leroux et al. conclude that a major difference between objects and animals is the animal's ability to move freely in its surrounding environment.<sup>93</sup> This makes sense when comparing traditional industrial robots inside a factory to wild animals or pets that can move around as they please. However, as the mobility of robots increase, this distinction might no longer be meaningful. In the future, robots might escape their boundaries in similar ways as animals and cause injuries to third persons, even without negligence on the part of the keeper.<sup>94</sup>

Ultimately, the application of a liability theory that is based on multiple classifications would be challenging in practice. Aside from the relatively obvious distinction between armed robots and robot-toys, specific determinations of different risk-levels are difficult.<sup>95</sup> The question arises of who or what kind of body should decide these questions. For example, should these questions be answered by the courts or by the legislature?<sup>96</sup> A more proactive approach in this respect might be an agency for robotics and artificial intelligence, as suggested by the European Parliament, which could classify robots and offer guidance.<sup>97</sup>

## **2. Robots as Kids**

A second possibility would be to treat autonomous robots as children. While parents are expected to care for their children and keep them from harming others, kids still pose a risk to

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<sup>93</sup> *Leroux et al.*, euRobotics, Suggestion For A Green Paper on Legal Issues in Robotics, Grant Agreement Number: 248552, public report, Dec 2012, 55.

<sup>94</sup> *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 131 (2011).

<sup>95</sup> *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1864 (2014); see also *Pagallo*, The Laws of Robots, 126 (2013).

<sup>96</sup> See *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 Advanced Robotics 1861, 1868 (2010).

<sup>97</sup> See *European Parliament*, Resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL)), p. 8, 10.

third persons due to their immaturity and childish irresponsibility.<sup>98</sup> Similarly, owners of autonomous systems could be seen as responsible for looking after their robots.

#### **a) Law in the US and the EU**

Under US law, there is no general strict liability for parents when their children cause damage. Parents are normally subject to the reasonable person standard (negligence) when supervising their children.<sup>99</sup> In addition, parents can be liable if they had knowledge of their child's dangerous personality.<sup>100</sup> In some instances, special statutes can impose strict liability to parents for intentional torts committed by their children.<sup>101</sup> However, if robots were seen as children under US law, negligence liability and the standard of care would likely apply.<sup>102</sup>

In most European states, a similar liability of parents for their children exists.<sup>103</sup> In general, there are fault-based models (English and German law) and some doctrines of strict liability (Spain, France, Italy).<sup>104</sup> In contrast to American law, most civil law countries do not make the standard of liability dependent upon the parent's knowledge of a child's dangerous tendencies.<sup>105</sup> Spanish, French, and Italian law apply strict liability to parents for injuries caused by minors.<sup>106</sup> French courts have gone beyond German and Spanish courts and have increasingly imposed strict liability, reducing the role of fault in order to secure protection of

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<sup>98</sup> *Giliker*, Vicarious Liability in Tort: A Comparative Perspective, 196 (2010).

<sup>99</sup> *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1864 (2014).

<sup>100</sup> *Pagallo*, The Laws of Robots, 125 (2013).

<sup>101</sup> See for example S.C. Code Ann. § 63-5-60 for strict liability for parents up to \$ 5,000 for certain injuries; *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1864 (2014).

<sup>102</sup> *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1864 (2014).

<sup>103</sup> *Giliker*, Vicarious Liability in Tort: A Comparative Perspective, 196 (2010).

<sup>104</sup> *Giliker*, Vicarious Liability in Tort: A Comparative Perspective, 206, 210 (2010); for Italian law see *Pagallo*, The Laws of Robots, 125 (2013).

<sup>105</sup> *Pagallo*, The Laws of Robots, 125 (2013).

<sup>106</sup> *Giliker*, Vicarious Liability in Tort: A Comparative Perspective, 210 (2010); for Italian law *Pagallo*, The Laws of Robots, 125 (2013).

the injured parties.<sup>107</sup> Parents can evade liability only if “external, unforeseeable and unavoidable event[s] occurred”.<sup>108</sup>

## **b) Application to Autonomous Robots**

The analogy to the liability of parents for the acts of their children seems possible for several reasons. Firstly, autonomous robots might be seen as adaptable and unpredictable, just like young children.<sup>109</sup> As Lehmann-Wilzig stated already in 1981, robots could be compared to children because of their “relatively high intelligence and low moral responsibilities”.<sup>110</sup> Secondly, another underlying reason for strict liability of parents is that children often cannot be sued in their own right due to their age.<sup>111</sup> This would also be true for autonomous robots, who likewise lack legal personality. Furthermore, minors are guided by their parents and are often able to change their behavior according to their parent’s influence. Somewhat similarly, robots can, in some circumstances, be educated or influenced by their user.<sup>112</sup>

However, a second glance might change the picture. First, it must be taken into account that in US law, and also in many European countries, the fault-based negligence approach is still substantial. Hence, these theories do not provide a large transnational basis for the establishment of a strict liability regime. More importantly, the comparison between robots and children might not be ideal for fundamental reasons. As Janal posits, there might be similarities in the learning capabilities of robots and children, but the underlying societal

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<sup>107</sup> See with references to the relevant cases in France *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 214 (2010).

<sup>108</sup> *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 215 (2010).

<sup>109</sup> *Janal*, *Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen*, in: *Gless/Seelmann, Intelligente Agenten und das Recht* (2016) 141, 143; see also *Pagallo*, *Killers, fridges, and slaves: a legal journey in robotics*, *AI & Society*, 347, 352-353 (2011).

<sup>110</sup> *Lehmann-Wilzig*, *Frankenstein Unbound – Towards a legal definition of Artificial Intelligence*, in: *Futures*, 442, 450 (1981).

<sup>111</sup> *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 212 (2010).

<sup>112</sup> *Leroux et al.*, *euRobotics, Suggestion For A Green Paper on Legal Issues in Robotics*, Grant Agreement Number: 248552, public report, Dec 2012, 55.

goals in relation to robots and children are different.<sup>113</sup> Humans program robots to learn, but unforeseeable robot acts are meant to stay under human control.<sup>114</sup> On the other hand, parents encourage children and young adults to become independent members of society, giving them space to develop their own personalities.<sup>115</sup> Although it seems possible that robots will play a larger part in society as technology advances, robots are ultimately meant to help society, not to develop own personalities in the same sense as is desired for children.

### **3. Robots as Employees**

A third option would be to treat robots as employees of their owners and apply the theory of vicarious liability. This doctrine holds the defendant liable for torts committed by other persons.<sup>116</sup> In ancient Rome, the theory of respondeat superior (or the “master-servant-rule”, a kind of vicarious liability) triggered the civil liability of the master for torts committed by his slaves.<sup>117</sup> A central reason for the comparison of robots to slaves is that slaves were considered “things” and were expected to act on behalf of their masters.<sup>118</sup> Nowadays, the most common example of vicarious liability is in the context of the workplace.<sup>119</sup> Vicarious liability is not based on the employer’s own harmful act, but on his relationship with the tortfeasor.<sup>120</sup>

#### **a) Law in the US and the EU**

Under the doctrine of respondeat superior, an employer in the US is strictly liable towards

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<sup>113</sup> *Janal*, Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 141, 143 (2016).

<sup>114</sup> *Janal*, Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 141, 143 (2016).

<sup>115</sup> *Janal*, Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 141, 143 (2016).

<sup>116</sup> *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 1 (2010).

<sup>117</sup> *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 385 (2015).

<sup>118</sup> *Pagallo*, Killers, fridges, and slaves: a legal journey in robotics, *AI & Society*, 347, 351 (2011).

<sup>119</sup> *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 55; see also *Pagallo*, *The Laws of Robots*, 130 (2013); *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 385 (2015).

<sup>120</sup> *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 1 (2010).

third parties for the tortious acts of his employees.<sup>121</sup> Strict liability applies even if the employer acted with reasonable care in hiring and supervising his employee.<sup>122</sup> The only requirement is that the agent committed the tort in the scope of his employment.<sup>123</sup> The underlying justification for this doctrine is fairness, i.e. that the employer should be liable for torts committed by employees, since he is also the one controlling them and benefiting from their work.<sup>124</sup>

Similar versions of the vicarious liability doctrine are common across the EU.<sup>125</sup> Liability is usually strict, meaning that it is unattached to any kind of fault on the side of the employer. Article 1242 of the French Civil Code, for example, holds the employer unconditionally liable for torts of his employees.<sup>126</sup> However, there is one exception in German law, wherein the employer is not liable for torts committed by the employee if the employer can prove that he carefully selected and controlled the employee.<sup>127</sup> Hence, in Germany, liability is not strict – the employer is only presumed to be at fault.<sup>128</sup> In general, however, the rule of vicarious liability in common law and civil law countries declares the employer strictly liable for the tortious acts of his employee.<sup>129</sup> Just as the American doctrine requires that the tort occurred “in the scope of his employment”, there are similar requirements in European law. The Italian

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<sup>121</sup> Restatement (Third) of Agency, § 7.07; *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1863 (2014).

<sup>122</sup> *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1863 (2014).

<sup>123</sup> *Lev v. Beverly Enterprises-Massachusetts, Inc.*, 929 N.E.2d 303, 308 (Mass. 2010); *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1863 (2014).

<sup>124</sup> *Dobbs et al.*, Hornbook on Torts, 756 (2013); see also *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 Fla. L. Rev. 1803, 1863 (2014).

<sup>125</sup> *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 Computer Law & Security Review 376, 385 (2015).

<sup>126</sup> For the old law see *Zweigert/Kötz*, An Introduction to Comparative Law, 635 (1998).

<sup>127</sup> See § 831 par. 1 S. 1 of German Civil Code; see also *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 Computer Law & Security Review 376, 385 (2015); *Zweigert/Kötz*, An Introduction to Comparative Law, 633 (1998).

<sup>128</sup> *Giliker*, Vicarious Liability in Tort: A Comparative Perspective, 22 (2010).

<sup>129</sup> *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 Computer Law & Security Review 376, 385 (2015).

code requires that the harm be caused “under [...] work contract activities”<sup>130</sup>, the German Code (although not strict) only holds the employer liable for damages resulting “in execution of the task”, and in France the employee must have caused the harm in the exercise of his functions.<sup>131</sup> One other factor is important in civil law and common law doctrines: the ability to control the employee, usually describing the power of determining the means, time and place of the work to be done.<sup>132</sup> On the other hand, an employee “acting on [his] own behalf” can serve as a defense of the employer, excluding strict liability.<sup>133</sup>

## **b) Application to Autonomous Robots**

Following the liability doctrine of respondeat superior, robot owners could be strictly liable for torts committed by intelligent robots.<sup>134</sup> Liability would not depend on the owner’s own negligence, treating robots as employees acting “within the scope of employment”.<sup>135</sup> Regarding the use of robots in factories, it is very likely that courts would follow this link and assume that the activity of the robot belonged to some kind of work.<sup>136</sup> As robots become more sophisticated and make decisions autonomously, one could possibly argue that the robot developed his own purpose and did not act in the scope of employment, but on his own behalf.<sup>137</sup> However, the distinction of certain activities being under the scope of employment do not fully make sense in regards to robots, since they do not have any legal personality or funds and would leave the injured party without recourse.<sup>138</sup> Therefore, one could argue that

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<sup>130</sup> Pagallo, *The Laws of Robots*, 131 (2013).

<sup>131</sup> See § 831 par. 1 S. 1 BGB (German Civil Code), “in Ausführung der Verrichtung” for the German Code; see for French law *Zweigert/Kötz, An Introduction to Comparative Law*, 635 (1998).

<sup>132</sup> Giliker, *Vicarious Liability in Tort: A Comparative Perspective*, 55 (2010).

<sup>133</sup> Asaro, *A Body to Kick, but Still No Soul to Damn*, in: Lin et al., *Robot Ethics*, 169, 179 (2012).

<sup>134</sup> Chopra/White, *A Legal Theory for Autonomous Artificial Agents*, 128 (2011).

<sup>135</sup> *Lev v. Beverly Enterprises-Massachusetts, Inc.*, 929 N.E.2d 303, 308 (Mass. 2010); Hubbard, *Sophisticated Robots: Balancing Liability, Regulation, and Innovation*, 66 Fla. L. Rev. 1803, 1863 (2014); Chopra/White, *A Legal Theory for Autonomous Artificial Agents*, 128.

<sup>136</sup> Pagallo, *The Laws of Robots*, 131 (2013).

<sup>137</sup> Asaro, *A Body to Kick, but Still No Soul to Damn*, Lin et al., *Robot Ethics*, 169, 179 (2012).

<sup>138</sup> Janal, *Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen*, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 141, 161 (2016); see also Hanisch, *Haftung für Automation*, 196 (2010).

the owner should be liable even if robot acts are unforeseeable and outside of the scope of employment.<sup>139</sup> Chopra and White<sup>140</sup> also make an economic argument: knowing the risk, employers would only engage intelligent robots where the benefits are greater than possible costs.<sup>141</sup>

However, one crucial point is the requirement that the principal must control the manner and means of the agents work.<sup>142</sup> The higher the level of autonomy and the greater the self-learning abilities of the robots, the smaller the actual control of the user could be. The changes of the workplace have led the courts to interpret the control test loosely.<sup>143</sup> It no longer focuses on the factual control, but on the possibility of being able to control the employee.<sup>144</sup> On the one hand, one could argue that the user of a robot has general control over the robot. The user decides when, how long, and where to use that robot. However, systems interconnectedness and certain configurations can make any control more difficult.<sup>145</sup> The factual control could be shared between the manufacturer and other software programmers, or there is the possibility that no one has exclusive control over a specific robot.<sup>146</sup>

Another argument against the application of this doctrine is the idea that the employer's liability was created in light of the "unique nature of human employees", who can act as self-conscious members of a community and engage in intellectual interactions.<sup>147</sup> Therefore, one could argue that the application of the doctrine depends on the level of autonomy of the robot. Only if a robot does possess these characteristics could the theory of respondeat superior

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<sup>139</sup> *Janal*, Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen, in: Gless/Seelmann, *Intelligente Agenten und das Recht*, 141, 161 (2016)

<sup>140</sup> *Chopra/White*, *A Legal Theory for Autonomous Artificial Agents*, 129.

<sup>141</sup> *Chopra/White*, *A Legal Theory for Autonomous Artificial Agents*, 129 (2011).

<sup>142</sup> Restatement (Third) of Agency, § 7.07, ct. f; see also *Chopra/White*, *A Legal Theory for Autonomous Artificial Agents*, 128 (2011).

<sup>143</sup> *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 78 (2010).

<sup>144</sup> *Giliker*, *Vicarious Liability in Tort: A Comparative Perspective*, 67 (2010).

<sup>145</sup> *Calo*, *Robotics and the Lessons of Cyberlaw*, 103 *Calif. L. Rev.* 513, 543-544 (2015).

<sup>146</sup> *Calo*, *Robotics and the Lessons of Cyberlaw*, 103 *Calif. L. Rev.* 513, 544 (2015).

<sup>147</sup> *Hubbard*, *Sophisticated Robots: Balancing Liability, Regulation, and Innovation*, 66 *Fla. L. Rev.* 1803, 1864 (2014) with more references.

apply.<sup>148</sup> Similarly, according to Pagallo<sup>149</sup> and Chopra and White,<sup>150</sup> the theory of vicarious liability should only apply to certain kinds of robots that can be seen as a legal agents acting for the owner, since this theory focuses on the responsibilities and interactions of the agent with third parties.<sup>151</sup>

#### **4. Liability for Abnormally Dangerous Activities**

Lastly, there are theories of strict liability regulating great sources of danger that could be applied to autonomous robots.<sup>152</sup>

##### **a) Law in the US and the EU**

In the US, anyone carrying out or involved in activities that pose a “serious risk of harm, cannot be made safe, and [are] not common to the community”, is strictly liable for injuries to other people.<sup>153</sup> This rule of law originated from the old English case *Rylands. v. Fletcher*,<sup>154</sup> where the defendant was held liable for injuries that resulted from a water reservoir that flooded the mineshaft of his neighbor.<sup>155</sup> One requirement the English courts took especially seriously was that the dangerous “thing” must escape the owner’s property and cause mischief somewhere else.<sup>156</sup> In general, the American and English cases are very similar, declaring the storage of large quantities of water in tanks, the possession of explosives and flammable liquids, or the operation of drilling devices as abnormally dangerous.<sup>157</sup> Furthermore, the

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<sup>148</sup> Hubbard, *Sophisticated Robots: Balancing Liability, Regulation, and Innovation*, 66 Fla. L. Rev. 1803, 1863 (2014).

<sup>149</sup> Pagallo, *The Laws of Robots: Crimes, Contracts, and Torts*, 132 (2013).

<sup>150</sup> Chopra/White, *A Legal Theory for Autonomous Artificial Agents*, 130 (2011).

<sup>151</sup> Pagallo, *The Laws of Robots: Crimes, Contracts, and Torts*, 132 (2013).

<sup>152</sup> Dobbs, *The Law of Torts*, 3; see also Chopra/White, *A Legal Theory for Autonomous Artificial Agents*, 120-121 (2011); see also Cerka *et al.*, *Liability for damages caused by artificial intelligence*, 31 *Computer Law & Security Review* 376, 386 (2015).

<sup>153</sup> Schaerer *et al.*, *Robots as Animals: A Framework for Liability and Responsibility in Human-Robot Interactions*, 18<sup>th</sup> IEEE Proc. Int. Symp. on Robot and Human Interactive Communication, Toyama, 72, 74 (2009).

<sup>154</sup> *Rylands v. Fletcher*, (1868) LR 3 HL 330.

<sup>155</sup> Chopra/White, *A Legal Theory for Autonomous Artificial Agents*, 131 (2011).

<sup>156</sup> Wagner, *Comparative Tort Law*, in: Reimann/Zimmermann, *Comparative Law*, 1004, 1031 (2007).

<sup>157</sup> Zweigert/Kötz, *An Introduction to Comparative Law*, 670 (1998).

courts require some “special circumstances in the locality”<sup>158</sup> and a “non-natural”<sup>159</sup> or “exceptional”<sup>160</sup> use of the land.

## **b) Application to Autonomous Robots**

Historically, American courts applied strict liability for hazardous activities to injuries caused by “airplanes, blimps, and hot air balloons”, even if this standard switched back to negligence standards throughout time.<sup>161</sup> It might be questionable if future robots will pose such great threats as was envisioned by the theories of especially dangerous activities or objects.<sup>162</sup> To the contrary, it can be argued that, for example, self-driving vehicles will be much safer than vehicles under the control of humans, thereby making a strict liability statute on the grounds of this theory counterintuitive.<sup>163</sup>

However, autonomous systems could simply be dangerous in different ways than envisioned in the initial rule of law. The different areas of application, the type of the robot, and the specific characteristics of robots could be important factors.<sup>164</sup> Cerka et al. define a source of danger as a “specific object of the physical world that has specific properties” and portray AI as a fitting example.<sup>165</sup> Its dangerousness stems from its ability to gather information from the environment and respond autonomously.<sup>166</sup> As a consequence, they hold the AI developer

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<sup>158</sup> *Zweigert/Kötz*, An Introduction to Comparative Law, 670 (1998).

<sup>159</sup> *Chopra/White*, A Legal Theory for Autonomous Artificial Agents, 131 (2011).

<sup>160</sup> *Gordley/Von Mehren*, An Introduction to the Comparative Study of Private Law, 375 (2006), citing *V. J. Lyons & Co., Ltd.*, [1947] A.C. 156 (H.L.).

<sup>161</sup> For applying negligence standards to the operator of an aircraft see *Crosby v. Cox Aircraft Co. of Wash.*, 746 P.2d 1198, 1202 (Wash. 1987); see also *Duffy/Hopkins*, Sit, Stay, Drive: The Future of Autonomous Car Liability, 16 *SMU Sci & Tech L. Rev.* 453, 475-476 (2013) with more references.

<sup>162</sup> Critical of generally treating robots as abnormally dangerous and for a more differential approach *Christaller et al.*, Robotik: Perspektiven für menschliches Handeln in der zukünftigen Gesellschaft, 154 et seq. (2001); in a similar direction also *Günther*, Roboter und rechtliche Verantwortung, 239 (2016); see also *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, *ZRP* 2017, 168, 169.

<sup>163</sup> *Vladeck*, Machines Without Principles: Liability Rules and Artificial Intelligence, 89 *Wash. L. Rev.* 118, 146 (2014).

<sup>164</sup> *Günther*, Roboter und rechtliche Verantwortung, 239 (2016).

<sup>165</sup> *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 386 (2015).

<sup>166</sup> *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 386 (2015).

liable for damages resulting from software agents.<sup>167</sup> However, focusing on autonomous robotic machines in the physical world, liability could also be attributed to the owners or users of robots, who deploy these systems for their benefit.

Another factor resulting in a higher level of dangerousness is the complexity and impenetrableness of modern robots.<sup>168</sup> Due to these characteristics, proving fault will become very difficult, if not impossible.<sup>169</sup> Also, the growing mobility of robots intensifies the risks they pose. It is conceivable that autonomous service robots, such as lawnmowers or delivery robots, could leave their owner's property and cause damage elsewhere. In these cases, the "escape" requirement would be met.

In addition to the dangerous characteristics of the object or activity, the doctrine of abnormally dangerous activities requires that the activity is not "one of common usage".<sup>170</sup> The more common autonomous systems become in everyday life, the less likely it will be for courts to declare the use of robots as uncommon and thereby *abnormally* dangerous.<sup>171</sup>

## D. Conclusion

When it comes to the unforeseeable but harmful acts of autonomous robotic machines, our laws must find a balance between a robot's "parent", who might not be guilty, and the "equally blameless victim".<sup>172</sup> In order to regulate the specific risks of these intelligent robots, a strict liability regime seems appropriate, since the role of human control and, thereby, the

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<sup>167</sup> *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 386 (2015).

<sup>168</sup> *Christaller et al.*, Robotik: Perspektiven für menschliches Handeln in der zukünftigen Gesellschaft, 156 (2001).

<sup>169</sup> *Christaller et al.*, Robotik: Perspektiven für menschliches Handeln in der zukünftigen Gesellschaft, 156 (2001).

<sup>170</sup> *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 *Fla. L. Rev.* 1803, 1865 (2014).

<sup>171</sup> *Hubbard*, Sophisticated Robots: Balancing Liability, Regulation, and Innovation, 66 *Fla. L. Rev.* 1803, 1865 (2014).

<sup>172</sup> *Lehmann-Wilzig*, Frankenstein Unbound – Towards a legal definition of Artificial Intelligence, in: *Futures*, 442, 451 (1981).

probability of fault will decrease. While the proposed solutions in the US and the EU are similar, the scopes of the discussed liability theories differ from one country to the next. Nevertheless, all models seem plausible to some extent. Ultimately, the theory of parental liability might seem the least fitting due to fundamental differences between robots and children,<sup>173</sup> whereas a kind of vicarious liability or liability for dangerous activities seems most fitting.<sup>174</sup> However, the theory of dangerous activities might not be a long-term solution either, as the underlying rationale of the theory will become inadequate at some point. Moreover, there are also many similarities when comparing robots to animals. One advantage of treating robots as animals would be the fact that one would not have to consider any special status or rights of the robots, as would be inevitable when comparing them to children or employees.<sup>175</sup> Also, strict liability for animals is based exactly on the unpredictability of animals and the lack of control owners have, to a certain extent, over erratic animal behavior.<sup>176</sup>

In general, a single broad statute encompassing the liability for all kinds of robots might be “illusory”.<sup>177</sup> Instead, the creation of various categories seems more realistic.<sup>178</sup> Categories should be based on several factors: the level of autonomy, learning capabilities, dependence on data (self-contained or external), the operating environment, and the level of risk inherent

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<sup>173</sup> *Janal*, Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen, in: Gless/Seelmann, Intelligente Agenten und das Recht, 141, 143 (2016).

<sup>174</sup> In this direction *Cerka et al.*, Liability for damages caused by artificial intelligence, 31 *Computer Law & Security Review* 376, 387 (2015).

<sup>175</sup> *Asaro*, A Body to Kick, but Still No Soul to Damn, Lin et al., *Robot Ethics*, 169, 178 (2012).

<sup>176</sup> *Kelley et al.*, Liability in Robotics: An International Perspective on Robots as Animals, 24 *Advanced Robotics* 1861, 1864 (2010); *Schaerer et al.*, Robots as Animals: A Framework for Liability and Responsibility in Human-Robot Interactions, 18<sup>th</sup> IEEE Proc. Int. Symp. on Robot and Human Interactive Communication, Toyama, 72, 74-75 (2009).

<sup>177</sup> *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, *ZRP* 2017, 168, 169.

<sup>178</sup> See for the proposal of different categories *Bertolini*, *RoboLaw: Why and how to regulate robotics*, *Robohub* article from 29 October 2014, available at <http://robohub.org/robolaw-why-and-how-to-regulate-robotics> (last visited 29 November 2018); *Lohmann*, Ein europäisches Roboterrecht – überfällig oder überflüssig?, *ZRP* 2017, 168, 169; in this direction also *Pagallo*, Killers, fridges, and slaves: a legal journey in robotics, *AI & Society*, 347, 353 (2011).

to the specific robot.<sup>179</sup> Since it is unlikely that users of autonomous systems will be able to assess whether their machine is generally safe or if the model might have been dangerous in the past,<sup>180</sup> the introduction of a centralized agency might be a good solution.

Furthermore, it seems appropriate to limit strict liability to some extent, as traditional liability regimes normally do.<sup>181</sup> Relating to the exceptions for parents and keepers of animals, a robot user could be able to escape liability if he proves that “the dangerous propensities of the robot were reasonably unknown, a fortuitous event occurred” or “humans could not prevent the harmful behavior”.<sup>182</sup> This would not be possible under the respondeat superior liability scheme.<sup>183</sup> However, a too generous limitation concerning unpredictable behavior would be contradictory to the underlying reason for the establishment of a strict liability regime in the first place. If the same criterion would be used as a limitation to the statute, not much would be gained. Therefore, the liability could be limited to injuries caused by the specific risks of autonomy, which could be described as injuries due to bugs in the software, “an unpredictable self-learning behavior, or defective data”.<sup>184</sup>

To conclude, it seems that fault-based liability regimes are not fully capable of determining liability when it comes to the specific risks of autonomous robots. A strict liability regime would, on the other hand, ensure legal certainty and provide compensation for victims. However, the construction of a new doctrine poses challenges for courts and legal scholars across the world.

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<sup>179</sup> European Commission, Study on emerging issues of data ownership, interoperability, (re-) usability and access to data, and liability, 2017, SMART number 2016/0030, 108-110; see also *Pagallo*, Killers, fridges, and slaves: a legal journey in robotics, *AI & Society*, 347, 353 (2011).

<sup>180</sup> *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 126 (2013).

<sup>181</sup> *Pagallo*, Killers, fridges, and slaves: a legal journey in robotics, *AI & Society*, 347, 353 (2011).

<sup>182</sup> *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 132 (2013).

<sup>183</sup> *Pagallo*, The Laws of Robots: Crimes, Contracts, and Torts, 132 (2013).

<sup>184</sup> *Janal*, Die deliktische Haftung beim Einsatz von Robotern – Lehren aus der Haftung für Sachen und Gehilfen, in: Gless/Seelmann, Intelligente Agenten und das Recht, 141, 159 (2016).