THE REGULATION OF ARTIFICIAL INTELLIGENCE

JOÃO PAULO DE ALMEIDA LENARDON

Tilburg 2017

THE REGULATION OF ARTIFICIAL INTELLIGENCE

Master Thesis

Tilburg Institute for Law, Technology and Society

LLM Law and Technology 2016/2017

JOÃO PAULO DE ALMEIDA LENARDON

ANR: 383 370

SNR: 2001216

Thesis Supervisor: Dr Nadezhda Purtova

Second Reader: Silvia De Conca, LL.M.

Tilburg

14th of June 2017

ACKNOWLEDGEMENTS

This work would not have been possible without some very special people by my side. My parents, who were always there to give me their unconditional support, and provide me with their vast wisdom. My girlfriend, who helped me during the hard times, and always made me smile. My friend Riyad, who made it all more joyful. And all my friends and relatives who gave me strength and motivation to start this journey.

I would also like to thank the university and all the alumni who made this possible through their support. As well as my peers and supervisors, who gave me some invaluable feedback on my work.

TABLE OF CONTENTS

THE REGULATION OF ARTIFICIAL INTELLIGENCE

João Paulo A. Lenardon[1]

Tilburg University

ABSTRACT

New advances in the field of artificial intelligence are creating new challenges to the existing laws and raising serious ethical questions. Due to the power and complexity of this new technology, influential people, even within the industry, are starting to call for a regulation of the sector. Regulation can, indeed, be very impactful, but it also carries risks. This thesis tries to solve this problem, answering whether artificial intelligence should be regulated and, if so, which basic principles should it follow to be successful. To reach such result, it uses a sociological methodology, aiming to analyse how law, legal proceedings and public policies would impact the field of artificial intelligence and society. Extensive bibliographic surveys and case studies will be made, with a qualitative approach, to gain the necessary empirical knowledge to reach a satisfactory conclusion and answer these important questions.

KEYWORDS: legal sociology, regulation, artificial intelligence, risk assessment, principles.

[1] Author. Graduated with a Law degree. Currently coursing the international master's Law and Technology at Tilburg University, for which he was granted the Alumni Scholarship.

1. INTRODUCTION

The objective of this thesis is to analyse if artificial intelligence should be regulated. To achieve this goal, and to better understand its use in contemporary times, this work will also explore what artificial intelligence is, its importance, and history.

1.1. Definition of Artificial Intelligence

The Oxford Dictionary defines artificial intelligence as the "theory and development of computer systems able to perform tasks normally requiring human intelligence,"[2] a definition that is also used by some scholars.[3] However, others prefer to define it as "the design of intelligent agents,"[4] including different types of intelligence, not only human.

This last approach will be used in this work, treating artificial intelligence, more precisely, as the development of a flexible agent, capable of adapting itself to various situations not previously known and learning through experience, achieving a goal not possible to traditional computer systems.[5] This definition seems to be in accord with the current scientific understanding of this subject, and is widely used in the literature.[6]

The definition of artificial intelligence is of great importance, and this topic will be further discussed in the third chapter.

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[2] The Oxford English Dictionary, 'artificial intelligence' <https://en.oxforddictionaries.com/definition/artificial_intelligence> accessed 1 December 2016.

[3] Michael Negnevitsky, *Artificial Intelligence: A Guide to Intelligent Systems* (2nd edn, Pearson Education Limited 2005) 18; Pei Wang, 'What Do You Mean by "AI"?' [2008] 171 Frontiers in Artificial Intelligence and Applications 362.

[4] Stuart J. Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (Prentice Hall 1995) 31-52; David L. Poole, Alan K. Mackworth and Randy Goebel, *Computational Intelligence: A Logical Approach* (Oxford University Press 1998) 1; Joost Nico Kok and others, 'Artificial Intelligence: Definition, Trends, Techniques, and Cases' (2002) 1 Encyclopedia Of Life Support Systems 1095, 1096.

[5] Marcus Hutter and Shane Legg, 'Universal Intelligence: A Definition of Machine Intelligence' [2007] Minds and Machines 391, 405-423; Pei Wang, 'What Do You Mean by "AI"?' [2008] 171 Frontiers in Artificial Intelligence and Applications 362, 371-372.

[6] Stuart J. Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (Prentice Hall 1995) 31-52; Joost Nico Kok and others, 'Artificial Intelligence: Definition, Trends, Techniques, and Cases' (2002) 1 Encyclopedia Of Life Support Systems 1095, 1096; Marcus Hutter and Shane Legg, 'Universal Intelligence: A Definition of Machine Intelligence' [2007] Minds and Machines 391, 405-423; Pei Wang, 'What Do You Mean by "AI"?' [2008] 171 Frontiers in Artificial Intelligence and Applications 362, 371-372.

1.2. The History of Artificial Intelligence

Since the 1940's, artificial intelligence has been subject to studies within the field of computer science, pushed by authors like Vannevar Bush and Alan Turing,[7] soon becoming a distinct subfield.[8] Nevertheless, the term "artificial intelligence" only came to be with John McCarthy, in 1956.[9]

The studies on artificial intelligence were based on the idea that they would allow us to better comprehend the human mind and construct superior machines that would improve our lives.[10]

During the subsequent years, the field witnessed an enormous growth in popularity and the onset of a certain "euphoria" among researchers. The Proposal for the Dartmouth Summer Research Project on Artificial Intelligence is a good example of this, in which the authors, experts in their respective fields, thought they could make real advancements in artificial intelligence within only two months of intense research.[11]

The inflated expectations, partly caused by the press, coupled with the small and slow advancements in the area, and some very pessimist reports, led to a great disillusion in the area. This frustration led governments to drastically cut their funding to researches in the field during the 1970's, and completely shut down programs and investments during the 1980's. Some scientists tried to continue their work by renaming it "machine learning", "knowledge-based system" and "pattern recognition", for example, and tried to pursue other kinds of funding. However, during the 1980's, the private sector also stopped supplying researchers to focus on the computer revolution of that time.[12]

This period, known as "A.I. winter", created a taboo among the scientific community that continues to these days.[13] This inhibition to talk about this matter may become a problem

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[7] Brian McGuire and others, 'The History of Artificial Intelligence' (Course Web Service for the University of Washington - Computer Science & Engineering - History of Computing Projects, Washington, December 2006) 4 <http://courses.cs.washington.edu/courses/csep590/06au/course-projects.html> accessed 29 November 2016.

[8] Edwina L. Rissland, 'Artificial Intelligence and Law: Stepping Stones to a Model of Legal Reasoning' (1990) 99 The Yale Law Journal 1957, 1958.

[9] Brian McGuire and others, 'The History of Artificial Intelligence' (Course Web Service for the University of Washington - Computer Science & Engineering - History of Computing Projects, Washington, December 2006) 4 <http://courses.cs.washington.edu/courses/csep590/06au/course-projects.html> accessed 29 November 2016.

[10] Edwina L. Rissland, 'Artificial Intelligence and Law: Stepping Stones to a Model of Legal Reasoning' (1990) 99 The Yale Law Journal 1957, 1959.

[11] Eliezer Yudkowsky, 'Artificial Intelligence as a Positive and Negative Factor in Global Risk' in Nick Bostrom and Milan M. Ćirković (ed), *Global Catastrophic Risks* (Oxford University Press 2008), 37-38.

[12] Brian McGuire and others, 'The History of Artificial Intelligence' (Course Web Service for the University of Washington - Computer Science & Engineering - History of Computing Projects, Washington, December 2006) 17-21 <http://courses.cs.washington.edu/courses/csep590/06au/course-projects.html> accessed 29 November 2016.

[13] Eliezer Yudkowsky, 'Artificial Intelligence as a Positive and Negative Factor in Global Risk' in Nick Bostrom and Milan M. Ćirković (ed), *Global Catastrophic Risks* (Oxford University Press 2008), 38-39.

as artificial intelligence is beginning to interfere in our everyday lives and is expected to bring great changes in the upcoming years,[14] as discussed in the next sub-chapter.

Despite the aforementioned constraint in the academic field, the late 1990's and the beginning of the 21st century saw an increase of hope, as the private sector started to invest in artificial intelligence, pursuing greater productivity and profitability.[15]

Thus, some years ago, the world witnessed the insertion of intelligent mechanisms into people's everyday lives. It first began with additions to pre-existing technologies, like video-games,[16] and contextual searches,[17] but not much time after, these advancements made possible the creation of new tools, like virtual personal assistants,[18] home assistants[19] and recommendation services.[20]

[14] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 18-41; Carl Benedikt Frey and Michael A. Osborne, 'The Future of Employment: How Susceptible are Jobs to Computerization?' (2017) 114 Technological Forecasting and Social Change 254.

[15] Brian McGuire and others, 'The History of Artificial Intelligence' (Course Web Service for the University of Washington - Computer Science & Engineering - History of Computing Projects, Washington, December 2006) 20 <http://courses.cs.washington.edu/courses/csep590/06au/course-projects.html> accessed 29 November 2016.

[16] James Wexler, 'Artificial Intelligence in Games: A Look at the Smarts behind Lionhead Studio's "Black and White" and Where It Can and Will Go in the Future' (dissertation, University of Rochester 2002) <https://www.cs.rochester.edu/~brown/242/assts/termprojs/games.pdf> accessed 30 November 2016; Kat Bailey, 'What Middle-earth: Shadow of Mordor Says About the Possible Future of Gaming' (*US Gamer*, 9 June 2014) <http://www.usgamer.net/articles/middle-earth-shadow-of-mordor-future-of-games> accessed 30 November 2016; Kris Graft, 'When Artificial Intelligence in Video Games Becomes...artificially Intelligent' (*Gamasutra*, 22 September 2015) <http://www.gamasutra.com/view/news/253974/When_artificial_intelligence_in_video_games_becomesartificially_intelligent.php> accessed 30 November 2016.

[17] Blair Hanley Frank, 'Microsoft Fires Back at Google with Bing Contextual Search on Android' (*PC World*, 20 August 2015) <http://www.pcworld.idg.com.au/article/582584/microsoft-fires-back-google-bing-contextual-search-android/> accessed 30 November 2016.

[18] Apple's Siri, Microsoft's Cortana, Google's Assistant, and Amazon's Alexa are good examples of personal assistants. For more information about them, see, respectively: Apple Inc., 'IOS 10 – Siri' (*Apple*) <http://www.apple.com/ios/siri/> accessed 30 November 2016; Microsoft Corporation, 'Cortana - Meet Your Personal Assistant' (*Microsoft*) <https://www.microsoft.com/en/mobile/experiences/cortana/> accessed 30 November 2016; Google, 'Google Assistant - Your Own Personal Google' (*Google*) <https://assistant.google.com/> accessed 30 November 2016; Amazon, 'Alexa' (*Amazon.com*) <https://developer.amazon.com/alexa> accessed 30 November 2016.

[19] Amazon Echo and Google Home are the latest home assistant released by the time this work was made. For more information about them, see, respectively: Amazon, 'Echo & Alexa, designed around Your Voice' (*Amazon.com*) <https://www.amazon.com/Amazon-Echo-Bluetooth-Speaker-with-WiFi-Alexa/dp/B00X4WHP5E> accessed 30 November 2016; Google, 'Get to Know Google Home' (*Google*) <https://madeby.google.com/home/> accessed 30 November 2016.

[20] Spotify and Netflix use this tool. For more information, see, respectively: Ben Popper and Alex Welsh, 'Tastemaker: How Spotify's Discover Weekly Cracked Human Curation at Internet Scale' (*The Verge*, 30 September 2015) <http://www.theverge.com/2015/9/30/9416579/spotify-discover-weekly-online-music-curation-interview> accessed 30 November 2016; Alexis Kleinman, 'How Netflix Gets Its Movie Suggestions So Right' (*The Huffington Post*, 08 July 2013) <http://www.huffingtonpost.com/2013/08/07/netflix-movie-suggestions_n_3720218.html> accessed 30 November 2016.

1.3. Current Impact of Artificial Intelligence

Recently, artificial intelligence is acquiring the ability to exercise some functions that were previously exclusive to humans, resulting in small, but perceptible changes to human interaction. For instance, this shift can be observed in customer services, where individuals, instead of communicating directly with other humans, have their first contact with bots.[21]

Perhaps a greater example of change brought by artificial intelligence can be found in the financial sector, that has already replaced humans with machines, making stock tickers and trading tickets automated.[22] Even financial analysts might soon be replaced by machines, with enterprises such as Goldman Sachs in the forefront of this replacement process.[23] This change not only affects areas such as employment and workplace, but also has the potential to modify the financial sector itself.[24]

These examples illustrate well the current impact caused by artificial intelligence. Nonetheless, development is constant, and these systems are becoming yet more refined and competent, even in fields that are said to require creativity. For instance, intelligent machines have already been capable of developing mechanisms to lie and deceive to flourish in a competitive environment,[25] to conceal its communication with other machines,[26] to write,[27] to code,[28] to paint,[29] and to even create and propose scientific theories.[30] These developments can have an enormous impact on intellectual property rights and employment.

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[21] Michael Schneider, 'Bots, Messenger and the Future of Customer Service' (*TechCrunch*, 7 May 2016) <https://techcrunch.com/2016/05/07/bots-messenger-and-the-future-of-customer-service/> accessed 30 November 2016.

[22] For a brief explanation on the meaning of the terms 'stock ticker' and 'trading ticket', see: 'Ticker Symbol', *Investopedia* <http://www.investopedia.com/terms/t/tickersymbol.asp> accessed 29 May 2017; 'Deal Ticket', *Investopedia* <http://www.investopedia.com/terms/d/deal_ticket.asp> accessed 29 May 2017.

[23] Nathaniel Popper and Jonno Rattman, 'The Robots Are Coming for Wall Street' *The New York Times Magazine* (New York, 25 February 2016) <http://www.nytimes.com/2016/02/28/magazine/the-robots-are-coming-for-wall-street.html?_r=1> accessed 30 November 2016.

[24] World Economic Forum, 'The Future of Financial Services' (Final Report, June 2015), 153-162 <http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf> accessed 10 May 2017.

[25] Kristina Grifantini, 'Robots "Evolve" the Ability to Deceive' (*MIT Technology Review,* 18 August 2009) <https://www.technologyreview.com/s/414934/robots-evolve-the-ability-to-deceive/> accessed 23 April 2017.

[26] Martín Abadi and David G. Andersen, 'Learning to Protect Communications with Adversarial Neural Cryptography' <https://arxiv.org/pdf/1610.06918v1.pdf> accessed 22 April 2017.

[27] Jonathan Holmes, 'AI is already making inroads into journalism but could it win a Pulitzer?' *The Guardian* (London, 3 April 2016) <https://www.theguardian.com/media/2016/apr/03/artificla-intelligence-robot-reporter-pulitzer-prize> accessed 23 April 2017.

[28] Matt Burgess, 'Microsoft's AI writes code by looting other software' *Wired* (San Francisco, 23 February 2017) <http://www.wired.co.uk/article/ai-write-code-microsoft> accessed 23 April 2017.

[29] Jane Wakefield, 'Intelligent Machines: AI art is taking on the experts' (*BBC News*, 18 September 2015) <http://www.bbc.com/news/technology-33677271> accessed 23 April 2017.

[30] Daniel Lobo and Michael Levin, 'Inferring Regulatory Networks from Experimental Morphological Phenotypes: A Computational Method Reverse-Engineers Planarian Regeneration' (2015) 11 (6) PLOS Computational Biology.

It is way beyond the scope of this work to list all the products and services that are changing with the advent of artificial intelligence, but the examples above serve well to illustrate the state we are currently in. Because of these new technologies powered by "smart codes", new ethical and legal questions are arising, as this thesis will explain in the following part.

1.4. Law and Artificial Intelligence

Not only society, but the legal world will be impacted by the issues brought by artificial intelligence. Intellectual property rights, competition law, labour law, criminal law, tort law, data protection law, just to name a few, will be affected by artificial intelligence. This automation is already present in many fields of research, and embedded into a wide array of products and services, and will create a multitude of legal issues. Consequently, this new technology does not need to evolve into sentient beings, like the fictional character C3PO,[31] to have significant impact on society and law.

New sets of regulation, however, are not created simply because a new technology emerges and cause great impact on law. In fact, the existing rules also apply to artificial intelligence. An example of that are the laws on privacy and data protection, that also apply to technologies such as A.I.[32]

However, as the Internet before it,[33] artificial intelligence is a disruptive technology that brings new economic and societal changes, which the current law may not be perfectly suited to address, especially when coupled with hardware that allows A.I. to interact with the world. And the existence of legal gaps can lead to problems.[34]

This legal challenge can be observed in the transportation sector. The auto industry is already designing driverless cars, powered by artificial intelligence.[35] Nevertheless, despite its imminent deployment, a self-driving car raises new questions, which cannot be solved by the

[31] George Lucas, 'Star Wars' (Hollywood, Twentieth Century Fox Film Corp. 1977).
[32] Regulation 2016/679 of 27 April 2016 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) [2016] OJ L119/1.
[33] Ryan Calo, 'Robotics and the Lessons of Cyberlaw' (2015) 103 (3) California Law Review 513, 517-525.
[34] Viktoras Tiažkijus, 'Gaps in Labour Lawand Their Influence on Flexibility and Stability of the Labour Law System' [2012] Jurisprudencija 1551.
[35] Anthony Levandowski and Travis Kalanick, 'Pittsburgh, Your Self-Driving Uber Is Arriving Now' (*Uber Newsroom*, 14 September 2016) <https://newsroom.uber.com/pittsburgh-self-driving-uber/> accessed 30 November 2016; The Tesla Team, 'All Tesla Cars Being Produced Now Have Full Self-Driving Hardware' (*Tesla Motors*, 19 October 2016) <https://www.tesla.com/en_GB/blog/all-tesla-cars-being-produced-now-have-full-self-driving-hardware?redirect=no> accessed 1 December 2016; Google, 'Google Self-Driving Car Project' (Google) <https://www.google.com/selfdrivingcar/> accessed 30 November 2016.

current set of rules.[36] An example is how to give cars permission to drive, or how to assess their security. As a result, regulatory agencies will have to provide new ways to test and authorize cars and their systems to be able to drive on the streets. New security standards will have to be set to avoid the damage an intelligent system can cause to the passengers of the car and to third parties.[37] Privacy and data protection laws will also have to deal with this new technology, as a self-driving car has to manipulate a large quantity of data, some of which are personal.[38]

Moreover, companies like Mercedes-Benz are building into the codes of their cars what can be called the solution to the trolley problem. It means that corporations are previously deciding who should die in the case of an accident.[39] The ethical problems it raises are significant, as the legitimacy of carmakers to make such decision, if their decision is correct or if it will be socially accepted as such.[40]

Another example that causes legal uncertainty is the use of autonomous weapons in warfare.[41] Governments are building fully-autonomous robots for military purposes, with the ability to kill.[42] This raises so much questions that, in 2015, an International Joint Conference on Artificial Intelligence, with over 1,000 experts in the area, including Elon Musk and Stephen Hawking, signed an open letter to ban military autonomous weapons.[43] In the same year, the UN held the Meeting of Experts on Lethal Autonomous Weapons Systems in Geneva to discuss the issue.[44]

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[36] Susanne Pillath, 'Automated vehicles in the EU' (Briefing – European Parliamentary Research Service, January 2016) 3, 6-11. For more on this topic, see chapter 3.1.3.A.

[37] Susanne Pillath, 'Automated vehicles in the EU' (Briefing – European Parliamentary Research Service, January 2016) 3.

[38] Chris Woodyard and Jayne O'Donnell, 'Your car may be invading your privacy' *USA Today* (McLean, 25 March 2013) <https://www.usatoday.com/story/money/cars/2013/03/24/car-spying-edr-data-privacy/1991751/> accessed 03 May 2017.

[39] Michael Taylor, 'Self-Driving Mercedes-Benzes Will Prioritize Occupant Safety over Pedestrians' *Car and Driver* (Ann Arbor, 7 October 2016) <http://blog.caranddriver.com/self-driving-mercedes-will-prioritize-occupant-safety-over-pedestrians/> accessed 30 November 2016.

[40] Peter Dizikes, 'Driverless Cars: Who Gets Protected?' (*MIT News*, 23 June 2016) <http://news.mit.edu/2016/driverless-cars-safety-issues-0623> accessed 30 November 2016.

[41] Wolff H. von Heinegg and Gian Luca Berutto (ed), *International Humanitarian Law and New Weapon Technologies* (FrancoAngeli 2012) ch 4; Jeffrey S. Thurnher, 'The Law That Applies to Autonomous Weapon Systems' (2013) 17 (4) ASIL Insights <https://www.asil.org/insights/volume/17/issue/4/law-applies-autonomous-weapon-systems> accessed 10 May 2017.

[42] Lora G. Weiss, 'Autonomous Robots in the Fog of War' *IEEE Spectrum* (New York, 27 July 2011) <http://spectrum.ieee.org/robotics/military-robots/autonomous-robots-in-the-fog-of-war> accessed 30 November 2016.

[43] Nayef Al-Rodhan, 'The Moral Code: How To Teach Robots Right and Wrong' *Foreign Affairs* (New York, August 12, 2015) <https://www.foreignaffairs.com/articles/2015-08-12/moral-code> accessed 1 December 2016.

[44] Denise Garcia, 'Battle Bots: How the World Should Prepare Itself for Robotic Warfare' *Foreign Affairs* (New York, 5 June 2015) <https://www.foreignaffairs.com/articles/2015-06-05/battle-bots> accessed 1 December 2016.

Apart from these examples, artificial intelligence incites a plethora of other questions which current law is not able to clarify, as, for instance, the liability issues raised when a smart machine causes physical damage to someone.[45] Or the distribution of the economic fruits of artificial intelligence and its impact on the working force.[46]

Notwithstanding its importance and significance, there is a shortage of academic studies about the regulation of artificial intelligence, leaving some issues unanswered. For instance, which measures should be taken to avoid the dangers resulting from the deployment of untested systems; or the creation of minimum criteria to train an A.I. system used by public security authorities to not affect negatively already marginalized groups.[47]

The existing literature, when approaching the subject, deals with the risks and difficulties of regulating the field, the precautions necessary when creating those controls, and/or the parameters to regulate.[48] Nonetheless, there is a deeper and more basic question that needs to be answered before discussing any of these topics:

Should artificial intelligence indeed be regulated at all, and why?

These are the two central questions of this thesis.

This work intends to answer these questions and close this lacuna on the subject, with hopes that the answer can offer a more robust basis for subsequent research on the regulation of A.I.

To answer these questions, this thesis will use depart from a premise that a regulation should serve a purpose; and therefore, a field should only be regulated if such rules can succeed in its mission to bring benefits to the sector of artificial intelligence, and to society. This thesis

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[45] George S. Cole, 'Tort Liability for Artificial Intelligence and Expert Systems' (1990) 10 (2) Computer/Law Journal 127.

[46] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 42-43.

[47] Kate Crawford and Ryan Calo, 'There is a blind spot in AI research' (2016) 538 Nature 311; Matthew U. Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law and Technology 353, 354-356.

[48] Eliezer Yudkowsky, 'Artificial Intelligence as a Positive and Negative Factor in Global Risk' in Nick Bostrom and Milan M. Ćirković (ed), *Global Catastrophic Risks* (Oxford University Press 2008); AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 10-11, 42-49; Matthew U. Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law and Technology 353; Committee on Technology, 'Preparing for the Future of Artificial Intelligence' (National Science and Technology Council – Executive Office of the President of the United States of America, 12 October 2016) 30-34 <https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf> accessed 15 April 2017; Andrew Tutt, 'An FDA for Algorithms' (2017) 69 Administrative Law Review; European Parliament Committee on Legal Affairs, *Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))* (A8-0005/2017, 2017); Corinne Cath and others, 'Artificial Intelligence and the "Good Society": the US, EU and UK approach' [2017] Science and Engineering Ethics <https://link.springer.com/article/10.1007/s11948-017-9901-7> accessed 26 April 2017.

will focus on State regulation, through the use of legislation. It is also good to emphasise that this thesis discusses regulation in a more abstract way, elaborating a concept that can be applicable regardless of the branch of the law.[49]

1.5. Structure and Methodology

This work will try to answer the research questions by answering more precise sub-questions:

What is regulation? What type of regulation is used in this thesis? What are the possible risks and benefits of regulating? What does a regulation need to be successful?

In chapter 2, the thesis will form the basis to answer the main question. As the question revolves around regulation, the chapter will briefly examine its definition and nature. It will also analyse the risks a "bad" legislation might create, like disabling the development of automation; as well as examine the benefits of a "good" legislation, like making this technology more palatable and accessible, improving risk access and management, fostering the interdisciplinary discussion of this field, and avoiding unnecessary harm due to technical or philosophical failures.[50] The terms "bad" and "good" here referred shall also be explored to escape subjectivity.

What are the possible risks and benefits of regulating artificial intelligence? Is there a compelling reason to regulate it?

In chapter 3, it will take the discussions about regulation held in the previous chapter and apply them to the current reality of artificial intelligence. This will result in an extensive risk assessment, analysing the benefits and drawbacks a regulation might have on artificial intelligence, and how it reflects on society. With such analysis, the chapter will begin to answer the main question, of whether artificial intelligence should be regulated.

Is it possible for a regulation on artificial intelligence to succeed? How?

In chapter 4, it will continue to answer the main question. Considering the premise that fundaments this research, this chapter will analyse the steps necessary for an intervention on A.I. to be successful, and whether it is possible to achieve such accomplishment.

Should artificial intelligence indeed be regulated? Why?

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[49] This thesis acknowledges that artificial intelligence will have different impacts on each branch of law, and a possible regulation must consider this. This thesis already showed some examples in the introduction, and will discuss other examples throughout this work. In chapter 4.2.1., it argues that different aspects of artificial intelligence, like its development and use, should be regulated differently.

[50] Eliezer Yudkowsky, 'Artificial Intelligence as a Positive and Negative Factor in Global Risk' in Nick Bostrom and Milan M. Ćirković (ed), *Global Catastrophic Risks* (Oxford University Press 2008), 13-17.

It will all culminate into chapter 5, that will recapitulate the discussions held up until then, so it can confirm the answer to the main question and conclude the thesis.

Therefore, this work will do an extensive literature review, departing from a regulator's perspective. It shall analyse if the benefits of regulation outweigh its risks, aiming to protect the interests of people. This methodology will be utilised to gain the necessary knowledge to reach a satisfactory conclusion and produce original work to complement the existing literature.

2. 'GOOD' AND 'BAD' REGULATION

As explained in the previous chapter, the recent developments in the field of artificial intelligence raise a series of ethical and legal questions. So much so that even some members of the private sector, that are prominently against governmental intervention, are talking about the dangers of A.I. and even calling for regulation.[51] However, all this innovation occurs by default, with little to no specific regulatory innovation or adaptation, as well as little academic discussion on the potential regulation of A.I.[52]

This chapter briefly examines the definition and nature of regulation, analyses the risks a "bad" legislation might create, and examine the benefits of a "good" legislation. The terms "bad" and "good" here referred shall also be explored to escape subjectivity. Following a logical sequence, it starts by explaining the meaning of the term "regulation", which raises much controversy, even for experienced justices.[53]

For that, an extensive bibliographic survey was made, to capture the most recent conceptions of regulation, which, in turn, were qualitatively analysed and compared, to come with the most accurate definition that could be used according to the essence and aims of this work. The same method was used to scrutinise the uses, risks, and possible benefits of regulation.

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[51] Matt McFarland, 'Elon Musk: "With artificial intelligence we are summoning a demon."' *The Washington Post* (Washington, D.C., 24 October 2014) <https://www.washingtonpost.com/news/innovations/wp/2014/10/24/elon-musk-with-artificial-intelligence-we-are-summoning-the-demon/?utm_term=.328424a5c128> accessed 28 February 2017; Kevin Rawlinson, 'Microsoft's Bill Gates insists AI is a threat' (*BBC News*, 29 January 2015) <http://www.bbc.com/news/31047780> accessed 28 February 2017.

[52] Matthew U. Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law and Technology 353, 354-356.

[53] Barack Orbach, 'What Is Regulation?' (2012) 30 (1) Yale Journal on Regulation Online, 1-2 <http://162.144.71.194/~yalejreg/jopdfs/orbach-what-is-regulation.pdf> accessed 15 February 2017.

2.1. Definition of Regulation

According to the Oxford Dictionary, the word carries different meanings. It might be 'a rule or directive made and maintained by an authority', in a more strictly governmental sense. However, it might also have a broader sense, meaning 'the action or process of regulating or being regulated'.[54]

Thus, while regulation has a broader definition, which is the set of parameters and rules that act as a guidance to behaviours, it has numerous connotations that can be used in the most variable ways. The existence of different meanings to regulation, altogether with the different existing personal views about politics and government intervention may cause certain difficulties in understanding it. These difficulties, consequently, have the potential to result in confusion while defining regulation and using the best term for each circumstance.[55] Therefore, it is indispensable to delimit how the word "regulation" is employed in the context of this thesis.

Amongst the various senses in which regulation can be understood, three are especially useful to this discussion: [56]

- A set of commands, where a set of binding rules are made by the government or any other regulatory agency;
- The intentional act of the state, where the state, in a broader sense, acts in a way to mould certain behaviour or to steer the market;
- All other ways of setting rules, parameters, and influences, like market regulation, professional bodies, and voluntary organisations.[57]

For the purpose of this thesis, regulation will be used in the first of these senses and shall comprise a more vertical top-down approach to regulation, in which the state sets binding rules to regulate artificial intelligence. Therefore, the analysis will be more focused on the ways states can command and control the development of A.I.[58]

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[54] The Oxford English Dictionary, 'regulation' <https://en.oxforddictionaries.com/definition/regulation> accessed 15 February 2017.
[55] Barack Orbach, 'What Is Regulation?' (2012) 30 (1) Yale Journal on Regulation Online, 3-10 <http://162.144.71.194/~yalejreg/jopdfs/orbach-what-is-regulation.pdf> accessed 15 February 2017.
[56] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 2-3.
[57] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 2-3.
[58] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 106-111.

2.2. Reasons to Regulate

In a world where nothing is perfect, humanity has struggled to make society work in a better way. One of the tools used for that is regulation, guiding the behaviour of people and objects. And many circumstances motivate regulation. Therefore, after defining regulation, it is important to discuss the reasons behind regulatory intervention.

One of those cases is the so-called market failure,[59] when the market supposedly fails to address a certain issue that may cause harm to the public interest.[60] As an example of market failure, there is the non-existence of a robust competitive environment, as is the case of a monopoly or oligopoly.[61] Other examples of market failures that are used as a motive to regulation are cases of excessive competition,[62] scarcity and rationing,[63] lack of adequate information,[64] or cases regarding public goods.[65]

Regulation is also put forth to protect human rights[66] and to promote social values, like solidarity and the protection of the environment.[67] When such values are disrespected, or when they face a significant risk of being disregarded, regulation acts to steer individuals' actions and to mould society, in a way to preserve and protect these virtues. Thus, regulation can be used not only as a means of maximising economic efficiency and promoting a fair distribution of wealth, but also to defend people and the values society deems to be relevant.

Furthermore, regulation also serves as a tool to help the development of a specific economic sector. If a determined sector has great importance within society, regulators can direct efforts to help it develop and grow more efficiently.[68] Regulation, in this sense, can

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[59] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 15.

[60] For more about the regulation of market failures, see: Stephen G. Breyer, *Regulation and Its Reform* (Harvard University Press 1982) 15-35; Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 15-22.

[61] Richard A. Posner, 'Natural Monopoly and Its Regulation' (1968) 21 Stanford Law Review 548 <http://chicagounbound.uchicago.edu/cgi/viewcontent.cgi?article=2861&context=journal_articles> accessed 15 March 2017; Edwin G. Dolan and David E. Lindsey, *Economics* (4th edn, The Dryden Press 1983) ch 23-24; Bruno Jullien and Wilfried Sand-Zantman, 'The Regulation of Monopoly' (2010) IDEI Report #16 <http://idei.fr/sites/default/files/medias/doc/by/jullien/idei_report16.pdf> accessed 15 March 2017.

[62] Stephen G. Breyer, *Regulation and Its Reform* (Harvard University Press 1982) 31-32.

[63] 'Enforcement of Priority and Rationing Regulations' (1942) 51 (7) The Yale Law Journal 1196.

[64] Paul Latimer and Philipp Maume, *Promoting Information in the Marketplace for Financial Services: Financial Market Regulation and International Standards* (Springer 2015) 49-84.

[65] Peter Drahos, 'The Regulation of Public Goods' (2004) 7 (2) Journal of International Economic Law 321.

[66] Roger Brownsword, 'What the World Needs Now: Techno-Regulation, Human Rights and Human Dignity' in Roger Brownsword (ed), *Global Governance and the Quest for Justice*, vol 4 (Hart Publishing 2004).

[67] Tony Prosser, *The Regulatory Enterprise: Government, Regulation and Legitimacy* (Oxford University Press 2010) 15-17 <https://books.google.nl/books?id=hfa35rySVdIC&dq=The+Regulatory+Enterprise:+Government,+Regulation,+and+Legitimacy&hl=pt-BR&source=gbs_navlinks_s> accessed 15 March 2017.

[68] George J. Stigler, 'The Theory of Economic Regulation' [1971] The Bell Journal of Economics and Management Science 3; Kevin Guerin, 'Encouraging Quality Regulation: Theories and Tools' (2003) New

provide the sector with legal certainty and stability, and even offer incentives and subsidies, allowing it to develop more than it would without intervention.

As a conclusion, regulation is used to achieve goals considered important for society. These goals can be timeless, as the betterment of people's lives, the protection of universal values, like life, and the overall advancement of humankind. Alternatively, these goals can be temporal, varying according to place and time, as the protection of some values, like equality, honour and social justice.

Consequently, when considering the path of regulation, it is necessary to ponder as much about humankind in general, as about the social group on which these rulings will take effect.

With the definition settled, and a firm foundation of what are the reasons to regulate, it is time to investigate what makes a regulation successful. With that information, it will be possible to evaluate whether a regulation on artificial intelligence can prosper, considering our reality.

2.3. Good Regulation

Knowing when to regulate and how to do it is a very complex task. For that, it is primordial to assess whether a regulation would be appropriate for the case. Then develop a regulation such that it can be regarded as successful in addressing the issue at stake.

Based on that, many authors have tried to come up with appropriate criteria on how to evaluate the efficiency and efficacy of a regulation.[69]

One of those criteria is brought up by utilitarianism, for which a regulation is deemed good when it maximises wealth.[70] Wealth here is not solely monetary, but it also encompasses the happiness and well-being of people.[71] So, according to this approach, a good regulation would be one that would generate the maximum amount of welfare to the biggest number of individuals, while spending the minimum amount of resources.

Zealand Treasury Working Paper 03/24, 2-3 <http://www.treasury.govt.nz/publications/research-policy/wp/2003/03-24/twp03-24.pdf> accessed 29 May 2017.

[69] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 25-26.

[70] Richard A. Posner, 'Utilitarianism, Economics, and Legal Theory' (1979) 8 (1) The Journal of Legal Studies 103.

[71] Roger Crisp, 'Well-Being', *The Stanford Encyclopedia of Philosophy* (Summer edn, 2016) <https://plato.stanford.edu/entries/well-being/> accessed 20 March 2017.

This criterion is not enough, as it has limitations regarding the weight given to specific rights for this cost-benefit analysis. The question raised by this critique is, when confronting rights are at stake, how much does each one value, and how should it be calculated?

It also lacks the moral impetus to protect and promote certain rights, especially when facing a greater gain. An example of this can be seen when a polluting company generates enough wealth to cover the costs of the natural destruction it creates.[72]

Therefore, to make a regulation succeed, efficiency, per se, is not sufficient. Hence, it is also necessary for it to obey other criteria, as follow: [73]

- **Necessity:** as previously stated, there must be a reason for the state to intervene, as the promotion of human rights or the correction of a market failure;
- **Legitimacy:** the regulators should be legally and socially legitimate to conduct the process, and the regulation should have a legal basis. For more technical issues, which is the case of technology, it is of great importance that the regulators have sufficient expertise in the field;
- **Targeting:** regulation should focus on the issue at stake and avoid hitting other targets;
- **Proportionality:** the regulation must have rules and allocate resources in a way that is proportional to the end it wants to achieve;
- **Legal Stability:** the regulation must be certain, the rules consistent, and the legal obligations predictable, to promote legal certainty;
- **Flexibility:** it should be flexible to adapt to factual changes and remain relevant and effective face to the ever-changing circumstances;
- **Transparency and accountability:** all the process of regulation must be accompanied by a justification of the decisions made, and be available to the public. Such information, and the process as a whole, should be fair, accessible, inclusive, clear, simple, and user-friendly, allowing public scrutiny. Whenever possible, all the stakeholders should be notified and consulted previously. Those being regulated should have a reasonable time to comply with the rules;

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[72] Ronald M. Dworkin, 'Is Wealth a Value?' (1980) 9 (2) The Journal of Legal Studies 191; Bernard Williams, 'A Critique of Utilitarianism' in Christina Hoff Sommers and Frederic Tamler Sommers (eds), *Vice & Virtue in Everyday Life: Introductory Readings in Ethics* (5th edn, Hartcourt College 2001).

[73] Better Regulation Task Force, *Principles of Good Regulation* (British Government 2003); Stavros B. Thomadakis, 'What Makes Good Regulation?' (IFAC Council Seminar, Mexico City, 14 November 2007); Peter Mumford, 'Best Practice Regulation: Setting Targets and Detecting Vulnerabilities' (2011) 7 (3) Policy Quarterly 36; Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 26-39.

- **Effectiveness:** the regulation should constantly be evaluated to ensure it is beneficial and is achieving its goal.

It is hard to obey this entire array of criteria at the same time. Some situations sometimes require a focus on certain aspect in detriment of others.

In the case of technology, for instance, because of the fast pace of its development, it is prejudicial to call for a public participation before every decision, because it demands too much time and, consequently, makes regulation lag behind the innovations, losing power and effectiveness. Therefore, greater flexibility and adaptability are required to maintain its relevance with the rapid technological evolution, in detriment of transparency and accountability. It also requires greater expertise from regulators, as technology tends to be a complex matter. So, here, arguably, higher technical knowledge has greater importance than representativeness.[74] This is just an example of how, sometimes, it is necessary to focus on some criteria in detriment of others.

The conclusion is that a good regulation has to take all of those criteria into consideration and try to satisfy them all. When impossible, it is a good solution to focus on some, but not completely forget the others; it is a matter of balancing them in the best way possible.

2.4. Bad Regulation

It is hard to make a regulation successful. It consumes time, as well as human and material resources: from the time stakeholders and regulators spend discussing and formulating it; from all resources allocated into putting it into force; from investments in compliance; to all the capital used to evaluate, control, and enforce it. Thus, if a regulation is not sufficiently well prepared, it risks not doing the good it was supposed to do and, on top of that, waste resources unnecessarily, turning into a failure.

There are many ways for a regulation to fail. The first one is ineffectiveness. If a regulation does not reach its goal, all the time and resources spent will be wasted. So, not only will the problem persist, but other areas will also be affected by the draining of resources by the failed regulation.

[74] This is merely an example. That is not to say that issues such as transparency, accountability, and representativeness are not needed when regulating a technology. Indeed, all these factors should be considered in each different case. This thesis will further analyse the requisites for a good regulation on A.I. in the subsequent chapters, especially the fourth one.

Another one is inefficiency, where although the regulation is somewhat beneficial, it costs too much, causing or enhancing other problems. As a conclusion, this failed regulation will not be worth the effort.

Moreover, a malfunctioning regulation may have other unintended consequences, which cause more harm than the initial problem it tries to solve.[75] It may generate, for example, a disruption of the system, making the outcome worse than the original situation. Alternatively, the new rules may allow agents to exploit it, creating breaches that may as well worsen the overall conditions.

Here, it is appropriate to mention the risk of escalation, where regulation itself produces more of the thing it tries to avoid. As an example of this, the hostile detention of delinquents may cause violent protests, with physical aggressions and destruction of property. Another example is that the prohibition of a certain substance may paradoxically cause it to be used more.

There is also the problem of displacement, where regulation, instead of ending the problem, only makes it change. E.g.: new pollution caps are created in a certain place to diminish the levels of dirt in the atmosphere, but the polluting industries simply go to another country and maintain their contamination habits; consequently, pollution continues to harm that initial place.

Not to mention the possibility of a regulation harming a legitimate activity while trying to solve the problem. E.g.: the case of surveillance, that is used to combat crimes, but also hinders people's privacy.

There is also the risk of moral hazard, where the sense of security created by the regulation makes people less preoccupied and, therefore, more susceptible to the harm the regulation intended to prevent.

Moreover, regulation has the power to stir the attention away from the real problem, either by chasing unobtainable objectives while ignoring the obtainable ones or by distracting the efforts from the real dangers.[76]

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[75] For a deeper analysis of the examples given here and for a broader array of cases in which regulation fails, see: Sam D. Sieber, *Fatal Remedies: The Ironies of Social Intervention* (1st edn, Plenum Press 1981); Mitchel Y. Abolafia and Martin Kilduff, 'Enacting Market Crisis: The Social Construction of a Speculative Bubble' (1988) 33(2) Administrative Science Quarterly 177; Peter N. Grabosky, 'Unintended Consequences of Crime Prevention' (1996) 5 Crime Prevention Studies 25; Martin Lodge and Kai Wegrich, *Managing Regulation: Regulatory Analysis, Politics and Policy* (Palgrave Macmillan 2012).

[76] For an example of this regulatory failure, see: John W. Maxwell, Thomas P. Lyon and Steven C. Hackett, 'Self-Regulation and Social Welfare: The Political Economy of Corporate Environmentalism' [2000] The Journal of law and Economics 583.

Either way, regulating a certain field is a very complex activity, which involves significant risks and may cause more harm than good. Being aware of such dangers is only the initial step, and each case requires an extensive study to be carried out before any conclusion.

Artificial intelligence is no different. If one ponders to regulate this field, they must begin with the analysis of whether there is a reason to do so. If positive, it is imperative to assess its risks and possible benefits. That is what the next chapters will try to accomplish. All the notions of regulation acquired in this chapter will be applied to artificial intelligence, to answer the main question of this thesis: should artificial intelligence be regulated?

3. ARGUMENTS PRO AND AGAINST THE REGULATION OF A.I.

Artificial intelligence is an emerging technology that, despite its decades of existence, has only recently gained space and commercial projection.[77] With its new uses, it also poses new risks. Risks that raise the question of whether this technology should be regulated.

Regulation, as seen in the previous chapter, is a very complex subject and, to use it with artificial intelligence, one must analyse its risks. That is what this chapter is about. It tries to analyse the risks and difficulties faced by a possible regulatory regime, and compare them with the benefits it might generate.

3.1. Risks and Difficulties of Regulating A.I.

There are many risks involved in the act of regulating a new technology and, in the case of artificial intelligence, many arguments exist against this act, fearing it would cause more harm than good.

3.1.1. Defining A.I.

The first one is the problem of defining the object of regulation, crucial to the correct targeting of efforts. For a set of rules to be effective, it needs to clearly state what it regulates.[78] That can be a problem in this case. As noted in the introduction, there is no consensus over

[77] National Research Council, *Funding a Revolution: Government Support for Computing Research* (National Academy Press 1999) 216-222; Nils J. Nilsson, *The Quest for Artificial Intelligence: A History of Ideas and Achievements* (Cambridge University Press 2009) 589-632.

[78] As seen in chapter 2.3., a good regulation should have a clear target, so it can better focus on the issue at stake and avoid hitting other targets. Focusing resources in a clear and well-defined subject helps achieving the goal intended by the regulation.

what artificial intelligence means, and this might pose an extra difficulty, as a wrong definition can have undesirable consequences.

In the case the description is under-inclusive, a backdoor is open and can be exploited, allowing others to escape regulation, and cause unfair competition with the ones regulated, as well as expose people to unnecessary harm, caused by A.I. that did not endure any scrutiny. If over-inclusive, however, simple software and other mechanisms, that did not need to be controlled, may fall under the same category as artificial intelligence and suffer the same restrictions. This can be harmful to those sectors.[79]

Furthermore, if the definition is overly specific, subsequent advancements in artificial intelligence can cause the description to become obsolete, since it will not comprise the new technological improvements. Therefore, the regulation would become ineffective.[80]

Moreover, there is a fear that the use of broad terms, like "intelligence", can lead to interpretative difficulties when implementing those rules, or when discussing them on court.[81]

However, there are ways to overcome the difficulties above. For instance, this thesis used the following definition: artificial intelligence is "the design of intelligent agents,"[82] agents that are flexible, and capable of adapting itself to various situations not previously known and learning through experience, achieving a goal not possible to traditional computer systems.[83] This seems to be the appropriate terminology to be used. First, because it encompasses different types of intelligence, not only human. It also takes into consideration the flexible, adaptable, learning, and evolving nature of A.I. It is not overly narrow nor over-inclusive, and differentiate it from traditional computer systems. Moreover, it seems to be in

[79] As an example, a regulation with an over-inclusive definition of A.I. that requires codes to be approved by a committee before being deployed, may also force non-intelligent codes to be approved, slowing the development of inoffensive software, like videogames, and saturating the committee with unnecessary workload. For more examples of under- and over-inclusiveness, see: Roy L. Brooks, 'Race as an Under-Inclusive and Over-Inclusive Concept' [1994] Berkeley Journal of African-American Law & Policy 9; Scott J. Shapiro, 'What is the Rule of Recognition (And Does It Exist)?' in Matthew Adler and Kenneth Einar Himma (eds) *The Rule of Recognition and the U.S. Constitution* (Oxford University Press 2009).

[80] Bert-Jaap Koops, 'Should ICT Regulation be Technology-Neutral?' in Bert-Jaap Koops and others (eds), *Starting Points for ICT Regulation. Deconstructing Prevalent Policy One-Liners* (IT &Law Series vol 9, T.M.C. Asser Press 2006) 9-11.

[81] Matthew U. Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law and Technology 353, 358, 358-362.

[82] David L. Poole, Alan K. Mackworth, and Randy Goebel, *Computational Intelligence: A Logical Approach* (Oxford University Press 1998), 1; Joost Nico Kok and others, 'Artificial Intelligence: Definition, Trends, Techniques, and Cases' (2002) 1 Encyclopedia Of Life Support Systems 1095, 1096.

[83] Marcus Hutter and Shane Legg, 'Universal Intelligence: A Definition of Machine Intelligence' [2007] Minds and Machines 391, 405-423; Pei Wang, 'What Do You Mean by "AI"?' [2008] 171 Frontiers in Artificial Intelligence and Applications 362, 371-372.

accord with the current scientific understanding of this subject, and is widely used in the literature.[84]

This definition, despite still using general terms, as "goal" and "traditional computer systems", can be effectively applied in a possible regulation, so long as there is some level of harmonisation regarding their meanings. After all, it is common to see legislations using broad and vague terms, as "fair", "just", "proportional", "equality", and "well-being".[85] It is also common to see broad concepts, as "energy", being the subject of rules, without much controversy.[86] In the case of divergent interpretations to these general terms, a central regulatory agency can serve as an interpreter, diminishing the interpretative variations.

However, it is important to emphasise that this thesis does not intend to bring the definitive solution to the definition of A.I., but rather serves as a basis for future and more elaborate discussions in the area.

Setting a legal definition for artificial intelligence might even be beneficial to the sector.[87] There are, currently, different definitions of A.I. being used by the industry, which causes communication problems between them. This issue results in a fragmented field, where research cooperation becomes more complex and arduous and may lead to inconsistent studies. Therefore, bringing a unifying definition has the potential to foster greater and easier cooperation among developers.[88] In the end, if a single definition cannot encompass every single usage of this technology, it is possible to enable some especial sector-specific descriptions to suit their needs better.

What is necessary is a solution that is well-delimited and understood, strong enough to promote a good cooperation among the different sectors, and flexible enough to encompass the multitude of specific usages of A.I. The definition brought by this thesis, if not sufficient, can be used as a starting point for such discussions.

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[84] Stuart J. Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (Prentice Hall 1995) 31-52; Joost Nico Kok and others, 'Artificial Intelligence: Definition, Trends, Techniques, and Cases' (2002) 1 Encyclopedia Of Life Support Systems 1095, 1096; Marcus Hutter and Shane Legg, 'Universal Intelligence: A Definition of Machine Intelligence' [2007] Minds and Machines 391, 405-423; Pei Wang, 'What Do You Mean by "AI"?' [2008] 171 Frontiers in Artificial Intelligence and Applications 362, 371-372.

[85] As an example, see: Regulation 2016/679 of 27 April 2016 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) [2016] OJ L119/1.

[86] John Danaher, 'Is effective regulation of AI possible? Eight potential regulatory problems' (*Philosophical Disquisitions*, 7 July 2015) <http://philosophicaldisquisitions.blogspot.nl/2015/07/is-effective-regulation-of-ai-possible.html> accessed 15 April 2017.

[87] Gary Lea, 'Why we need a legal definition of artificial intelligence' (*The Conversation*, 2 September 2015) <http://theconversation.com/why-we-need-a-legal-definition-of-artificial-intelligence-46796> accessed 20 April 2017.

[88] Pei Wang, 'What Do You Mean by "AI"?' [2008] 171 Frontiers in Artificial Intelligence and Applications 362.

3.1.2. Impacts of A.I.

Even if the definition of artificial intelligence does not become a problem, regulators still have to face the lack of knowledge about artificial intelligence, per se, and its uses and impacts on society. This is probably one of the greatest concerns when dealing with this subject.[89] It is directly or indirectly linked to the regulation's targeting, proportionality, and effectiveness.

Some argue that this technology has not yet matured, and might suffer great changes and improvements over the years, with diverse and maybe unpredictable uses.[90] Hence, it is still too early to understand the potentials and the impacts of artificial intelligence. Therefore, regulating it now may hinder the capabilities of this technology. More, the set of rules can very easily become irrelevant or completely ineffective.

Indeed, one cannot foresee everything and cannot fully overcome the unpredictability of the future, especially when dealing with an apparent disruptive technology, such as A.I., which turns this job even more difficult and prone to failure. However, as presented in the introduction, A.I. is not a technology from the future, but from the present. It is already being used and commercialised, and its effects are becoming increasingly tangible and better understood. For instance, a good number of studies have already been made on the impacts of artificial intelligence in sectors such as transportation,[91] medicine[92] and data protection.[93]

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[89] Eliezer Yudkowsky, 'Artificial Intelligence as a Positive and Negative Factor in Global Risk' in Nick Bostrom and Milan M. Ćirković (ed), *Global Catastrophic Risks* (Oxford University Press 2008), 1-28; Matthew U. Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law and Technology 353, 358-359, 363-366; Amitai Etzioni and Oren Etzioni, 'Why Regulating AI Is A Mistake' *Forbes* (Jersey City, 9 January 2017) <https://www.forbes.com/sites/ciocentral/2017/01/09/why-regulating-ai-is-a-mistake/#19faf9c82be3> accessed 15 April 2017.

[90] Tim Worstall, 'Exactly What We Don't Need – Regulation of AI And Technology' *Forbes* (Jersey City, 12 October 2016) <https://www.forbes.com/sites/timworstall/2016/10/12/exactly-what-we-dont-need-regulation-of-ai-and-technology/#4385eaf05333> accessed 11 June 2017.

[91] Transportation Research Board, 'Artificial Intelligence in Transportation: Information for Application' (Transportation Research Circular E-C113, Washington D.C., January 2007); AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 18-24; Networking and Information Technology Research and Development Subcommittee, 'The National Artificial Intelligence Research and Development Strategic Plan' (National Science and Technology Council – Executive Office of the President of the United States of America, 13 October 2016), 8-9.

[92] Niels Peek and others, 'Thirty years of artificial intelligence in medicine (AIME) conferences: A review of research themes' (2015) 65 Artificial Intelligence in Medicine 61; AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 25-30; Sobia Hamid, 'The Opportunities and Risks of Artificial Intelligence in Medicine and Healthcare' (Cambridge University Science and Policy Exchange, Summer 2016).

[93] Information Commissioner's Office, 'Big data, artificial intelligence, machine learning and data protection' <https://ico.org.uk/media/for-organisations/documents/2013559/big-data-ai-ml-and-data-protection.pdf> accessed 13 May 2017; Various, 'Artificial Intelligence, Robotics, Privacy and Data Protection' (Room document for the 38th International Conference of Data Protection and Privacy Commissioners, October 2016)

Furthermore, studies have already been carried to understand the impacts of artificial intelligence on law,[94] and it is already known that our current legislation will face problems dealing with the subject, as the next sub-chapter explains in further detail.

It is already known that artificial intelligence may have an impact on the transportation sector,[95] on the liability issue,[96] on the distribution of goods and opportunities,[97] amongst other things.[98] So, at this moment, there is no need to ponder if artificial intelligence will give rise to vengeful sentient robots. Regulators can focus on the technology available now and the ones emerging on the next ten to fifteen years.

On these technologies, we already have enough knowledge and are able to make more solid predictions.[99]

Scientists may not know everything about it, but neither do they know everything about the environment, the climate, or our health. Nevertheless, these sectors have all been subject to regulation. One cannot always wait to know everything about the subject to act.

Law has historically been mainly reactive and, when it tries to mould some technology after it has been solidified in the social, political, and economic spheres of society, control

<https://edps.europa.eu/sites/edp/files/publication/16-10-19_marrakesh_ai_paper_en.pdf> accessed 13 May 2017.

[94] Mireille Hildebrandt, 'Law as Information in the Era of Data-Driven Agency' [2016] Modern Law Review 1.

[95] Transportation Research Board, 'Artificial Intelligence in Transportation: Information for Application' (Transportation Research Circular E-C113, Washington D.C., January 2007); AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 18-24; Networking and Information Technology Research and Development Subcommittee, 'The National Artificial Intelligence Research and Development Strategic Plan' (National Science and Technology Council – Executive Office of the President of the United States of America, 13 October 2016), 8-9.

[96] George S. Cole, 'Tort Liability for Artificial Intelligence and Expert Systems' (1990) 10 (2) Computer/Law Journal 127; Peter M. Asaro, 'Robots and Responsibility from a Legal Perspective' (2007) <http://www.peterasaro.org/writing/ASARO%20Legal%20Perspective.pdf> accessed 16 May 2017; Gary Lea, 'Who's to blame when artificial intelligence systems go wrong?' (*The Conversation*, 16 August 2015) <http://theconversation.com/whos-to-blame-when-artificial-intelligence-systems-go-wrong-45771> accessed 16 May 2017.

[97] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 42-43.

[98] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016).

[99] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 42-43; Committee on Technology, 'Preparing for the Future of Artificial Intelligence' (National Science and Technology Council – Executive Office of the President of the United States of America, 12 October 2016), 30-34.

becomes difficult, expensive, and time-consuming, and change may become impractical.[100] The consequences of waiting can be severe, making any post factum control, impossible.[101]

Furthermore, the introduction of a regulatory regime at this moment could have positive impacts. Regulatory intervention at this point could avoid the ineffectiveness of the law by anticipating on rather than lagging behind technology.[102]

Therefore, this thesis argues that, taking into consideration the knowledge experts already have on the issue, and the current timing to act, it is already possible to regulate artificial intelligence in a meaningful and impactful way.

3.1.3. Artificial Intelligence and the Existing Regulations

Another issue to be discussed is about the suitability of the current rules to deal with artificial intelligence. After all, even if the meaning and impacts of A.I. were perfectly known and document, there would be no need for novelty in regulation if the current rules could seamlessly manage this technology.

As concluded in the second chapter, a new regulation would need a reason to exist if it aspires to be successful. If the current norms are still suitable to address the issues brought by A.I., there will be one less reason to regulate it. A new regulation, in this case, could augment the existing bureaucracy, and possibly create legal contradictions and loopholes, ultimately hindering the development of A.I. and generating other damages, like the exploitation of such loopholes.

However, artificial intelligence is a disruptive technology that brings new economic and societal changes, which the current law is not perfectly suited to address, especially when coupled with hardware that allows A.I. to interact with the world. This unsuitability of the current laws creates legal gaps and can lead to problems.[103]

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[100] Wolfgang Liebert, 'Collingridge's dilemma and technoscience: An attempt to provide a clarification from the perspective of the philosophy of science' (2010) 7 (1) Poiesis & Praxis 55, 57-61.

[101] The arguments in this section, up to this point, can be summarized by the Collingridge's dilemma. See: Wolfgang Liebert, 'Collingridge's dilemma and technoscience: An attempt to provide a clarification from the perspective of the philosophy of science' (2010) 7 (1) Poiesis & Praxis 55, 57.

[102] Ronald Leenes and others, 'Regulatory challenges of robotics: some guidelines for addressing legal and ethical issues' (2017) 9 (1) Law, Innovation and Technology, 7; John Markoff, 'How Tech Giants Are Devising Real Ethics for Artificial Intelligence' *The New York Times* (New York, 1 September 2016) <https://www.nytimes.com/2016/09/02/technology/artificial-intelligence-ethics.html?_r=0> accessed 16 April 2017.

[103] Viktoras Tiažkijus, 'Gaps in Labour Lawand Their Influence on Flexibility and Stability of the Labour Law System' [2012] Jurisprudencija 1551.

This thesis will now present two examples to illustrate this issue. These examples were chosen for their importance, and for the immediate impact artificial intelligence will have in those areas.[104]

A. Transportation

This legal challenge can be observed in the transportation sector. The auto industry is already designing driverless cars, powered by artificial intelligence.[105] Nevertheless, despite its imminent deployment, fully autonomous cars are still not allowed, due to the Vienna Convention on Road Traffic, ratified by most European states.[106] According to this convention, a car needs a human driver to be allowed in the streets. The Regulation No. 79 of the UN/ECE also does not authorise 'autonomous steering systems'.[107] Moreover, many countries, in their national laws, require the driver to always have his hands on the steering wheel, and even require the human driver to be in primary control.[108]

Not to mention that any mass-produced car must be previously type-approved to be used on public roads. And autonomous cars are not yet included in such provisions and, therefore, are not allowed.[109]

In this sense, the regulation must be changed and adapted to incorporate this new technology. However, simply allowing driverless vehicles would not be enough, and the regulation would have to deal with several other issues. For example, if it is necessary to have a driver ready to take control in case the car encounters a problem. Or if such "backup" driver should have a license. Or if cars need a system to force a stop in case the driver, for any reason,

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[104] This thesis chose to tackle one sector-specific (transportation) and one broader example (liability). The fact that the transportation sector was cited in the introduction also weighted in the choice of this example. To know more about the importance of these issues, and about the impact of artificial intelligence, see: George S. Cole, 'Tort Liability for Artificial Intelligence and Expert Systems' (1990) 10 (2) Computer/Law Journal 127; Susanne Pillath, 'Automated vehicles in the EU' (Briefing – European Parliamentary Research Service, January 2016).

[105] Anthony Levandowski and Travis Kalanick, 'Pittsburgh, Your Self-Driving Uber Is Arriving Now' (*Uber Newsroom*, 14 September 2016) <https://newsroom.uber.com/pittsburgh-self-driving-uber/> accessed 30 November 2016; The Tesla Team, 'All Tesla Cars Being Produced Now Have Full Self-Driving Hardware' (*Tesla Motors*, 19 October 2016) <https://www.tesla.com/en_GB/blog/all-tesla-cars-being-produced-now-have-full-self-driving-hardware?redirect=no> accessed 1 December 2016; Google, 'Google Self-Driving Car Project' (Google) <https://www.google.com/selfdrivingcar/> accessed 30 November 2016.

[106] Convention on Road Traffic (Vienna, 8 November 1968) 1042 U.N.T.S. 17, entered into force 21 May 1977, arts 8, 13.

[107] Regulation No 79 of the Economic Commission for Europe of the United Nations (UN/ECE) – Uniform provisions concerning the approval of vehicles with regard to steering equipment [2006] OJ L137/25.

[108] Lennart S. Lutz, 'Automated Vehicles in the EU: A Look at Regulations and Amendments' (*Gen Re*, March 2016) <http://www.genre.com/knowledge/publications/cmint16-1-en.html> accessed 16 May 2017; Anders Eugensson, 'Overview of Regulations for Autonomous Vehicles' (Initiative Seminar, Gothenburg, 27 October 2016) 3-6 <https://www.chalmers.se/en/areas-of-advance/Transport/calendar/initiative-seminar-2016/Documents/JanHellaker.pdf> accessed 15 May 2017.

[109] Directive 2007/46/EC of 5 September 2007 establishing a framework for the approval of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles (Framework Directive) [2007] OJ L263/1.

cannot engage in such task. Or if such driver can engage in other activities, such as use handheld devices, like a cell phone. Or if the intelligent system should necessarily incorporate any security lines into its code. Or how to access the safety of such vehicles before approving them. Among many other questions currently unanswered.[110]

In sum, the current legislation does not allow autonomous vehicles to be used on public roads, and, even if it did, it leaves plenty of questions unanswered, which leads to legal insecurity, and disincentives the development and deployment of such technology in Europe. Not regulating this technology may cause Europe to trail the US, whose states are already regulating autonomous vehicles, and are leading the development of this technology.[111]

Therefore, the regulation of artificial intelligence would help the transportation sector adopt this technology at a faster pace, cover the existing legal gaps, and create security standards to the industry.

B. Liability[112]

Artificial intelligence also challenges the existing theories of liability.[113] Due to its autonomous, adaptable, ever-evolving, and sometimes unpredictable nature, a machine can very well produce an output that was not directly caused by its creation process, nor could it be foreseen.

Therefore, one cannot hold the creator liable if they did not act with the intent to cause damage, and if the damage itself was not presumable and could not be foreseen.

Unless the defendant acts in a blatant disregard for common sense, there is also no liability for negligence if there is no regulation, guideline, best practices, or any safety standard in the industry on which to base any allegation.

Products liability, on its side, will be very limited. First, the A.I. must be a product, commercially sold by the defendant. The product must be defective and reach the final user

[110] Susanne Pillath, 'Automated vehicles in the EU' (Briefing – European Parliamentary Research Service, January 2016).

[111] Anders Eugensson, 'Overview of Regulations for Autonomous Vehicles' (Initiative Seminar, Gothenburg, 27 October 2016) 3-6 <https://www.chalmers.se/en/areas-of-advance/Transport/calendar/initiative-seminar-2016/Documents/JanHellaker.pdf> accessed 15 May 2017; Éanna Kelly, 'As robots begin to take the wheel in Europe, few are prepared' (*Science Business*, 6 April 2017) <http://sciencebusiness.net/news/80221/As-robots-begin-to-take-the-wheel-in-Europe-few-are-prepared> accessed 16 May 2017.

[112] Liability is a concept of great importance in many fields of law, like criminal law and contract law. This section will focus on tort law, even though some of these concerns also apply to other areas.

[113] George S. Cole, 'Tort Liability for Artificial Intelligence and Expert Systems' (1990) 10 (2) Computer/Law Journal 127; Peter M. Asaro, 'Robots and Responsibility from a Legal Perspective' (2007) <http://www.peterasaro.org/writing/ASARO%20Legal%20Perspective.pdf> accessed 16 May 2017; Gary Lea, 'Who's to blame when artificial intelligence systems go wrong?' (*The Conversation*, 16 August 2015) <http://theconversation.com/whos-to-blame-when-artificial-intelligence-systems-go-wrong-45771> accessed 16 May 2017.

with no substantive alteration, and the defect must be the cause of the damage.[114] But not always the intelligent system will be commercially available, and the user might also be the creator. Moreover, it is technically hard to trace the cause of a system's output, because the A.I. is not linear and there is no line of code that can be traced as the cause. Therefore, it is difficult to find a 'defect', and even harder to find the causal link between such defect and the damage. Thus, it is safe to conclude that this theory will only apply to a narrow parcel of cases, and even then, it will be impractical sometimes.

One applicable theory is the strict liability, where there is no need of intent or negligence. The problem, in this case, is who is liable.

Artificial intelligence might be created by assembling different parts, each made by a different person or group, without them knowing of the final product. Another company might be responsible for producing data to train the system, and yet another company may perform the training, with one or more datasets, coming from one or diverse sources. Moreover, the owner/user has the capability to mould the system, and the way it functions, because the system is evolving and adaptable. This becomes even more problematic if the A.I. is cloud-based, and is used by different people, each one contributing to the development of the system.

The coders, the compilers, the dataset builders, the trainers, the users. All of them contribute to the functioning of the system and ultimately influence the outcome. Nonetheless, from this list, the user is, theoretically, the one with fewer technical knowledge of the system, and the one with the less economic power to repair the damages, so placing the responsibility upon them does not sound morally correct. However, placing the responsibility upon someone else will reopen the question of who is liable.

This legal conundrum can even result in helpless victims, with no one liable for the damage caused.

Regulation, in this case, would serve to assign responsibilities and give precise rules about liability relating to artificial intelligence, which would protect the victims and generate legal certainty.

As mentioned, these are only two of many examples of how the existing rules will struggle to absorb this new technology satisfactorily.

[114] George S. Cole, 'Tort Liability for Artificial Intelligence and Expert Systems' (1990) 10 (2) Computer/Law Journal 127, 159.

3.1.4. Technological Neutrality

Another important issue to be considered is the question of 'technological neutrality'. In general terms, the theory of 'technological neutrality' defended by some scholars, defends the idea that regulation should be technologically neutral, save for some exceptions.[115]

According to this view, regulation should focus on the effects of technology, and not on the technology itself. By being technologically specific, the regulation may not concentrate on the uses and consequences of said technology. Furthermore, the rules can become outdated with the development of new technologies. Hence, by being neutral, the regulation can focus on the most important part – the consequences of such technology; and, simultaneously, the rules can easily adapt to new developments, as it is not chained to a certain machinery.

However, this principle has exceptions. For instance, certain areas of the law focus more on procedural issues. This can be seen, for example, in the transportation sector, in which the machinery and the technology it uses is of great importance, hence, technology-specific rules are more utilised.

Furthermore, technology-specific norms are preferred when the functions, and consequently, the effects of a certain technology are unique, and differ from other mechanisms.[116] An example is nuclear energy, that, for its differing risks, uses, and consequences, has specific regulations.

As seen, the challenges artificial intelligence imposes are unlike any other before it. For the first time, we will have to deal with creations capable of learning on their own, of deceiving and overcoming the capabilities of their creators, of developing traits and capacities without further intervention, and of acting with autonomy. These features are unique to artificial intelligence and are the source of many challenges this technology imposes. For law not to lag behind this new technological breakthrough, it is necessary to create specific rules that suit these novel characteristics of A.I.

Furthermore, the technology behind artificial intelligence is better defined and better understood than its consequences. Hence, a technologically-neutral regulation may cause

[115] Bert-Jaap Koops, 'Should ICT Regulation be Technology-Neutral?' in Bert-Jaap Koops and others (eds), *Starting Points for ICT Regulation. Deconstructing Prevalent Policy One-Liners* (IT &Law Series vol 9, T.M.C. Asser Press 2006).

[116] Bert-Jaap Koops, 'Should ICT Regulation be Technology-Neutral?' in Bert-Jaap Koops and others (eds), *Starting Points for ICT Regulation. Deconstructing Prevalent Policy One-Liners* (IT &Law Series vol 9, T.M.C. Asser Press 2006) 6-10.

undesirable side-effects, like hinder good unintended uses and consequences of this technology.[117]

Moreover, as previously explained, a good definition of A.I. is broad enough to encompass future developments in the field, and consequently, necessary for a regulation not to lag behind new technological advancements.

Accordingly, this technology has to be specifically regulated.

3.1.5. Impacts of a Regulation on A.I.

Another big concern is related to the adverse effects a possible regulation might have on the development and deployment of artificial intelligence. Arguably, regulation would increase the costs and the bureaucracy during the development and deployment of artificial systems. Furthermore, as explained before, some argue that the impacts of A.I. are not entirely understood, and a regulation at this moment would be imprecise, possibly hindering the development of this technology. Thus, some authors claim that a regulation at this point has the potential to disrupt the existing scientific research and the market around artificial intelligence, with possibly catastrophic results. This rupture can hinder advancements in the area, slow down or even prevent the availability of solutions that use A.I., augment bureaucracy, hamper the existing competitiveness and cause a series of economic disarrangements in the sector.[118]

Likewise, some authors argue that the use of prohibitions and other "tougher" regulations may deviate the development of A.I. from legitimate actors to illegitimate and shadowy ones, creating a black market, where the dangers imposed by this technology increase at all instances.[119]

In the same line, a poorly designed regulation might, on top of all collateral effects here described, create a bad public image to the sector, also pushing legitimate actors away from this promising technology.[120]

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[117] Chris Reed, 'Taking Sides on Technology Neutrality' [2007] Script-ed 263; Chris Reed, 'The Law of Unintended Consequences – Embedded Business Models in IT Regulation' (2007) (2) Journal of Information Law and Technology <http://www2.warwick.ac.uk/fac/soc/law/elj/jilt/2007_2/reed/reed.pdf> accessed 29 May 2017.

[118] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 10, 48; Ronald Leenes and others, 'Regulatory challenges of robotics: some guidelines for addressing legal and ethical issues' (2017) 9 (1) Law, Innovation and Technology, 7; Andrew Fogg, 'Artificial Intelligence Regulation: Let's not regulate mathematics!' (*import.io*) <https://www.import.io/post/artificial-intelligence-regulation-lets-not-regulate-mathematics/> accessed 15 April 2017.

[119] Jeffrey A. Miron and Jeffrey Zwiebel, 'The Economic Case Against Prohibition' [1995] The Journal of Economic Perspectives 175, 189.

[120] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 48.

In sum, the introduction of control mechanisms to this area can be disastrous for scientists, companies, entrepreneurs, consumers, and for society as a whole.

On the other hand, a well-balanced regulation can be very beneficial. As seen, even the mere adoption of a legal definition of A.I. has the ability to foster innovation and cooperation.

For companies and entrepreneurs, a proper regulation of A.I. could help them improve the professionalisation in the area, with incentives to the qualification of personnel and the creation of better processes. It could help them adapt better to changes in society and advancements in technology. It could facilitate their engagement with stakeholders and make them more transparent. As well as create a culture within companies to treat A.I. as if they held responsibility for it, pushing for greater investment in desirable forms and uses for the technology.[121] This could also lead to a change in their financial situations, shifting capital and investments to responsible innovations within the sector.

To the scientific field, a proper regulation could result in greater investments in research, increased availability of experts, and more interdisciplinary discussion of this field, leading to a higher generation of knowledge and more innovation.[122]

To consumers, the use of a unified definition of artificial intelligence, and the existence of more precise rules concerning artificial intelligence, could make this technology more understandable and accessible. Likewise, the existence of security standards, clear liability rules, greater interdisciplinary discussion, and more cooperative research, can lead to safer and more secure products, to increased quality of services, and more confidence in the technology. This has the potential to make people more acknowledgeable and familiar with this technology, probably boosting the interest for those products, creating more demand, and leveraging the popular support.

To society, it can improve the existing risk assessment and management related to A.I., and avoid unnecessary harm due to technical or philosophical failures.[123] It can, by requiring more transparency, empower the media and civil society groups, which can become

[121] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 48-49.
[122] As shown in chapter 3.1.1., the creation of a unifying definition of artificial intelligence has the potential to foster scientific cooperation and produce more consistent results throughout the field of artificial intelligence. Chapter 4.1.2. also discusses how a good regulation should incentivize greater research on the field, endorse the capacitation of professionals, and promote interdisciplinary discussions.
[123] Eliezer Yudkowsky, 'Artificial Intelligence as a Positive and Negative Factor in Global Risk' in Nick Bostrom and Milan M. Ćirković (ed), *Global Catastrophic Risks* (Oxford University Press 2008), 13-17

more credible sources for the public and in courts.[124] Moreover, it can also improve the economy with greater incentives to high-tech companies. Ultimately, by creating a favorable environment to the healthy growth of A.I., people can maybe deploy this technology to solve problems that have been long afflicting humanity, as well as to avoid new ones.

So, regulators can, by acting correctly, create, and enforce "a virtuous cycle of activity involving internal and external accountability, transparency, and professionalisation"[125] to the benefit of all.

3.1.6. Regulators

A good regulation must be developed by legitimate actors.[126] In the case of artificial intelligence, they must also hold excellent theoretical and practical knowledge on the field. But not always legitimacy is a synonym of expertise, and these two factors are not always balanced.[127] Subsequently, finding the right balance between the two is a delicate task.

This subject will be fully addressed in the fourth chapter, along with a possible solution to this dilemma. Nevertheless, it is necessary to acknowledge, at this moment, that this problem exists, and can cause very adverse consequences if not managed with care.

Namely, if it lacks legitimacy, there is the risk of non-compliance because the regulation might be perceived as illegitimate, resting ineffective.[128] Furthermore, due to lack of representativeness and accountability, the regulation of artificial intelligence by non-democratically legitimate actors may result in bias, as non-legitimate regulators might promote their private agendas, in detriment of society. In these cases, regulation would generate more harm than benefits.

If lacking expertise, the regulators will not be able to address the issues of artificial intelligence with the necessary diligence. Unskilfulness and negligence, resulting from the lack of proper expertise, have the capacity to generate even more harm than it tries to solve, and all the undesirable consequences of a bad regulation can emerge from such regulatory malpractice. Not to mention that non-expert regulators will most likely face difficulties in monitoring.[129]

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[124] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 49.
[125] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016), 49.
[126] Chapter 4.2.2. deals with questions of legitimacy and expertise within the government.
[127] Michael Heazle and John Kane (eds), *Policy Legitimacy, Science and Political Authority: Knowledge and Action in Liberal Democracies* (Routledge 2016) ch 1-2.
[128] Christopher H. Wellman, 'Liberalism, Samaritanism, and Political Legitimacy' [1996] Philosophy and Public Affairs 211, 212; Allen Buchanan, 'Political Legitimacy and Democracy' (2002) 112 Ethics 689, 689-692.
[129] John Danaher, 'Is Anyone Competent to Regulate Artificial Intelligence?' (*Institute for Ethics and Emerging Technologies*, 21 November 2015) <https://ieet.org/index.php/IEET2/more/Danaher20151121> accessed 16 April 2017.

However, as shown in the fourth chapter,[130] there are means of balancing a democratic sense of legitimacy and the expertise from people close to the sector. This can be achieved via a real exchange channel between politicians and scientists; and the creation of different levels of regulation, like a legislation that sets the principles and ground rules, and a technical regulatory body to deal with the more complex and variable nuances.

Therefore, this is an issue, but a minor one, that can be solved with the correct equilibrium between those two requirements.

3.1.7. Compliance and Monitoring

Another issue related to its effectiveness is one of compliance and monitoring.

Matthew U. Scherer summarises very well this issue. He divides these concerns into "ex-ante" and "ex-post", or before and after the development of the artificial intelligence.[131]

These are the ex-ante compliance and monitoring problems, or problems that might occur during the development of A.I., as organised by him:

- **Discreetness:** Developers can operate in a much less visible way, which is highly difficult to monitor. For example, the developing team might be composed of a small group of people, scattered around many jurisdictions, using the Internet and other readily-available tools, driving little to no attention to their operations.
- **Discreteness:** An intelligent agent might be built by simply assembling pre-existing tools. Moreover, these instruments can be made independently, without any cooperation or any previous knowledge of their use in that system.
- **Diffuseness:** A consequence of the previous problems. Projects involving A.I. can be carried by multiple people and organisations, each one operating in a different location, and using different tools.
- **Opacity:** Intelligent agents can be built using various components, many of which might be proprietary, making reverse engineering techniques more complex. Consequently, both regulators and third parties, as scholars and journalists, will face difficulties in analysing such machinery and attesting their safety and compliance with the rules and parameters in place. Moreover, the very autonomous nature of A.I. can pose another barrier to the analysis and

[130] More precisely, chapter 4.1.2.

[131] Matthew U. Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law and Technology 353, 353-373.

understanding of each system, making possible undesirable features hard to detect.

The ex-post problems, or problems that might occur after the release of such technology, are as follow:

- **Liability:** As previously explained,[132] due to the autonomous, evolving, and sometimes unpredictable nature of A.I., tort law will have to treat this technology differently.
- **Control:** Artificial intelligence can be very complex and produce very powerful intelligent agents, which evolve, learning from the environment. It is possible, due to its complexity, power, and adaptability, that the user or operator loses control over it – either because of a lack of expertise or because the system changed itself or spread itself into other machines or software. This has the potential to cause great harm, and even affect power plants or other sensitive services, while being difficult to control or to avoid.

The ex-ante problems are serious, yet similar to the ones faced on the Internet.[133] This is a time where the Internet is spread and widely available, at least across Europe, and where the Internet of things is growing rapidly.[134] And these devices and services pose a significant risk to personal data. Yet, the regulations on privacy and data protection show that, despite these problems and difficulties, regulations can be enforced.[135]

Moreover, the fact that giant corporations, like Google, Amazon, IBM, and Microsoft are leading the advances in artificial intelligence[136] shows that, at least for now, these problems can be minimized, once it is much easier to monitor the actions of a big corporation than to

[132] Chapter 3.1.3.B.

[133] Actions in the internet can be executed by a small group of people, acting independently, from different jurisdictions, without much cooperation, using different tools, and operating in different schemes, making them difficult to notice, or to trace back. The hacktivist 'group' Anonymous utilizes these elements in its favour. See: Leo González Pérez, 'Cómo funciona Anonymous, el grupo hacker que amenaza con atacar Facebook' *Clarín* (Buenos Aires, 30 October 2011) <https://www.clarin.com/mundo_web/funciona-Anonymous-amenaza-atacar-Facebook_0_BJZIvBihvmg.html> accessed 12 June 2017.

[134] Eurostat, 'Internet access and use statistics – households and individuals' (Eurostat – Statistics Explained, 30 January 2017) <http://ec.europa.eu/eurostat/statistics-explained/index.php/Internet_access_and_use_statistics_-_households_and_individuals> accessed 23 April 2017.

[135] Examples: (1) The mere existence of a data protection regulation has already shown signs of potential to stir companies' actions. (2) Successful cases have been brought to Justice against breaches in data protection legislation. See, respectively: Christopher Kuner, *European Data Protection Law* (Internet Update 1.0, Oxford University Press 2007) 3 <http://global.oup.com/booksites/content/9780199283859/updates/> accessed 12 June 2017; Case C-362/14 *Maximillian Schrems v Data Protection Commissioner* [2015] ECLI:EU:C:2015:650.

[136] John Danaher, 'Is effective regulation of AI possible? Eight potential regulatory problems' (*Philosophical Disquisitions*, 7 July 2015) <http://philosophicaldisquisitions.blogspot.nl/2015/07/is-effective-regulation-of-ai-possible.html> accessed 15 April 2017.

examine lots of spread small companies or simple groups of unorganized people spread throughout the continent. Yet, the situation could shift, and a proper regulation must take this into consideration.

The liability issue, in turn, shows the need for regulation, as the current legislation is not prepared to deal with all the novelties brought by artificial intelligence. In this line, clear rules should be made to clarify who is liable for an accident caused by a self-driving car that made a wrong decision, for example.

The control issue is another example of a problem that shows how dangerous it is to not set ground rules for the development of A.I. A proper regulation will have to deal with this. This way, this problem might be solved even before the product is released, avoiding this ex-post issue. As explained in the fourth chapter, there are methods to insert safeguards to avoid programmers and users from losing control over it, and guarantee that humans can always intervene and override any decision made by A.I.

3.2. Whether to Regulate A.I.

To regulate or not to regulate A.I.? That is the question.[137]

This thesis argues that regulatory intervention is inevitable. Politicians from different jurisdictions, like the United Kingdom,[138] United States of America[139] and the European Union,[140] for example, have already begun discussing the issue, and seem to be favourable to an intervention. Likewise, there seems to be public support for such regulation. In the biggest and most comprehensive poll made about artificial intelligence to the present date, Morning Consult found that, among the 2200 North-American adults interviewed, the clear majority support the regulation of A.I., either nationally (71%) or internationally (67%). Moreover, this support remains stable throughout all ethnical, geographical, political, and religious groups considered in the survey.[141] As seen in a recent open letter on artificial intelligence, thoughts

[137] Phrase taken from the title of this article: Kate Brogan, 'To Regulate or not to Regulate? That is the AI Question' (*Compelo*, 14 February 2017) <http://www.compelo.com/ai-regulation/> accessed 22 April 2017.
[138] Abel Castilla and Jeremy Elman, 'Artificial intelligence and the law' (*TechCrunch*, 28 January 2017) <https://techcrunch.com/2017/01/28/artificial-intelligence-and-the-law/> accessed 21 April 2017.
[139] Committee on Technology, 'Preparing for the Future of Artificial Intelligence' (National Science and Technology Council – Executive Office of the President of the United States of America, 12 October 2016), 30-34.
[140] European Parliament Committee on Legal Affairs, *Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))* (A8-0005/2017, 2017); Sam Shead, 'European politicians have voted to rein in the robots' (*Business Insider Nederland*, 16 February 2017) <https://www.businessinsider.nl/european-meps-to-vote-on-robots-ai-2017-2/?international=true&r=US> accessed 15 April 2017.
[141] Morning Consult, 'National Tracking Poll #170401 – March 30 – April 01, 2017' <https://morningconsult.com/wp-content/uploads/2017/04/170401_crosstabs_Brands_v3_AG.pdf> accessed 17 April 2017.

about controlling this technology are also shared amongst experts and people professionally involved in the field.[142] This inevitability can also be seen in a newly formed Partnership on A.I., where the leading companies in the sector gathered themselves to self-regulate the field within the private sector.[143]

Despite still having some time until regulations start to come up, an accident involving artificial intelligence or an impactful book or another form of media about the theme have the potential the accelerate the process.[144]

Also, after analysing the problems and difficulties of regulating artificial intelligence, and comparing the arguments both in favour and against it, the conclusion is that it is possible not only to regulate, but to do so in a satisfactory way. Nevertheless, "being possible" or inevitable is not a sufficient answer to the question that was put forward in this thesis.

It is necessary to consider if there is reason enough to regulate and if a good regulation is possible, with all its requirements.

3.2.1. Reasons to Regulate

From the moment this new technology starts to challenge the existing legislation and to raise questions our laws seem to be unable to answer,[145] we need to, at least, adapt the existing norms to absorb the changes.

However, as seen, these questions permeate various branches of law, from tort law to jus in bello and jus ad bellum, passing by intellectual property rights and consumer law. And the challenges it imposes are unlike any other before it. For the first time, we will have to deal with creations capable of learning on their own, of deceiving and overcoming the capabilities

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[142] Future of Life Institute, 'An Open Letter: Research Priorities for Robust and Beneficial Artificial Intelligence' (*Future of Life Institute*) <https://futureoflife.org/ai-open-letter/> accessed 22 April 2017; Stuart Russell, Daniel Dewey and Max Tegmark, 'Research Priorities for Robust and Beneficial Artificial Intelligence' (2015) 36 (4) The Journal of Record for the AI Community 105.

[143] The Partnership is formed by: The Association for the Advancement of Artificial Intelligence (AAAI), the American Civil Liberties Union (ACLU), Amazon, Apple, Deep Mind, Facebook, Google, IBM, Microsoft, and Open AI. More information about this partnership can be found at their website: <https://www.partnershiponai.org/#>.

[144] Matthew U. Scherer, 'Poll shows overwhelming support for national and international regulation of AI' (*Law and AI*, 12 April 2017) <http://www.lawandai.com/2017/04/12/poll-shows-overwhelming-support-for-national-and-international-regulation-of-ai/#more-827> accessed 17 April 2017.

[145] Some examples were given in the introductory chapter. For more examples of legal challenges introduced by artificial intelligence, see: AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016),44-48; Markus Häuser, 'Do robots have rights? The European Parliament addresses artificial intelligence and robotics' (*CSM Law-Now*, 6 April 2017) <http://www.cms-lawnow.com/ealerts/2017/04/do-robots-have-rights-the-european-parliament-addresses-artificial-intelligence-and-robotics?sc_lang=de> accessed 14 May 2017; Jean-Sébastien Desroches and Shan Jiang, 'Artificial intelligence and its legal challenges' (*Lexology*, 1 May 2017) <http://www.lexology.com/library/detail.aspx?g=c4a60414-b563-477d-898b-48fd2f55d1fa> accessed 14 May 2017.

of their creators, of developing traits and capacities without further intervention, and of acting with autonomy.

For law not to lag behind this new technological breakthrough, it is necessary to create specific rules that suit these novel characteristics of A.I.

This legal necessity to regulate is driven by the lack of proper solutions given by current regulations. However, it cannot occur without care. As seen, regulating this field carries many risks, so it is prudent to work with caution. This might be yet another reason to start a regulatory movement now.

As stated, regulations already seem to be inevitable, but some happenings may rush the call for action. Therefore, it is wise to start conversations as soon as possible, so to avoid possible hurried measures, which might be detrimental. This is probably the weakest motivation to be presented here – to regulate now, with proper time, to avoid future bad regulations. In layman terms, it is like reasoning to do something because it will probably be done anyways, so it better be done right. Despite weak, this argument helps strengthen the other motives, which are more robust.

Beyond the legal necessity and the call for prudence, the protection of socially relevant values is also a compelling reason to regulate. In this line, a regulation can foster the creation of better training datasets, create standards, and ensure all steps were taken to the development of a more robust system. This serves to avoid cases of racism, sexism, and other forms of discrimination involving A.I., which have already occurred, more than once.[146] It could also protect values as equality, transparency, justice, fairness, privacy, and accountability.

There is also the fact that the private sector is already taking steps to regulate itself.[147] The drawbacks of this movement are that the private sector acts with no transparency, no accountability, no socio-political legitimacy before society, and may even lack long-term planning, especially when dealing with the sharing of opportunities and benefits of this new

[146] Sarah Perez, 'Microsoft silences its new A.I. bot Tay, after Twitter users teach it racism [Updated]' (*Tech Crunch*, 24 March 2016) <https://techcrunch.com/2016/03/24/microsoft-silences-its-new-a-i-bot-tay-after-twitter-users-teach-it-racism/> accessed 23 April 2017; Jordan Pearson, 'It's Too Late – We've Already Taught AI to Be Racist and Sexist' (*Motherboard*, 25 May 2016) <https://motherboard.vice.com/en_us/article/weve-already-taught-artificial-intelligence-to-be-racist-sexist> accessed 23 April 2017; Sam Levin, 'A beauty contest was judged by AI and the robots didn't like dark skin' *The Guardian* (London, 8 September 2016) <https://www.theguardian.com/technology/2016/sep/08/artificial-intelligence-beauty-contest-doesnt-like-black-people> accessed 23 April 2017.

[147] Jessica Conditt, 'Tech's biggest names are working to regulate AI research' (*Engadget*, 9 January 2016) <https://www.engadget.com/2016/09/01/facebook-google-microsoft-amazon-ibm-ai-panel/> accessed 27 April 2017.

technology.[148] Not to mention the real possibility of enterprises putting their interests in front of society's. This is not something desirable when dealing with such powerful tool, capable of so many marvels, and so much harm. So, a public intervention could serve as a means to balance this, weighing both public and private interests, and paving the path to the healthy development of A.I.

On top of all that, regulation, as previously discussed, can also be beneficial to A.I., promoting a better understanding and confidence among the population, promote bigger investments and research cooperation, promote fair competition, amongst other assets.

In conclusion to this topic, A.I. has good motivations to be regulated: the unfitness of the current rules, a pragmatic sense of prudence, the protection of social values, the balance of interests, or the amelioration of the development of A.I. and the market around it. One could base a regulation in any of those reasons, but to better grasp the whole situation and to better prepare the basis of such rules, a regulation should consider all these motives at the same time.

4. A GOOD A.I. REGULATION

If a regulation has a reason to exist, the next step is to check if a good regulation is possible, before tracing any further plan. Considering the premise that fundaments this research, this chapter will analyse the steps necessary for an intervention on A.I. to be successful, and whether it is possible to achieve such accomplishment.

4.1. Is a Good Regulation Possible?

As seen in the second chapter, there are some requisites for a regulation to be successful. This section will analyse those conditions and evaluate whether a good regulation on artificial intelligence is possible.

- **Necessity:** as expressed in section 3.2.1., there are compelling enough reasons to the existence of a regulation;
- **Legitimacy:** there is the possibility to balance democratic legitimacy and scientific expertise;
- **Targeting:** regulation, with the use of a good definition of A.I. and the available scientific knowledge, can focus on the issue at stake and avoid hitting other targets;

[148] Corinne Cath and others, 'Artificial Intelligence and the "Good Society": the US, EU and UK approach' [2017] Science and Engineering Ethics, 3-4 <https://link.springer.com/article/10.1007/s11948-017-9901-7> accessed 26 April 2017.

- **Proportionality:** the regulation can balance the protection of social values and the dynamicity of the private sector, while being able to have rules and allocate resources in a way that is proportional to the ends it wants to achieve;
- **Legal Stability:** Relying on a strong foundation, a good definition of A.I., and a definite set of rules and standards, can make the regulation certain, have predictable legal obligations, and promote legal certainty;
- **Flexibility:** The use of a strong foundation and flexible rules, sensitive to the advancements in the field, can make the regulation remain relevant and effective face to the ever-changing circumstances;
- **Transparency and accountability:** it is possible, during the development of regulation, to justify the decisions made, and make them available to the public. Such information, and the process as a whole, can be fair, accessible, inclusive, clear, simple, and user-friendly, allowing public scrutiny. Whenever possible, all the stakeholders can be notified and consulted previously. Those being regulated can have a reasonable time to comply with the rules;
- **Effectiveness:** it is possible to make it effective. The regulation can constantly be evaluated to ensure it is beneficial and is achieving its goal.
- **Efficiency:** this is probably the most difficult to assess beforehand, without real numbers and an extensive list of resources. If the regulation manages to fulfil all the reasons stated in sub-topics 3.1.3. and 3.2.1., or, if it can, at the same time, protect the social values at stake, promote a greater understanding on the topic, avoid the possible risks brought by this new technology, incentivize the private sector, and foster increased investment and cooperation in the scientific field, the regulation will bring enormous benefits to all stakeholders. Diminishing the burdens of compliance and monitoring by sharing the responsibilities between the public and private sectors is a good way to lessen the costs and avoid unnecessary bureaucracy, without compromising the goals. This way, it is possible to say that, despite being a difficult and very complex topic, it is possible for a regulation to be efficient.

Only a long and complex discussion, with extensive research, can answer if all of these elements can be entirely fulfilled in real life, or if the compliance with one requisite happens in detriment of other.

Still, after the analysis made, it is easy to say that regulation is possible, and probably inevitable. Not only that, it is the right thing to do and can result in a successful endeavour, bringing good results to all involved.

Knowing a good regulation is possible brings us to the next question. What are the steps necessary to make it possible? What path should be taken to successfully regulate artificial intelligence? This is what the next sub-chapters aim to answer.

However, due to the length of such discussion, they will stick to the general ideas around it, and debate about the necessary basis for a regulation to succeed in the sector.

4.2. The Basis for a Good Regulation on A.I.

As demonstrated in the third chapter, regulation is essential to the healthy development of A.I., and, for various reasons already mentioned, it is advisable to the state to take part in this process and use its power and political legitimacy to help lay down the basis for a good A.I.-driven society, e.g. to mitigate or avoid the shortcomings of the private sector self-regulation.

The state can act in various ways.[149] In fact, a good regulation should contain both hard and soft law[150] and have a right mix of horizontal and vertical approaches.[151] As reports on the subject have concluded, any action should be followed by investments and incentives in education, training of the workforce, promotion of human rights, inclusivity of marginalised portions of society, and further scientific study to best understand the technology and its impacts.[152] Many different approaches can be used concurrently.

However, it is beyond the scope of this work to treat all those aspects and scrutinise all those points. As exposed in the second chapter, this thesis will focus on top-down regulation, or the issuing of rules by the government, in a more vertical level. Even then, as cleared the introduction of this chapter, this thesis will only focus on the basis for the construction of such regulation.

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[149] Robert Baldwin, Martin Cave and Martin Lodge, *Understanding Regulation: Theory, Strategy, and Practice* (2nd edn, Oxford University Press 2012) 103-311.

[150] Ugo Pagallo, 'Three Lessons Learned for Intelligent Transport Systems that Abide by the Law' (*Jusleter IT*, 24 November 2016) <http://jusletter-it.weblaw.ch/issues/2016/24-November-2016/three-lessons-learne_9251e5d324.htmlprint> accessed 28 April 2017.

[151] This sentence mentioned some expressions, such as 'hard law', that need some clarifying. (1) 'Hard law', in short, means a legally binding rule; while 'soft law' comprises the rules that, despite not being legally enforceable, have legal and social significance. (2) A vertical regulatory approach happens when a person or entity, in the case, the government, intervenes by issuing rules and standards, that shall be enforced upon other actors; while in a horizontal approach, the actors involved (may also include the government) jointly coordinate their efforts to regulate a certain field through cooperation. See, respectively: Liziane P. S. Oliveira and Márcia Rodrigues Bertoldi, 'A Importância do Soft Law na Evolução do Direito Internacional' [2012] RIDB 6265, 6268-6278; Blake Hudson and Jonathan D. Rosenbloom, 'Uncommon Approaches to Commons Problems: Nested Governance Commons and Climate Change' [2013] Hastings Law Journal 1273, 1316-1316.

[152] Corinne Cath and others, 'Artificial Intelligence and the "Good Society": the US, EU and UK approach' [2017] Science and Engineering Ethics <https://link.springer.com/article/10.1007/s11948-017-9901-7> accessed 26 April 2017.

4.2.1. A General Regulation

One of the unknowns in the area is whether artificial intelligence should have one omnibus general regulation to deal with all its forms or if it should be sector-specific. In the first, regulation would centralise the rules about artificial intelligence, like development and liability; while, in the second, each sector would enact its rules, and regulate artificial intelligence based on its particularities. To answer that, it is necessary to understand the complex nature of A.I.

Artificial intelligence is a very complex subject, involving fields like mathematics, computer science, data analytics, information technology, and others. That is only on the technical side of it. Also, when embedded into real-life applications, the same algorithm can be used in a vast number of fields, like civil aviation, drones, self-driving cars, and targeted missiles. The same algorithm, as well, can be used in entirely different areas, like medicine, and Jeopardy.[153] In sum, it involves many fields of expertise, from social[154] to natural sciences, and has many and very diverse applications. Nevertheless, the algorithmic nature of an intelligent agent remains the same.

Because of the algorithmic nature of artificial intelligence, it is hard to rely solely on a sector by sector approach, because an algorithm can transcend the technology it is embedded in, and have various uses in different fields. Moreover, a shared algorithmic nature makes it better for a regulation that targets its essence. Therefore, a general and centralised regulation on artificial intelligence is a wiser choice in this situation.

Also, having a different regulation on artificial intelligence across all the many sectors affected by it would probably result in great inconsistencies, with many different, and sometimes contradictory rules, creating an enormous administrative burden, and a great loss of time and money.[155] Not to mention that each category may apply their own agenda and narrow vision, without an analysis of the big picture. Furthermore, the lack of communication between sectors may result in different solutions to the same problem; or worse, one sector may struggle

[153] Lauren F. Friedman, 'IBM's Watson Supercomputer May Soon Be The Best Doctor In The World' (*Business Insider*, 22 April 2014) <http://www.businessinsider.com/ibms-watson-may-soon-be-the-best-doctor-in-the-world-2014-4?international=true&r=US&IR=T> accessed 29 April 2017.

[154] For instance, linguistic is used in the creation of natural language interfaces; and criminology is used in the development of intelligent crime prevention tools. See: Richard S. Rosenberg, 'Artificial Intelligence and Linguistics: A Brief History of a One-Way Relationship' [1975] Proceedings of the First Annual Meeting of the Berkeley Linguistics Society 379; Tim Hornyak, 'Precrime: Artificial intelligence system can predict data theft by scanning email' (*PC World*, 2 October 2014) <http://www.pcworld.com/article/2691132/artificial-intelligence-system-can-predict-data-theft-by-scanning-email.html> accessed 12 June 2017.

[155] Commission, 'Impact Assessment' SEC(2012) 72 final + SEC(2012) 73 final, 19-20.

with an issue that has already been solved by the others. This is particularly troublesome when applied to ambivalent codes, that may be employed in different situations, which is the norm.[156]

Therefore, a single regulation would be the best decision, at least to issues regarding the development, training, and deployment of intelligent systems.[157] Liability issues can also be centralised, as the nature of artificial intelligence is vital.[158] In the case of specific algorithms, developed exclusively to be used in specific cases, a sector specific regulation may be applied, complementary to the central rulings, so 'the full spectrum of unique challenges that A.I. brings to society are addressed'.[159]

This thesis acknowledges that the use of artificial intelligence, when regulated, can be better addressed by each sector. After all, different concerns emerge from the use of intelligent systems in different sectors, like transportation and warfare. The same applies to the availability of specialised datasets to train intelligent systems to be used in specific sectors, like the data used to train autonomous cars.

In the case of shared regulatory jurisdiction over a certain aspect or use of artificial intelligence, the regulatory agencies could work together to find an inclusive and harmonised solution to be applied in those cases.

This centralization should also be geographic. The complexity, opacity and dangerousness of this technology require joint effort to be dealt with. Furthermore, the volatile and versatile nature of artificial intelligence requires unified rules and excellent cooperation, because, as said, artificial intelligence is created and used without much respect to national borders. [160] Particularly in Europe, with the free movement of goods, services, and workers, A.I.'s mobility becomes even greater. So, a harmonised regulation across all the European Union[161] is the best way to do it. This geographical centralization avoids the creation of different and, possibly, incompatible legislations across the member-states. Therefore, it can

[156] Andrew Tutt, 'An FDA for Algorithms' (2017) 69 Administrative Law Review, 21.
[157] This way, it is possible to implement 'kill switches' in case the system goes out of control; or to ensure that every system can be overridden by authorised human intervention; or to implement codes to impede a system from causing harm. These examples illustrate well how a general regulation would work.
[158] See chapter 3.1.3.B.
[159] Corinne Cath and others, 'Artificial Intelligence and the "Good Society": the US, EU and UK approach' [2017] Science and Engineering Ethics, 9 <https://link.springer.com/article/10.1007/s11948-017-9901-7> accessed 26 April 2017.
[160] Andrew Tutt, 'An FDA for Algorithms' (2017) 69 Administrative Law Review, 20-22.
[161] The European Parliament has already requested the Commission to submit a proposal for a Directive on robotics and artificial intelligence. It is beyond the scope of this thesis to discuss the details and intricacies of such legislation. For more, see: European Parliament Committee on Legal Affairs, *Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))* (A8-0005/2017, 2017) 19; Consolidated Version of the Treaty on the Functioning of the European Union [2012] OJ C326/01, arts 26, 114, 225.

even foster the commerce and growth of artificial intelligence within Europe, for companies and scientists do not need to comply with an array of different national rules, but only one.

4.2.2. Legitimacy and Expertise

Knowing that a harmonised central regulation is the best choice available is a good beginning. Yet, another question arises from that, which is: who should be making such regulation? As discussed before, finding the right balance between democratic legitimacy and scientific expertise is key to a successful endeavour in the area.

Historically, parliaments are held as the most democratically legitimate institute within society. In Europe, at least, MPs are democratically elected, are legally accountable for their acts, and have to comply with the transparency rules currently in place. Furthermore, due to their political nature, theoretically, they should report directly to the population, their voters. Some might argue it is not enough, but this institution was created to be both democratic, and legitimate, both legally and socially.

However, the parliament is a political body, and not technocratic; therefore, expertise is not a requisite to be elected. Moreover, since its members must deal with society in general, and its diverse issues, they are not selected to tackle one single subject. Hence, the body is usually composed of people from a diverse array of fields, with different levels of expertise. For being general, it lacks technical focus and does not have the necessary specialisation in many fields. Amongst these areas, lies artificial intelligence.[162]

Artificial intelligence is a sector that requires significant expertise, and even the experts in one field cannot fully handle it. It is an area that requires many specialists, from many different disciplines. Another factor that adds complexity to the field of artificial intelligence is that software, hardware, and data must all be equally comprehended and analysed, for they form a bigger and unified ecosystem, in which one is dependent on the other to function.[163] This must be seriously considered in a proper regulation. However, regulatory agencies, a governmental body[164] that usually hold a good level of expertise, do not always enjoy the same degree of democratic legitimacy as the parliament.[165]

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[162] Matthew U. Scherer, 'Regulating Artificial Intelligence Systems: Risks, Challenges, Competencies, and Strategies' (2016) 29 Harvard Journal of Law and Technology 353, 376-380.

[163] Luciano Floridi and Mariarosaria Taddeo, 'What is data ethics?' (2016) 374 (2083) Philosophical Transactions of the Royal Society A.

[164] Chapter 3.2.1. brings some arguments against the legitimacy of private institutions, such as technology companies.

[165] For being a governmental body, they are legally legitimate. However, due to their lack of representativeness, and sometimes, lack of accountability, part of the population may not perceive them as being as 'socially' legitimate as the parliament, which is elected by people. See: Martino Maggetti, 'Legitimacy and Accountability of Independent Regulatory Agencies: A Critical Review' [2010] Living Reviews in Democracy.

Therefore, a good regulation could be made in levels, with the involvement of the parliament and the group of experts, acting complementarily. The parliament, representing society, would be responsible for drafting a piece of legislation, with the definition of artificial intelligence, the principles, like justice and accountability, and some general rules. This same legislation would be responsible for creating a new regulatory agency. This agency, composed of experts, would deal with the more intricate aspects of regulation, creating more precise rules, interpreting the law, setting standards, addressing the liability issue, helping with compliance and monitoring.

This agency should be formed by many experts, specialised in the many sciences related to artificial intelligence – from social and human sciences, such as law and sociology, to formal sciences, such as mathematics and computer sciences – in an interdisciplinary and cooperative environment, so that problems can be solved in the most comprehensive manner.

This dynamic between legislation and regulatory body has other benefits aside from balancing legitimacy and expertise. Legislations tend to be more static, with slow and somewhat difficult changes, while agencies are more dynamic and can answer immediately to the evolution in the real world, and even anticipate changes. This anticipatory action is easier to an agency, as it remains permanently in contact with the regulated field, monitoring the emerging trends.[166] This way, the core principles brought by law get more power and significance, resulting in legal security and stability. On the other side, a fast and responsive agency can stir the rules according to the factual changes, maintaining them always effective and relevant. A strong core and a malleable body is a very welcoming combination in the formation of a good regulation on artificial intelligence.

4.2.3. Government Control with Self-Regulation

As is the case with the Internet and the use of personal data, the individual control of every kind of artificial intelligence is not possible. Factors like discreteness, discreetness, diffuseness, and opacity are some of the reasons for such impossibility.

To solve this problem, this thesis suggests regulators consider the same approach used to deal with personal data.[167] This system tries to solve the issues of compliance and monitoring by decentralising it, sharing responsibilities between the private and public sectors.

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[166] Shrupti Shah, Rachel Brody and Nick Olson, 'The regulator of tomorrow' (*Deloitte University Press*, 11 June 2015) <https://dupress.deloitte.com/dup-us-en/industry/public-sector/us-regulatory-agencies-and-technology.html> accessed 13 June 2017.

[167] Regulation 2016/679 of 27 April 2016 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) [2016] OJ L119/1.

In this sense, institutions that research, develop, or deploy solutions using artificial intelligence, may it be on the hardware, software, or data sectors, must have a skilled independent officer working within the institution, to ascertain the compliance with the norms, and to monitor them. These officers would have to respond to the regulatory agency, sending reports about the technologies whenever there is a significant change, so that the agency can be aware of any complex, insecure, dangerous, or troublesome intelligent system being developed or used.

This approach allows the regulatory agency to be aware of the technologies being used, without the need to individually check all of them. This can offer a significant boost regarding efficiency and efficacy, two much important factors in the design of sound regulatory systems.

Moreover, diminishing the burdens of compliance and monitoring by sharing the responsibilities between the public and private sectors is a good way to lessen the costs and avoid unnecessary bureaucracy, without compromising the goals.

4.3. Legislation and Regulatory Agency

The most basic pillars of a possible regulation have been discussed in the first half of this chapter. According to what was argued, a good regulation is centralised, both geographically and sectorial; shares responsibilities between the private and public sectors; has a piece of legislation with the most basic and general rules, and a regulatory agency to issue the most specific ones, as well as monitor them.

Some of these pillars need to be further discussed, namely the legislation and the regulatory agency. This further analysis will occur now, in the second half of this chapter.

4.3.1. The Regulatory Agency

A regulatory agency is key to a good regulation because it lets experts in the various fields related to artificial intelligence deal with the intricacies of such complex technology in a fast and responsive way. For its importance, it needs to be further examined.

In fact, Andrew Tutt already did an excellent job dissecting the role of agencies in the regulation of artificial intelligence. [168] According to him, a regulatory agency must accumulate unique tasks, serving as a standards-setting body, a soft-touch regulator, and a hard-edged regulator. [169] This thesis also adds other functions to it.

[168] For a longer and more detailed analysis of this topic, check his article: Andrew Tutt, 'An FDA for Algorithms' (2017) 69 Administrative Law Review.
[169] Andrew Tutt, 'An FDA for Algorithms' (2017) 69 Administrative Law Review, 15-17.

Moving to the ideas proposed, the agency can, when setting standards, also help the private sector to design and test algorithms to guarantee their compliance with said minimum levels of efficiency, including factors such as security, safety, predictability, and understandability in its analysis. It can also issue guidelines, recommendations, and best practices.

For instance, the agency can, when possible, classify algorithms according to their use, complexity, or danger, so to apply different levels of exigency, and perform various types of control. This same classification can be used to create varying levels of liability. This can be useful to differentiate artificial intelligence created for games, which apparently do not pose any threat, from the technology used to drive cars and pilot aeroplanes, which can be fatal.

This differentiation can also be used to distinguish technologies, as a company that develops the base algorithms should fulfil certain requirements, while companies specialised in developing training data must have other preoccupations.[170]

As a soft touch regulator, the agency can require transparency, openness, and disclosure from institutions. The agency itself can provide certifications and audits, or it can require external mechanisms, always ensuring the protection of the institutions' trade secrets.[171]

It can, in a harder approach to regulation, impose sanctions, or restrictions, like in the use of artificial intelligence for activities that cause physical harm to people, as in armaments. It could also require previous approval to enter the market to some forms of artificial intelligence, like the ones used in self-driving cars, for example. This cannot be the rule, for now, and must be applied to specific sectors, not to steer innovation away.[172]

Another work that can be done by the agency is to perform studies and convoke all the stakeholders to discussions, from industries to consumer protection associations, to maintain its rules always relevant, adjusted to the current problems and prepared to face the next upcoming issues.[173] These studies and multi-stakeholder discussions can also serve as a means for society to acknowledge the situation, get to know different perspectives, and prepare itself for the future. Not to mention that the agency, in conjunction with the industry and the

[170] Andrew Tutt, 'An FDA for Algorithms' (2017) 69 Administrative Law Review, 15-17.
[171] Sandra Wachter, Brent Mittelstadt and Luciano Floridi, 'Why a right to explanation of automated decision-making does not exist in the General Data Protection Regulation' (*The Alan Turing Institute*, 28 December 2016) 43-44 <https://www.turing.ac.uk/publications/right-explanation-automated-decision-making-not-exist-general-data-protection-regulation/> accessed 28 April 2017.
[172] Andrew Tutt, 'An FDA for Algorithms' (2017) 69 Administrative Law Review, 19.
[173] Corinne Cath and others, 'Artificial Intelligence and the "Good Society": the US, EU and UK approach' [2017] Science and Engineering Ethics, 21-22 <https://link.springer.com/article/10.1007/s11948-017-9901-7> accessed 26 April 2017.

academy, can help steer the technology itself, in a way to maximise the benefits it can generate. Who knows, it might even help change society, to better use technology.

It is also good to remember the power and influence it will have on the A.I. officers that will work within the institutions.

4.3.2. Principles and Rules

Aside from the regulatory agency, this thesis will, in this last part, highlight some principles and rules that can appear in a possible regulation. As discussed before, the regulation would be primarily made by legislators. The law would bring the principles and the basic rules to regulate artificial intelligence across all sectors. The agency would, then, work on more precise rules to complement such legislation.

It is important to emphasise the limitations of this section. The primary focus of this chapter is to discuss the possibility of a 'good' regulation, and how to achieve such goal. This sub-chapter will not, therefore, delve into details about the content of such regulation. Moreover, this thesis deals with artificial intelligence in general, instead of focusing on a single issue; therefore, it is impossible to say much about the content of a regulation without much details about each particular issue. Thus, this section is bound to be superficial, and will serve only to illustrate the points made to this point.

As said, the regulation of artificial intelligence can help consumers build trust towards this new technology, which is vital to a healthy growth in the sector. Such trust also has the capacity to nourish the use of this technology for the construction of a better society. To build such confidence, however, we must ensure that A.I. systems are minimally safe, to avoid their exploitation; respect socially relevant values; are ethically deployed; are accountable and transparent; protect privacy and personal data; and respect the existing laws and norms.[174]

To achieve the results above, policymaking must primarily focus on getting to know artificial intelligence and prepare society for it. Periodic discussions, constant evaluations, public hearings, and steady scientific studies must be assured. Modifications must be made in the educational sector to prepare future generations to have a better understanding of such technology, and to use it responsibly. New capacitation programs must be created to the existing working force, so the current generation does not suffer from the transition. Social and

[174] Jill Priluck, 'When Bots Collude' *The New Yorker* (New York, 25 April 2015) <http://www.newyorker.com/business/currency/when-bots-collude> accessed 15 April 2017; International Business Machines Corporation, 'Preparing for the future of artificial intelligence: IBM response to the White House Office of Science and Technology Policy's Request for Information (Summer 2016)' <https://www.research.ibm.com/cognitive-computing/cognitive-horizons-network/downloads/IBM_Research_CSOC_OSTP_Response%20v2.pdf> accessed 15 April 2017.

economic policies must be discussed to ensure society is prepared to the implementation of A.I. Partnerships with universities must be created to the inclusion of interdisciplinary courses in their institutions, creating academics prepared to discuss and study artificial intelligence and its effects. Grants and scholarships can be set up to foster research in the field. All this can be inserted, in one way or another, into the regulation. Not only obligations and prohibitions must exist, but a whole range of norms and policies must coexist to create a fertile environment for the proper development of A.I. so that society can benefit from the fruits of this technological advancement.

Then, any regulation must handle the responsibility and liability issues. Multi-stakeholder reunions, audiences and discussions must occur, so that a complete analysis can be carried and a right balance between consumer protection and industrial profitability can be reached.

The next step is to make sure artificial intelligence respect socially relevant values. This can be done by the inclusion of principles, that will serve as a north to any rule, and will shape the regulation as a whole.

In this sense, both the American and European governments have already made reports, highlighting the principles that should guide any regulation on A.I. The Americans were briefer on this matter, saying artificial intelligence should be developed respecting principles such as non-discrimination, justice, fairness, transparency, and accountability.[175]

The European Parliament, in its turn, took this matter seriously and released a lengthier list of principles. Just to illustrate this fact, their report says a regulation on artificial intelligence would have to respect 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[176]

[175] Committee on Technology, 'Preparing for the Future of Artificial Intelligence' (National Science and Technology Council – Executive Office of the President of the United States of America, 12 October 2016) 30-34 <https://obamawhitehouse.archives.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf> accessed 15 April 2017.

[176] European Parliament Committee on Legal Affairs, *Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))* (A8-0005/2017, 2017) 10.

It seems evident that each culture values different conducts. In the European reality, A.I. should be used to further all the advancements the community have had so far regarding human rights, and private and social rights and guarantees. It shall be used to the betterment of people's lives and the wellbeing of society in general. In this sense, this thesis agrees with the report made by the Committee on Legal Affairs of the European Parliament.

One should not, however, squish this technology, so that its development becomes a burden. One must always remember that, by maintaining a favourable environment to the economic development of artificial intelligence, one would also be incentivizing the further advancement and development of such technology, bringing yet more benefits to society.

Artificial intelligence should be used to pursue the common good and the promotion of human dignity,[177] but for that to be successful, it is also necessary to create a favourable environment for businesses, for they are greatly responsible for the development of this technology.

Another thing to have in mind when discussing the principles that shall govern artificial intelligence is that the data used to feed the algorithms is of great importance for self-learning tools. Therefore, such databases should also be just, complete, unbiased and of high quality, to avoid discrimination and promote inclusiveness, as well as to avoid accidents and errors.[178]

This learning nature of artificial intelligence may justify the addition of some safeguards within the codes. For example, artificial intelligence should have guarantees that some basic 'learning' guidelines will be followed, so, for instance, a highly developed self-driving car does not "learn" to overspeed by analysing other cars doing it, or an intelligent chat system does not 'learn' to spread racist messages. The inclusion of such guidelines may even help the distribution of responsibilities in case something wrong happens.[179]

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[177] Corinne Cath and others, 'Artificial Intelligence and the "Good Society": the US, EU and UK approach' [2017] Science and Engineering Ethics, 20-21 <https://link.springer.com/article/10.1007/s11948-017-9901-7> accessed 26 April 2017.

[178] Kate Crawford, 'Artificial Intelligence's White Guy Problem' *The New York Times* (New York, 25 June 2016) <https://www.nytimes.com/2016/06/26/opinion/sunday/artificial-intelligences-white-guy-problem.html?_r=0> accessed 28 April 2017; Committee on Technology, 'Preparing for the Future of Artificial Intelligence' (National Science and Technology Council – Executive Office of the President of the United States of America, 12 October 2016), 30; Corinne Cath and others, 'Artificial Intelligence and the "Good Society": the US, EU and UK approach' [2017] Science and Engineering Ethics, 8 <https://link.springer.com/article/10.1007/s11948-017-9901-7> accessed 26 April 2017.

[179] Amitai Etzioni and Oren Etzioni, 'Why Regulating AI Is A Mistake' *Forbes* (Jersey City, 9 January 2017) <https://www.forbes.com/sites/ciocentral/2017/01/09/why-regulating-ai-is-a-mistake/#19faf9c82be3> accessed 15 April 2017.

Another good safeguard would be the inclusion of "kill buttons" so artificial intelligence can be turned off in case something bad happens. Alternatively, the inclusion of lines of code that allow humans to always override the decisions of an intelligent agent.[180] Along these lines, the company DeepMind has already implemented safeguards into their A.I. systems, ensuring they do not learn to override human control.[181] This example shows that safeguards of the type are a serious matter, but are possible to be dealt with in the development process.

Some claim that artificially intelligent agents should be constructed in such a way to allow reverse engineering, so academics, journalists, and other interested researchers can evaluate such systems and detect possible errors and dangers hidden within it, augmenting the transparency and accountability of such technology.[182] Nonetheless, it is a risky movement, as it can stir companies away, fearing to have their trade secrets revealed.

But not only humans can work to ensure compliance. Artificial intelligence may be used to help humans monitor artificial intelligence.[183] In fact, artificial intelligence can be incorporated by regulatory agencies and help regulate their fields, including the area of artificial intelligence, here in discussion. Techno-regulation might be the future. Any regulation should be prepared to adhere to this new technology.

Regulation on A.I. has to embrace the future, and this also means welcoming the very same technology it intends to regulate. If done correctly, a regulation on A.I. has the potential to help this technology thrive, bringing many benefits to humankind.

This chapter concludes by answering the final sub-questions. Considering the requisites for a 'good' regulation to exist, it is possible for a regulation on artificial intelligence to succeed. Following the arguments present in this chapter, this thesis claims that a centralised general regulation is more appropriate for artificial intelligence, due to its nature. Furthermore, as a result of its complexity, such regulation would be better if a piece of legislation laid the

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[180] Hayley McDowell, 'Artificial Intelligence: Robo Rules & Regulation' (*The Trade*, 11 April 2016) <http://www.thetradenews.com/Technology/Artificial-Intelligence--Robo-Rules---Regulation/> accessed 15 April 2017.

[181] David Suydam, 'Regulating Rapidly Evolving AI Becoming a Necessary Precaution' (The Huffington Post, 27 September 2016) <http://www.huffingtonpost.ca/david-suydam/artificial-intelligence-regulation_b_12217908.html> accessed 16 April 2017.

[182] AnnaLee (Anno) Saxenian and others, 'Artificial Intelligence and Life in 2030' (One Hundred Year Study on Artificial Intelligence [AI100]: 2015-2016 Study Panel, Stanford University 2016) 43.

[183] Hayley McDowell, 'Artificial Intelligence: Robo Rules & Regulation' (*The Trade*, 11 April 2016) <http://www.thetradenews.com/Technology/Artificial-Intelligence--Robo-Rules---Regulation/> accessed 15 April 2017; Martin Arnold, 'Market grows for "regtech", or AI for regulation' *Financial Times* (London, 14 October 2016) <https://www.ft.com/content/fd80ac50-7383-11e6-bf48-b372cdb1043a> accessed 15 April 2016.

basic rules and principles, while a regulatory agency dealt with the intricacies of such technology, issuing more precise rules, standards and guidelines.

5. CONCLUSION AND FINAL CONSIDERATIONS

In the last few years, artificial intelligence has emerged stronger than ever before. It was gradually introduced to existing technologies, but soon it rose, making possible new devices, and new uses and capabilities for existing ones.

This rise of A.I., however, caught society unprepared, for it brings new challenges to which our current laws cannot cope with. As a result of the unpreparedness of our rules, and the power and complexity of such technology, both law and society have to change and adapt to it.

Such changes and difficulties raise some questions about the regulation of artificial intelligence. This thesis, then, tries to answer some of the most basic questions regarding this topic: whether artificial intelligence should be indeed regulated, and why. To answer these questions, this thesis departed from a premise that a regulation should serve a purpose; and therefore, a field should only be regulated if such rules can succeed in its mission to bring benefits to the sector of artificial intelligence, and to society.

The thesis began the research by scrutinising regulation, what it means, what motivates its existence, and what it takes for it to be successful, ending with a warning regarding its many dangers. From that, it applied the knowledge obtained to the reality of artificial intelligence. The risks of regulation were analysed, comparing arguments both in favour and against the regulation of A.I. In the last chapter, it tried to find how a 'good' regulation could be created, and whether this endeavour could be successful.

As a result, it concluded that yes, a control system must be built, and the state must intervene in the process to ensure everyone is heard and every right guaranteed. Moreover, the regulation does not need to be a "necessary evil". On the contrary, it can bring many benefits to the field of A.I. and society in general. However, for that, the risks and dangers of the technology and regulation must be seriously considered, and this requires considerable expertise. This thesis also argued that, due to the nature of artificial intelligence, it would be better to have a centralised regulation on A.I., with harmonisation across Europe. Finally, as a result of the complexity of the subject, this thesis advised that legislators should create the

principles and the basic rules, while a regulatory agency would deal with the intricacies of said technology.

Summarising it, the answer is that artificial intelligence should be regulated, because, as demonstrated, there are compelling reasons to do so, and a good regulation is possible. It can succeed at allowing humanity to harness the benefits of A.I. to the construction of a better tomorrow.

It is important to emphasise that this thesis deals only with a vertical state regulation. Moreover, it approached the subject generically, dealing with artificial intelligence as a whole, without delving into its many intricacies. Nonetheless, this study serves to close a lacuna in the existing literature, and can be used as a basis for future and more focused researches on the subject.

It does not intend, however, to be the final answer to those questions. This is just a starting point for future explorations.

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