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AI'S WIDE OPEN: PREMATURE ARTIFICIAL INTELLIGENCE AND PUBLIC POLICY

LAUREN RHUE*, ANNE L. WASHINGTON**

PART 1: INTRODUCTION

Artificial intelligence promises predictions and data analysis to support efficient solutions for emerging problems. Yet, quickly deploying AI comes with a set of risks. Premature artificial intelligence may pass internal tests but has little resilience under normal operating conditions. As the scope of the novel coronavirus, SARS-Cov-2,[1] emerged as a defining global challenge in 2020, public

* Assistant Professor of Information Systems, University of Maryland, Robert H. Smith School of Business.

** Assistant Professor of Data Policy, New York University, Steinhardt School of Culture, Education, and Human Development.

[1] *Naming the coronavirus disease (COVID-19) and the virus that causes it*, WORLD HEALTH ORG. [WHO], https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-

health organizations mobilized artificial intelligence (AI) to find treatments,[2] spot outbreaks,[3] determine who to test,[4] and even to identify the most relevant literature.[5] Given the scale of this pandemic, it is critical that organizations venture beyond their self-interest and understand how to quickly develop and deploy AI systems for the public interest.

Organizations test early stage artificial intelligence in laboratory settings under ideal conditions. While AI may yield initially promising avenues, releasing it before it has been properly vetted can have wide-spread social implications, as well as legal ramifications. Once released in a complex real-world environment, sometimes things can take an unexpected turn.

Boeing Corporation is a tragic example of a company that released an artificial intelligence system too early, putting the general society at risk. Boeing's management decision to release its 737 Max jets with a faulty AI system led to lost lives and billions in economic damages.[6] Airline passengers had no awareness or ability to choose their aircraft equipment for travel. In situations where individual preference or consent is immaterial, such as Boeing's 737 Max jets, managers have a duty to manufacture artificial intelligence in the public interest. Boeing faced lawsuits from airlines who purchased the aircraft of 737 Max,[7]

causes-it [https://perma.cc/J3KX-MT6R] (providing the name for the new coronavirus discovered in late 2019 and the disease it causes, COVID-19, and explaining why the virus and disease have different names).

[2] Companies are using artificial intelligence to identify molecules and find new potential drugs to treat COVID-19. Ruth Reader, *Drug makers are using AI to help find an answer to the coronavirus*, FAST COMPANY, (Feb. 10, 2020), https://www.fastcompany.com/90461383/drug-makers-are-using-ai-to-help-find-an-answer-to-the-coronavirus [https://perma.cc/K5UC-AYT8].

[3] Bernard Marr, *Coronavirus: How Artificial Intelligence, Data Science And Technology Is Used To Fight The Pandemic*, FORBES, (Mar. 13, 2020), https://www.forbes.com/sites/bernardmarr/2020/03/13/coronavirus-how-artificial-intelligence-data-science-and-technology-is-used-to-fight-the-pandemic/#b9f88855f5fc [https://perma.cc/64QS-76TC] (referencing Canadian company BlueDot's use of AI to detect disease outbreaks and predict COVID-19 outbreaks before the WHO).

[4] *Id.*

[5] Will Knight, *Researchers Will Deploy AI to Better Understand Coronavirus*, WIRED, (Mar. 17, 2020), https://www.wired.com/story/researchers-deploy-ai-better-understand-coronavirus/ [https://perma.cc/DJX7-KRAS]

[6] *See* Nathan Bomey, *Boeing faces liabilities as CEO Dennis Muilenburg acknowledges 'apparent' 737 Max* problem, USA TODAY, (Apr. 5, 2019), https://www.usatoday.com/story/money/2019/04/05/boeing-ceo-dennis-muilenburg-737-max-crash-liability/3374837002/ [https://perma.cc/Q5Y2-CBL9].

[7] Alexis Keenan, *Boeing faces at least 35 lawsuits over its 737 Max 8 aircraft crashes*, YAHOO FINANCE, (Apr. 27, 2019), https://finance.yahoo.com/news/boeing-737-max-8-litigation-110901749.html. [https://perma.cc/4QXA-YLBB]; Andrew McIntosh, *Boeing faces lawsuit from two VIP 737 Max 8 buyers*, BIZ J., (Feb. 14, 2020), https://www.bizjournals.com/seattle/news/2020/02/13/boeing-faces-lawsuit-from-two-vip-737-max-8-buyers.html [https://perma.cc/X3ZJ-3VWU].

from pilots' unions,[8] and from the victims' families.[9] Each lawsuit highlights a different obligation that organizations that use AI have to business continuity, workplace safety, and public safety. We use Boeing, and other examples, as cautionary tales of premature artificial intelligence.

Organizations already employ artificial intelligence to efficiently execute decisions and to increase human exploration of knowledge, both internally and externally.[10] The goal of this Article is to articulate the consequences of situating data resources and human autonomy across multiple contexts, including the importance of situating management in the loop as well as humans in automated loops.[11] The challenge of regulating artificial intelligence is that its mechanisms are only visible to those with skilled knowledge *and* insider access to information.[12] This prerequisite of skilled knowledge is why we need lawyers with skills in science and technology. Artificial intelligence tools require oversight to prevent them from causing harm in the quest of helping, especially in the absence of explicit public policy.

This Article will argue that regulation of early and emerging artificial intelligence systems must address the management choices that lead to releasing the system into production. First, we present examples of premature systems in the Boeing 737 Max, the 2020 coronavirus pandemic public health response, and autonomous vehicle technology. Second, the analysis highlights relevant management practices found in our examples of premature AI. Our analysis suggests that redundancy is critical to protecting the public interest. Third, we offer three points of context for premature AI to better assess the role of management practices. AI in the public interest should: 1) include many sensors and signals; 2) emerge from a broad range of sources; and 3) be legible to the last person in the chain. Finally, this Article will close with a series of policy suggestions based on this analysis. As we develop regulation for artificial intelligence, we need to cast a wide net to identify how problems develop within the technologies and through organizational structures.

PART 2: AI IN THE PUBLIC INTEREST

Artificial intelligence is in the public interest when it destabilizes known-risk societal contexts increasing individual consequences without civic oversight or

[8] In re Boeing 737 Max Pilots Litigation, No. 1:19-CV-5008, 2020 WL 247404, at *1 (N.D. Ill. Jan. 16, 2020).

[9] Keenan, *supra* note 7; Brian Pascus, *Boeing is hit with U.S. lawsuit following 737 Max crash in Ethiopia*, CBS (Mar. 29, 2019), https://www.cbsnews.com/news/boeing-737-max-8-crash-lawsuit-ethiopia-airlines-chicago-federal-court/ [https://perma.cc/F8K8-HSZQ].

[10] *See* Bernard Marr, *supra* note 3.

[11] Danielle Keats Citron & Frank Pasquale, *The Scored Society: Due Process for Automated Predictions*, 89 WASH. L. REV. 1, 6-7 (2014).

[12] David Lehr & Paul Ohm, *Playing with the Data: What Legal Scholars Should Learn about Machine Learning*, 51 U.C.D. L. REV. 653, 675 (2017).

the ability to exercise personal discretion. In this section, we focus on the organizations that create and release artificial intelligence, often in the quest of solving broad social issues yet in the absence of explicit public policy that prevents them from causing harm.

In 2019, the White House issued the executive order to accelerate artificial intelligence within United States companies.[13] Federal laws define artificial intelligence using several distinct criteria: 1) any system that can perform non-repetitive tasks and/or learn from experience without human oversight; 2) any computer system involved in human-like perception; 3) a system designed to act like a human; 4) a computer system designed to act like a person; and 5) a computer system designed to act rationally and/or like a person.[14] This broad definition of artificial intelligence acknowledges the multifaceted nature of artificial intelligence and machine learning systems.

This multi-step nature of creating artificial intelligence systems yields legal implications.[15] Data scientists collect and process data before training and running models, and these steps yield different legal implications based on their use.[16] For example, when artificial intelligence is used in the hiring process, the data collection process—the choices of prior managers—may create a bias in employment decisions, potentially violating the disparate impact theories of the Equal Education Opportunities Act (E.E.O.A).[17] Furthermore, using model outputs in government decisions, such as automating suspicion and facial recognition, can produce questions about the Fourth Amendment its prohibition on unreasonable search and seizure.[18] There is a concern that these algorithms are "black boxes," meaning that people—even the data scientists creating the artificial intelligence—can not necessarily explain how any particular input affects another one.[19] Because of the unexpected consequences that can occur with artificial intelligence systems, the technology industry has overtly warned about

[13] Exec. Order No. 13,859, 84 Fed. Reg. 3,967 (Feb. 11, 2019).

[14] H.R. Res. 5515, 115th Cong. (2019) (enacted).

[15] Lehr & Ohm, *supra* note 12, at 673-74.

[16] *See id*. at 674.

[17] Solon Barocas & Andrew D. Selbst, *Big Data's Disparate Impact*, 104 CALIF. L. REV. 671, 671 (2016).

[18] Douglas A. Fretty, *Face-Recognition Surveillance: A Moment of Truth for Fourth Amendment Rights in Public Places*, 16 VA. J.L. & TECH. 430, 431 (2011).

[19] Citron & Pasquale, *supra* note 11, at 6.

these risks and technology giants such as Facebook,[20] Google[21] and Tesla's Elon Musk have called for AI regulation.[22]

The 2019 executive order suggests the U.S. federal government will not regulate AI extensively.[23] The government instead plans to focus on the development of new technologies to gain a competitive edge internationally.[24] For regulatory purposes, some scholars urge treating AI as a tool, not a "thing in and of itself."[25]

AI systems can provide benefits to universities, corporations, and governments.[26] However, despite their benefits, AI systems can cause problems when used to tackle consequential issues.[27] Often, systems are opaque to users yet can yield mortal consequences, such as black-box systems used to detect cancer.[28]

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[20] Mark Zuckerberg, *Four Ideas to Regulate the Internet*, FACEBOOK (Mar. 30, 2019), https://about.fb.com/news/2019/03/four-ideas-regulate-internet/ [https://perma.cc/3SAJ-Y7CA].

[21] Sundar Pichai, *Why Google thinks we need to regulate AI*, FIN. TIMES (Jan. 20, 2020), https://www.ft.com/content/3467659a-386d-11ea-ac3c-f68c10993b04.

[22] Matt McFarland, *Elon Musk: 'With artificial intelligence we are summoning the demon.'*, WASH. POST (Oct. 24, 2014, 2:37 PM), https://www.washingtonpost.com/news/innovations/wp/2014/10/24/elon-musk-with-artificial-intelligence-we-are-summoning-the-demon/; *see also Hearing: Task Force on Artificial Intelligence: The Future of Identity in Financial Services: Threats, Challenges, and Opportunities Before the H. Comm. on Financial Services*, 165th Cong. (2019) (statement of Anne L. Washington, Assistant Professor, New York University); Lauren Rhue, Racial Influence on Automated Perceptions of Emotions (Nov. 9, 2018) (unpublished manuscript), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3281765.

[23] Exec. Order No. 13,859, 84 Fed. Reg. 3967 (Feb. 11, 2019).

[24] *See* RUSSEL T. VOUGHT, DRAFT MEMORANDUM FOR THE HEADS OF U.S. EXEC. DEP'TS & AGENCIES: GUIDANCE FOR REGULATION OF ARTIFICIAL INTELLIGENCE APPLICATIONS, https://www.whitehouse.gov/wp-content/uploads/2020/01/Draft-OMB-Memo-on-Regulation-of-AI-1-7-19.pdf [https://perma.cc/F9RL-G5UY].

[25] *See, e.g.*, R. David Edelman, *Here's how to regulate artificial Intelligence properly,* WASH. POST (Jan. 13, 2020), https://www.washingtonpost.com/outlook/2020/01/13/heres-how-regulate-
artificial-intelligence-properly/.

[26] Kaplan & Haenlein consider government, university, and corporate case studies on the risks of AI. *See* Andreas Kaplan & Michael Haenlein, *Siri, Siri, in my hand: Who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence,* 62 BUS. HORIZONS 15, 19-21 (2019).

[27] *See id*.

[28] *See* Yun Liu et al., *Artificial Intelligence–Based Breast Cancer Nodal Metastasis Detection,* 143 ARCHIVES OF PATHOLOGY & LAB. MED. 859, 859-60 (2019); Konstantina Kourou et al., *Machine learning applications in cancer prognosis and prediction*, 13 COMPUTATIONAL & STRUCTURAL BIOTECHNOLOGY J. 8, 10-11 (2015).

Further, AI systems that prioritize patients in healthcare systems can lead to racial disparities in outcomes.[29] AI use and development in organizational contexts are susceptible to organizational pressures and constraints. These pressures can lead to the release of premature AI with disastrous consequences.

Legal scholars must consider frameworks for assessing AI systems and tools released prematurely, especially those that have a possibility of high impact. Organizations that produce artificial intelligence too soon must face consequences for any humanitarian and economic losses caused by their management decision. The potential consequences underscore the need for a sufficiently strong guard for the public interest. We recognize that public policy will always be a driving force behind emerging technology but regulators could look for management patterns to identify potential lapses in judgment. Below we present three examples of premature artificial intelligence.

2.1 Novel Coronavirus Pandemic

The pandemic provided an urgency to understand the virus by any means necessary, including the use of artificial intelligence. However, the legal system must consider the challenges that may arise from using existing artificial intelligence tools to solve new problems and releasing premature artificial intelligence. The effects of any inaccuracies, accidents, biases, and unexpected behaviors in the artificial intelligence system depend on how organizations manage those systems.

In late 2019, reports emerged from Wuhan, China that Chinese authorities treated scores of people for pneumonia of unknown cause.[30] Shortly thereafter, health officials identified a new coronavirus, later named SARS-Cov-2 by the World Health Organizations (WHO).[31] By January 2020, the novel coronavirus spread to dozens of other countries.[32] The WHO declared the situation a global health emergency on January 30, 2020.[33] In late February, the number of cases

[29] A health care algorithm scored patients based on the amount of money spent. Patients identified as white spent more money and therefore were prioritized over patients identified as black. *See* Ziad Obermeyer et al., *Dissecting racial bias in an algorithm used to manage the health of populations*, SCIENCE 366, 447 (2019); Carolyn Y. Johnson, *Racial bias in a medical algorithm favors white patients over sicker black patients,* WASH. POST (Oct. 24, 2019), https://www.washingtonpost.com/health/2019/10/24/racial-bias-medical-algorithm-favors-white-patients-over-sicker-black-patients/.

[30] *See, e.g.*, Zunyou Wu & Jennifer M. McGoogan, *Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China,* 323 JAMA 1239, 1242 (2020); Derrick Bryson Taylor, *A Timeline of the Coronavirus Pandemic*, N.Y. TIMES (Apr. 7, 2020), https://www.nytimes.com/article/coronavirus-timeline.html.

[31] *See* WHO, *supra* note 1.

[32] Taylor, *supra* note 30.

[33] *Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV),* WORLD HEALTH ORG. (2020), https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-

surged in countries globally to more than 87,000 worldwide.[34] Healthcare facilities in multiple countries became overwhelmed with the intensive needs of coronavirus patients as governments sought to reduce the virus spread by closing schools, restricting travel, and urging residents to stay at home.[35] Even Mount Everest closed to tourism as counties closed their borders to prevent the spread of the virus.[36] On March 11, the WHO declared the novel coronavirus outbreak a pandemic and the WHO chief, Dr. Tedros Adhanom Ghebreyesus, expressed concern about the government inaction towards the virus outbreak.[37] In the United States, the number of coronavirus cases exploded from less than 4,000 confirmed cases on March 15 to more than 160,000 confirmed cases on March 30.[38] Additionally, U.S. federal government issued new stay-at-home guidelines as state governments issued shelter-in-place orders to reduce the virus spread.[39]

Given the scale of this crisis, several organizations developed artificial intelligence systems for the pandemic.[40] For example, Delphi Research Group built artificial intelligence tools to predict and forecast the spread of the novel coronavirus.[41] Other artificial intelligence systems helped hospitals handle the changing caseload. One organization, CloudMedx, used sophisticated natural language processing and deep learning models to predict important elements of

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the-outbreak-of-novel-coronavirus-(2019-ncov) [https://perma.cc/ABU8-Y2FE]; Wu & McGoogan, *supra* note 30.

[34] *See id.*

[35] *See, e.g.,* Stan Choe, Lori Hinnant & Tim Sullivan, *Italian Hospitals Overwhelmed by Deaths Amid Coronavirus Outbreak*, BOSTON GLOBE (Mar. 12, 2020), https://www.bostonglobe.com/2020/03/12/nation/italian-hospitals-overwhelmed-by-deaths-amid-coronavirus-outbreak/ [https://perma.cc/MW45-EWU5].

[36] *Id.*

[37] *Coronavirus Confirmed As Pandemic by World Health Organization,* BBC NEWS (Mar. 11, 2020), https://www.bbc.com/news/world-51839944 [https://perma.cc/GP2H-QESU].

[38] CTR. FOR DISEASE CONTROL, CORONAVIRUS DISEASE 2019 (COVID-19), CASES IN U.S., (last updated Apr. 3, 2020), https://www.cdc.gov/coronavirus/2019-ncov/cases-updates/cases-in-us.html#2019coronavirus-summary [https://perma.cc/MY9Z-A32C].

[39] Sarah Mervosh, Denise Lu & Vanessa Swales, *Which States and Cities Have Told Residents to Stay Home*, N.Y. TIMES (last updated Apr. 3, 2020), https://www.nytimes.com/interactive/2020/us/coronavirus-stay-at-home-order.html; Michael D. Shear, *Trump Extends Social Distancing Guidelines Through End of April*, N.Y. TIMES (Mar. 29, 2020) https://www.nytimes.com/2020/03/29/us/politics/trump-coronavirus-guidelines.html.

[40] Patrick Howell O'Neill et al., *A flood of coronavirus apps are tracking us. Now it's time to keep track of them.*, MIT TECHNOLOGY REVIEW (May 7, 2020), https://www.technologyreview.com/2020/05/07/1000961/launching-mittr-covid-tracing-tracker/ [https://perma.cc/836G-JQR2]; Mark Sullivan, *Updated: This AI Camera Detects People Who May Have Covid-19,* FAST COMPANY (Mar. 19, 2020), https://www.fastcompany.com/90479220/this-ai-camera-detects-people-who-may-have-covid-19.

[41] Samuel Sigal, *You—yes, you—can help AI predict the Spread of* Coronavirus, VOX.COM (Mar. 19, 2020), https://www.vox.com/future-perfect/2020/3/19/21185686/ai-predicting-coronavirus-spread-forecasting-covid-19.

the pandemic surge, such as staffing needs and patient risk.[42] Further, CloudMedX developed its tools to sell to hospitals and other healthcare facilities.

Additionally, organizations repurposed existing artificial intelligence systems to address the pandemic. Athena, a visual analysis firm, is using an artificial intelligence system to determine whole body temperature as a means to diagnose Covid-19.[43] Athena's security system utilizes a network of thermal cameras to estimate the body temperatures of people in large crowds by thermally scanning twelve different points on the human body.[44] The U.S. Air Force had already employed Athena's technology to detect firearms in its facilities, and now it has expanded its use to detect fevers as well.[45]

The global pandemic encouraged organizations to repurpose existing technology to address the new challenges quickly. However, artificial intelligence systems may not translate into new contexts. For example, one artificial intelligence system to predict healthcare costs was recently repurposed to predict patient priority based on illness and, assuming that sicker patients spent more on healthcare, predicted lower priority scores for sicker African-American patients than for healthier, more affluent White patients.[46] Thus, the artificial intelligence system introduced bias when transported into a different context.[47] Notably, the problem of bias in artificial intelligence lies not necessarily in the AI system itself, but rather in the way that the system is managed and implemented.[48]

As the pandemic crisis unfolds, legal scholars should consider the management pressures to release artificial intelligence tools. What are the sources of observations and how is access to those data shared? What is the long-term impact of artificial intelligence tools such as virus forecasting and contact tracing? When do management practices have widespread impact, such as the management decisions made in hospitals? When should management practices be subject to oversight, and who has the ability to scrutinize management decisions and the resulting artificial intelligence tools?

2.2 Boeing

Boeing offers another example of prematurely released artificial intelligence in its 737 Max redesign. This example illustrates the risks of releasing artificial intelligence to meet management goals and ignoring technical concerns.

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[42] Nisa Amolis, *Is AI Smarter Than Humans to Flatten the Curve of COVID-19 (Coronavirus),* FORBES (Mar. 18, 2020), https://www.forbes.com/sites/nisaamoils/2020/03/18/is-ai-smarter-than-humans-to-flatten-the—curve-of-covid-19-coronavirus/#3b563a8e23c2.

[43] Sullivan*, supra* note 40.

[44] *Id.*

[45] *Id*.

[46] *See* Obermeyer et. al., *supra* note 29 at 447, 451-52.

[47] *Id*.

[48] *Id.* at 452-53.

The Boeing 737 Max originated as the most recent update to Boeing's long-standing 737 jet design.[49] Boeing 737 was launched in 1967 with state of the art design, but the demands of the airline industry changed over the decades.[50] In the early 2010s, Boeing decided to modernize the 737 to include technological improvements since its last resign in the 1990s.[51] However, airlines prefer to avoid the steep costs associated with retraining their pilots and mechanics on a new plane design, so Boeing resisted completely overhauling the 737 design at least in part to appease the airline industry.[52] Rather, the company decided to update the existing 737 design instead of creating an entirely new airplane design.[53] Boeing's engineers struggled to maintain existing design elements while simultaneously accommodating many of the technological advances that the company was pushing for.[54] Specifically, the new 737 design called for larger and more fuel efficient engines, but the size and location of these engines on the wing could result in the nose of the plane being pushed upward during flight, which in turn could cause the plane to stall under certain conditions.[55]

The Maneuvering Characteristics Augmentation System (MCAS) was the artificial intelligence system Boeing created to solve the problem.[56] MCAS would automatically push the nose of the plane downward if the plane was flying at too high of an angle.[57] The activation of MCAS was based on a single sensor that registered the angle of the nose.[58]

Boeing felt competitive pressure to get the 737 Max on the market to compete with their aircraft manufacturing rival Airbus.[59] In 2011, Airbus debuted a new digital fuel-efficient airplane design, the A320.[60] American Airlines, a longtime

[49] David Gelles, *Boeing 737 Max Needs Full F.A.A. Review, Crash Families Say*, N.Y. TIMES (Apr. 7, 2019), https://www.nytimes.com/2019/08/07/business/boeing-737-max-faa-recertification-stumo.html.

[50] Jack Nicas & Julie Creswell, *Boeing's 737 Max: 1960s Design, 1990s Computing Power and Paper Manuals*, N.Y. TIMES (Apr. 8, 2019), https://www.nytimes.com/2019/04/08/business/boeing-737-max-.html.

[51] *Id.*

[52] *Id.*

[53] *Id.*

[54] *Id.*

[55] Ralph Vartabedian, *How a 50-year-old design came back to haunt Boeing with its troubled 737 Max jet*, L.A. Times (Mar. 15, 2019), https://www.latimes.com/local/california/la-fi-boeing-max-design-20190315-story.html.

[56] Jack Nicas, et al., *Boeing Built Deadly Assumptions Into 737 Max, Bind to a Late Design Change*, N.Y. TIMES (June 1, 2019), https://www.nytimes.com/2019/06/01/business/boeing-737-max-crash.html.

[57] *Id.*

[58] Vartabedian, *supra* note 55.

[59] David Gelles et al., *Boeing Was 'Go Go Go' to Beat Airbus With the 737 Max*, N.Y. TIMES (Mar. 23, 2019), https://www.nytimes.com/2019/03/23/business/boeing-737-max-crash.html.

[60] Nicas & Creswell, *supra* note 50.

Boeing customer, was poised to close a deal with Airbus for hundreds of new planes unless Boeing could counter.[61] Boeing offered an update to its existing 737 design and committed to delivering the redesigned plane in six years instead of the ten years it would take to design a completely new plane.[62] This competitive threat lead to internal pressure for Boeing engineers to rush production of their drawings, leading to less detailed blueprints.[63] To facilitate a faster design, the process was compartmentalized and employees focused on their narrow aspect of the plane redesign.[64] Thus, some employees did not realize the impact that their decisions would have on other aspects of the plane and on the final overall design.[65]

These choices ultimately had tragic consequences. In October 2018, a 737 Max flight by Indonesia's Lion Air crashed into the Java Sea, killing all 189 passengers on board.[66] In 2019, a 737 Max flight by Ethiopia Airlines crashed, killing 157 people on board.[67] After the two crashes, the Boeing 737 Max was grounded indefinitely as investigators scrambled to identify and fix the problem.[68]

In the aftermath of the two fatal crashes, investigators discovered Boeing made several important management choices that led to a malfunctioning system.[69] The original design collected data from at least two types of sensors whereas the revised version used a single sensor.[70] Although redundancy is common in aviation, Boeing engineers explained that managers wanted to limit changes from the original 737 design so they refused to consider using two sensors.[71] Boeing also removed references and instructions regarding MCAS from

[61] Nicas et al., *supra* note 56.

[62] Nicas & Creswell, *supra* note 50.

[63] Nicas et al., *supra* note 56.

[64] *Id.*

[65] *Id.*

[66] Muktita Suhartano & Hannah Beech, *In Boeing Lion Air Crash, Indonesians Learn What Took Their Loved Ones*, N.Y. TIMES (Oct. 25, 2019), https://www.nytimes.com/2019/10/23/world/asia/boeing-737-max-lion-air-crash.html [https://perma.cc/AQL3-QR55].

[67] *Ethiopian Airline: 'No survivors' on Crashed Boeing* 737, BBC NEWS (Mar. 10, 2019), https://www.bbc.com/news/world-africa-47513508 [https://perma.cc/VU68-7X9Z].

[68] FEDERAL AVIATION ADMINISTRATION: FAA EMERGENCY ORDER OF PROHIBITION, PROHIBITING THE OPERATION OF BOEING COMPANY MODEL 737-8 AND 737-9 SERIES AIRPLANES (Mar. 13, 2019), https://www.faa.gov/news/updates/media/Emergency_Order.pdf [https://perma.cc/7UCC-YVLN].

[69] *See* Dominic Gates*, Flawed analysis, failed oversight: How Boeing, FAA certified the suspect 737 MAX flight control system*, SEATTLE TIMES (Mar. 21, 2019), https://www.seattletimes.com/business/boeing-aerospace/failed-certification-faa-missed-safety-issues-in-the-737-max-system-implicated-in-the-lion-air-crash/.

[70] Jack Nicas et al., *supra* note 56.

[71] *Id.*

the pilot's manual.[72] Plus, due to a design flaw, a warning light in the cockpit only worked when the purchaser had bought an optional add-on and was non-functional in standard models.[73] Management considerations ultimately influenced the design choices.

The two fatal crashes led to several lawsuits. Victims' families filed lawsuits against Boeing for wrongful deaths.[74] Pilots filed complaints against Boeing, alleging that Boeing misrepresented the design to pilots and covered up unsafe design choices, and those unsafe choices led to the crashes that grounded the planes and resulted in lost wages.[75] In 2016, two years before the crashes, pilots accused the Boeing 737 Max of acting unpredictably in a flight simulator.[76] Later, pilots accused the simulator of misrepresenting the physical difficulties involved regaining control from an errant MACS system,[77] alleging that the MCAS problems were known to Boeing but they released the 737 Max despite its problems. The pilots' lawsuit also alleged that Boeing removed the MCAS system from the pilot's manual and overhauled the system without telling regulators.[78] Furthermore, reports suggest that it was impossible to replicate the conditions in the two fatal crashes in the flight simulators, preventing pilots from understanding the challenges associated with regaining control of the system from MCAS.[79]

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[72] *Id.*

[73] BOEING, BOEING STATEMENT ON AOA DISAGREE ALERT (May 5, 2019), https://boeing.mediaroom.com/news-releases-statements?item=130431 [https://perma.cc/6YQU-8WWN].

[74] Janan Hanna, *Boeing settles more than 60 wrongful death cases filed after 737 MAX crashed in indonesia,* THE SEATTLE TIMES (Nov. 21, 2019, 8:07 AM), https://www.seattletimes.com/business/boeing-lawyer-says-more-than-60-lion-air-crash-cases-settled/ [https://perma.cc/BQ84-V3DZ].

[75] Alison Sider, *Southwest Airlines Pilots Union Sues Boeing, Alleging Lost Compensation,* WALL STREET JOURNAL (Oct. 7, 2019, 6:44 PM), https://www.wsj.com/articles/southwest-airlines-pilots-union-sues-boeing-alleging-lost-compensation-11570488092 [https://perma.cc/TU8S-N5KS].

[76] Pilots described the simulator as "running rampant" and difficult to control. *See* David Gelles & Natalie Kitroeff, *Boeing Pilot Complained of 'Egregious' Issue with 737 Max in 2016*, N.Y. TIMES (Oct. 23, 2019), https://www.nytimes.com/2019/10/18/business/boeing-flight-simulator-text-message.html [https://perma.cc/SRX5-YKYX].

[77] Natalie Kitroeff, *Boeing 737 Max Simulators Are in High Demand. They Are Flawed*, N.Y. TIMES (May 17, 2019), https://www.nytimes.com/2019/05/17/business/boeing-737-max-simulators.html [https://perma.cc/T8S8-XKQP].

[78] Plaintiff's Original Petition at 24-27, Sw. Airlines Pilots Ass'n. v. Boeing Co., No. DC-19-16290 (Tex. Dist. Ct. filed Oct. 7, 2019).

[79] *See* Kitroeff, *supra* note 77.

Shareholders filed suits against Boeing claiming that Boeing elevated profitability above airline safety and engaged in securities fraud, and as a result, investors suffered economic losses.[80] Airlines filed lawsuits against Boeing for the loss of revenue. When Boeing had to pull the 737 Max from the market, airlines who placed orders for the airplane, and booked flights using those planes, had to cancel their flights and refund their passengers' money.[81] Because Boeing let a defective product come to market, airlines alleged that they lost important revenue and sought compensation from Boeing.[82]

Boeing's premature artificial intelligence system underscores the multiple consequences that artificial intelligence can have in terms of human losses, employment losses, and economic losses.

2.3 Autonomous Vehicles

Autonomous vehicles (AV) are cars operated by artificial intelligence systems.[83] There are several potential developers of these types of systems, including Google spin-off Waymo, Uber, and GM.[84] These autonomous vehicles promise to drive people around, and some develop with the potential for human intervention, to take the wheel, and others do not.[85] GM's Cruise offers a self-driving car without a steering wheel.[86]

The Society of Automotive Engineers (SAE) identifies multiple levels of autonomy in autonomous vehicles, ranging from SAE Level 0, full human control,

[80] Hamza Shaban, *Boeing shareholder files class-action lawsuit, alleges plane maker concealed 737 Max safety risks*, WASHINGTON POST (Apr. 10, 2019 10:37 AM), https://www.washingtonpost.com/business/2019/04/10/boeing-shareholder-files-class-action-lawsuit-alleges-plane-maker-concealed-max-safety-risks/ [https://perma.cc/5XWS-TETM].

[81] Plaintiff's Original Petition, *supra* note 78 at 3.

[82] Robert l. Rabin, *Stanford Law's Robert Rabin on Boeing Accidents and Grounding: Who is Liable?*, STANFORD LAW SCHOOL (Mar. 14, 2019), https://law.stanford.edu/2019/03/14/stanford-laws-robert-rabin-on-boeing-737-accidents-and-grounding-who-is-liable/ [https://perma.cc/Q838-A4UL].

[83] *See* Rilind Elezaj, *How AI Is Paving the Way for Autonomous Cars*, MACHINEDESIGN (Oct. 17, 2019), https://www.machinedesign.com/mechanical-motion-systems/article/21838234/how-ai-is-paving-the-way-for-autonomous-cars [https://perma.cc/9F38-3BNW].

[84] Daisuke Wakabayashi, *Google Parent Company Spins Off Self-Driving Car Business*, N.Y. TIMES (Dec. 13, 2016), https://www.nytimes.com/2016/12/13/technology/google-parent-company-spins-off-waymo-self-driving-car-business.html [https://perma.cc/HDR6-SQHN].

[85] Jonathan Vanian, *GM's Cruise unveils new self-driving car without steering wheels and brake pedals*, FORTUNE (Jan. 21, 2020 10:49 PM), https://fortune.com/2020/01/21/gms-cruise-unveils-new-self-driving-car-without-steering-wheels-and-brake-pedals/ [https://perma.cc/5XE6-XWY7].

[86] *Id*.

to SAE Level 5, full AI control.[87] Currently, a gradient of autonomous vehicles are on the market and being tested.[88] Some vehicles can perform a single function such as automatic braking, others have a self-driving mode, and others are completely devoid of human intervention.[89] Tesla's Autopilot feature uses the input from sensors surrounding the undercarriage of the car and can detect objects surrounding the car.[90] Once the driver activates Autopilot, Tesla Model S will drive the car, including steering, lane changes, and controlling the brakes.[91] Tesla Autopilots sense whether the driver is touching the wheel, and will prompt them to do so if they are not.[92] Autonomous vehicles have a wide range of autonomy.

Uber tested completely self-driving cars, but the cars still rely on human intervention.[93] For one, Uber self-driving cars are not permitted to engage the emergency brake to prevent abrupt computer behavior, so the human operator is expected to engage the brake.[94] Without an indicator light, Uber expects that the driver, an Uber employee, will pay attention.[95] Uber's business model increased the attractiveness of autonomous vehicles, thus increasing pressure on ride-sharing companies to remove humans from operating the vehicles to garner a larger share of the customer fares.[96]

Autonomous vehicle regulation consists of a patchwork of existing laws, policies, and standards.[97] For example, current safety standards for the Federal Motor Vehicle Safety Standards would prohibit "nontraditional" elements like cars

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[87] Alex Davies, *Everyone Wants a Level 5 Self-Driving Car—Here's What That Means*, WIRED (Aug. 26, 2016, 2:12 PM), *https://www.wired.com/2016/08/self-driving-car-levels-sae-nhtsa/*.

[88] Bill Canis, *Issues in Autonomous Vehicle Testing and Deployment*, CONG. RES. SERV. (Feb. 11, 2020), https://fas.org/sgp/crs/misc/R45985.pdf.

[89] *E.g*., Davies, *supra* note 87.

[90] Cadie Thompson, *Here's how Tesla's Autopilot works*, BUSINESS INSIDER (July 1, 2016, 12:01 PM), https://www.businessinsider.com/how-teslas-autopilot-works-2016-7#the-forward-facing-camera-is-located-on-the-top-windshield-a-computer-inside-the-camera-helps-the-car-understand-what-obstacles-are-ahead-of-the-car-4.

[91] *Id.*

[92] Alex Davies, *The Unavoidable Folly of Making Humans Train Self-Driving Cars*, WIRED (June 22, 2018, 1:12 PM), https://www.wired.com/story/uber-crash-arizona-human-train-self-driving-cars/.

[93] *See id.*

[94] *See id.*

[95] *See id.*

[96] *See* Alex Davies, *The Very Human Problem Blocking the Path to Self-Driving Cars*, WIRED (Jan. 1, 2017, 7:00 AM), https://www.wired.com/2017/01/human-problem-blocking-path-self-driving-cars/.

[97] Eduardo Soares, Tariq Ahmad, Ruth Levush, Gustavo Guerra, James Martin, *Regulation of Artificial Intelligence: The Americas and the Caribbean*, LIBRARY OF CONGRESS (July 1, 2019), https://www.loc.gov/law/help/artificial-intelligence/americas.php#us.

without a steering wheel.[98] In 2011, Nevada adopted legislation on the testing of autonomous vehicles.[99] Furthermore, state governments also regulate artificial intelligence systems.[100] By 2018, 29 states adopted legislation and 11 governors issued executive orders about autonomous vehicles.[101] The results can lead to inconsistent oversight for the vehicles in the push to advance the technology,[102] yet autonomous vehicles affect all people on the road.

From our analysis of Boeing, pandemic technology, and autonomous vehicles, we argue that decisions made by the organization are materially significant to the design and deployment of artificial intelligence systems.

PART 3: MANAGEMENT PRACTICES AND PREMATURE AI

Internal management patterns can substantially influence the design of artificial intelligence systems, especially when released early. Premature AI systems are strongly influenced by internal management pressures, how external customers use them, where human input is situated in addition to the autonomy of the system itself.

3.1 Navigating Internal Management Pressures

Organizations developing artificial intelligence systems experience management pressures that lead them to develop the system in a particular manner for their clients and customers. These pressures are internal management patterns that influence the development of the artificial intelligence system.[103] Clients and customers use the outputs of artificial intelligence systems, often as-is because they have limited influence on the explicit design of the system. Their choices influence the use of the artificial intelligence systems. These pressures are external management patterns that influence the use of artificial intelligence systems.[104]

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[98] Removing Regulatory Barriers for Vehicles With Automated Driving Systems, 83 Fed. Reg. 2607-14 (proposed Jan. 18, 2018) (to be codified at 49 C.F.R. pt. 571).

[99] NEV. REV. STAT. §§ 482A.060-.080 (2019).

[100] Jennifer Betts, *Keeping an Eye on Artificial Intelligence Regulation and Legislation*, THE NATIONAL LAW REVIEW (June 14, 2019), https://www.natlawreview.com/article/keeping-eye-artificial-intelligence-regulation-and-legislation.

[101] *Autonomous Vehicles Self-Driving Vehicles Enacted Legislation*, NATIONAL CONFERENCE OF STATE LEGISLATURES (Feb. 18, 2020), https://www.ncsl.org/research/transportation/autonomous-vehicles-self-driving-vehicles-enacted-legislation.aspx.

[102] *See* Jeremy A. Carp, *Autonomous Vehicles: Problems and Principles for Future Regulation*, 4 U. PA. J.L. & PUB. AFF. 81, 97-98, 128 (2018).

[103] *Breaking Ground on Implementing AI, Instituting Strategic AI Programs: Moving from Promise to Productivity*, PLUTO SHIFT (Oct. 2019), https://plutoshift.com/wp-content/uploads/2020/01/BreakingGround_Survey_FINAL.pdf.

[104] *Id.*

Boeing developed MCAS for its 737 Max planes in response to management pressures.[105] Boeing originally decided to pursue another redesign of the 737, rather than design a completely new plane, to win business against Airbus.[106] Managers sought to avoid significant redesigns to the 737 Max, leading to using a single sensor to trigger MCAS and leaving MCAS out of the pilot's manual because it was rarely expected to trigger.[107] Many of these technical choices were led by the organizational pressures, despite the clear priority of safety for aviation technology.

Maintaining healthy business growth was not limited to those inside the company. Regulators proved susceptible to considering the business environment. For example, one theory is that the FAA relaxed oversight of Boeing to address Boeing's business needs.[108] Furthering this theory, in a Senate hearing, Senator Susan Collins noted that the FAA appeared focused on Boeing's business timeline instead of safety recommendations from engineers.[109] As a result, Boeing self-certified the plane's safety without stress-tests from regulators.[110] If organizations develop malfunctioning AI and deliver it into the markets, those developing organizations may be liable, especially for products that can be self-certified without oversight like in Boeing's case.[111]

Organizations face many additional pressures and incentives including the desire to accommodate their current client base.

3.2 Responding to External Customer Demands

Autonomous vehicle producers' business needs influence their design as well.[112] To accommodate political and public comfort, many autonomous vehicle manufacturers switched their focus to semi-autonomous cars.[113] However,

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[105] Bart Elias, *Cockpit Automation, Flight Systems Complexity, and Aircraft Certification: Background and Issues for Congress*, CONGRESSIONAL RESEARCH SERVICE 12, 15 (Oct. 3, 2019).

[106] *Id*. at 19.

[107] *Id*. at 12, 15.

[108] David Gelles & Natalie Kitroeff, *F.A.A. Leaders Face Scrutiny Over Boeing 737 Max Certification,* N.Y. TIMES (July 31, 2019), https://www.nytimes.com/2019/07/31/business/boeing-max-faa-senate.html [https://perma.cc/2N8P-YX5S].

[109] *Id.*

[110] Natalie Kitroeff et al., *The Roots of Boeing's 737 Max Crisis: A Regulator Relaxes Its Oversight,* N.Y. TIMES (July 27, 2019), https://www.nytimes.com/2019/07/27/business/boeing-737-max-faa.html, [https://perma.cc/SU7M-8PQP].

[111] Robert L. Rabin, *Standford Law's Robert Rabin on Boeing Accidents and Grounding: Who is Liable?,* STANFORD L. SCHOOL (Mar. 14, 2019), https://law.stanford.edu/2019/03/14/stanford-laws-robert-rabin-on-boeing-737-accidents-and-grounding-who-is-liable/ [https://perma.cc/MW96-89LP].

[112] *See* Davies, *supra* note 96.

[113] Alex Davies, *The Very Human Problem Blocking the Path to Self-Driving Cars*, WIRED (Jan. 1, 2017 7:00 AM), https://www.wired.com/2017/01/human-problem-blocking-path-self-driving-cars/ [https://perma.cc/5F52-RDAX].

many autonomous vehicle manufactures are rethinking this approach because there is substantial evidence that the handoff between humans and artificial intelligence systems required in semi-autonomous cars is untenable, even for professionals.[114] For example, even an Uber test driver employed by the company did not pay attention while training her car.[115] There is similar evidence that customers in semi-autonomous systems do not use the system as intended.[116] One driver began watching movies while on Autopilot, an action that directly contradicted the manual.[117] In a more typical products liability case, consumer misuse is a defense;[118] however, in an autonomous vehicle the purpose is to allow users to turn their attention elsewhere, which might eliminate the defense for manufacturers.[119]

Organizations that create artificial intelligence systems retain limited control over their systems after delivery. These organizations cannot supervise how customers, both intermediaries and end-users, interact, use, and/or modify their products. Tesla could not prevent people from overreliance on their Autopilot, leading to fatal crashes.[120]

Organizations may retain the right to remotely modify their product, but this strategy yields business risks. Tesla ran into negative publicity when it remotely uninstalled Autopilot on a car sold by a third-party car dealership,[121] arguing that the end-customer did not pay for it (even though the dealer arguably had purchased the Autopilot feature).[122]

Remote modification, and other technological choices, may constrain or enable customers' actions. How much liability can the end-user of these artificial

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[114] *See id.*

[115] *Id.*

[116] *See id.*

[117] Sam Levin & Nicky Woolf, *Tesla Driver Killed While Using Autopilot was Watching Harry Potter, witness says,* THE GUARDIAN (July 1, 2016), https://www.theguardian.com/technology/2016/jul/01/tesla-driver-killed-autopilot-self-driving-car-harry-potter [https://perma.cc/SBR7-NA6W].

[118] *See* Jeffrey K. Gurney, *Sue My Car, Not Me: Products Liability and Accidents Involving Autonomous Vehicles*, 13 U. ILL. J.L. TECH. & POL'Y 247, 268 (2013).

[119] *Id.*

[120] Sean O'Kane, *Tesla Hit With Another Lawsuit Over a Fatal Crash,* THE VERGE (Aug. 1, 2019, 5:59 PM), https://www.theverge.com/2019/8/1/20750715/tesla-autopilot-crash-lawsuit-wrongful-death [https://perma.cc/C69R-X5C8].

[121] Isobel Asher Hamilton, *Tesla quietly disabled the autopilot feature on a Model S*, BUSINESS INSIDER (Feb. 7, 2020, 7:52 AM), https://www.businessinsider.com/tesla-disables-autopilot-on-model-s-without-alerting-owner-2020-2 [https://perma.cc/D3XM-UVPL].

[122] Jason Torchinsky, *Tesla Remotely Removes Autopilot Features from Customer's Used Tesla Without Any Notice*, JALOPNIK (Feb. 6, 2020, 4:10 PM), https://jalopnik.com/tesla-remotely-removes-autopilot-features-from-customer-1841472617 [https://perma.cc/Y94A-EG7U].

intelligence systems given the constraints of the system introduced by the manufacturer?[123] If the AI tool's performance is substandard and does not meet its pre-stated goals, this situation may fall under breach-of-contract or defective products legal theories.[124] However, there are instances in which the AI "works" as stated but has other negative effects. In one hospital example, the administration used an artificial intelligence tool designed to predict cost to estimate patient risk and prioritize patients, and that out-of-context use led to unexpected consequences like prioritizing affluent white patients over sicker black patients.[125] In the case of autonomous vehicles, if the vehicle manufacturer sellers the cars to another company and their employee misuses the car, who is liable? These liability questions have not been adequately discussed.

3.3 Developing Appropriate Levels of Autonomy

Organizations that are incorporating AI in their systems define the decisions made by the users.[126] But not all artificial intelligence is created equal. On one end of the continuum, organizations are designing AI-enabled systems for complete autonomy, such as GM Cruise's autonomous vehicles. These vehicles are manufactured without a steering wheel, making it impossible for the humans in the car to intervene in case of emergency.[127] Particularly with totally autonomous artificial intelligence, it is imperative to understand whether people are actually at the mercy of the machine, especially when an errant AI system has societal implications.[128]

The continuum of autonomy in AI systems mirror the automated-weapons systems described by Professors Citron and Pasquale: Human-in-the-loop, Human-on-the-Loop, and Human-out-of-the-loop.[129] This continuum of AI-human hybrid decisions reflects the degree to which artificial intelligence can commit serious actions, such as killing enemy targets, without human intervention.

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[123] *See* Simon Chesterman, *Artificial Intelligence and the Problem of Autonomy*, 1 NOTRE DAME J. EMERGING TECH. (forthcoming 2020) (examining who pays the costs of liability and suggesting it will ultimately be consumers).

[124] *See* Karni A. Chagal-Feferkorn, *Am I an Algorithm or a Product? When Products Liability Should Apply to Algorithmic Decision-Makers*, 30 STAN. L. & POL'Y REV. 61, 77 (2019); Gurney, *supra* note 118, at 258-62.

[125] Johnson, *supra* note 29.

[126] Yash Raj Shrestha, Shiko M. Ben-Meneham, Georg von Krogh, *Organizational Decision-Making Structures in the Age of Artificial Intelligence*, 61 CAL. MGMT. REV. 66 (2019).

[127] Andrew J. Hawkins, *Exclusive Look at Cruise's First Driverless Car Without a Steering Wheel or Pedals*, THE VERGE (Jan. 21, 2020 8:14 AM), https://www.theverge.com/2020/1/21/21075977/cruise-driverless-car-gm-no-steering-wheel-pedals-ev-exclusive-first-look [https://perma.cc/Y5HL-X8QX].

[128] For a thorough examination of when we should be concerned about algorithms, *see generally* CATHY O'NEIL, WEAPONS OF MATH DESTRUCTION (2016).

[129] Citron & Pasquale, *supra* note 11, at 6-7.

In the first condition, *In-the-Loop*, humans retain control over the system so the artificial intelligence requires meaningful human intervention in order to accomplish the action.[130] In the second condition, *On-the-Loop*, designers enable the artificial intelligence to act with some autonomy but, if necessary, the artificial intelligence can be overridden by human intervention.[131] In the third condition, *Out-of-the-Loop*, designers create a completely autonomous system and, no matter the situation, people cannot intervene or override the system.[132]

In the "killer robot" scenario referenced by Professors Citron and Pasquale, the human consequences of autonomous artificial intelligence are starkly clear.[133] Our scenario, errant artificial intelligence systems unleashed by private organizations, adds severe economic consequences and legal ambiguity to the already potentially stark humanity consequences of lives lost.

In the first model of AI autonomy, *In-the-Loop*, organizations create artificial intelligence systems that require people to actively engage with them for the systems to act.[134] For many of the use cases for artificial intelligence, like temperature monitoring, in which the systems are not mission critical, it makes sense for people to have the ability to review the decision-making of the artificial intelligence.[135] This is especially true because those non-mission-critical AI systems have their model outputs more easily incorporated into a slower decision process.[136] For example, Athena's cameras that detect coronavirus fevers do not need to automatically make decisions; instead, the images can be delivered to a security guard to intervene and assist in the decision-making process.[137] This AI thus acts as a guideline for the managers and individual decision-makers.[138] Other artificial intelligence features are incorporated into mission-critical systems, which require that there are mechanisms to ensure human participation. For example, some semi-autonomous cars require the drivers to activate the AI and put their hands on the wheel in order to drive.[139] With many artificial intelligence systems used for guidance, such as the AI that identifies people with fever for a coronavirus diagnosis, the recommendations are sent out to another organization for further action. With these *In-the-Loop* cases, management processes are able to assess the output from the AI system and determine the helpfulness of the tools.

[130] *Id.* at 6.

[131] *Id.* at 7.

[132] *Id*.

[133] *Id*. at 6-7.

[134] *Id*.

[135] *Id*. at 7.

[136] *Id*. at 6-7.

[137] Sullivan, *supra* note 40.

[138] *See id*.

[139] Davies, *supra* note 96.

There are gradients in the *In-the-Loop* scenario, similar to the gradients of artificial intelligence in autonomous vehicles.[140] Perhaps the AI system can help with basic tasks, such as automated braking, but it cannot complete the entire action, driving, without human input.[141] Ultimately, management can be accountable for the consequences of accepting guidance from these systems.

In the second model of AI autonomy, *On-the-Loop*, organizations create artificial intelligence systems that act alone but allow people to intervene to override the system. [142] Similar to semi-autonomous vehicles, or cars with a self-driving mode, the person managing the artificial intelligence system is expected to maintain a watchful presence and be ready to control the car at the sign of a problem.[143] In these artificial intelligence systems, the responsibility presumably rests with the human driver.[144]

However, it appears unrealistic for average people to maintain that watchful presence over their AI systems. This is even true of employees of autonomous vehicle companies, who are tasked with maintaining watch over the systems, leading to fatal consequences.[145] Multiple drivers have crashed on Tesla Autopilot because the drivers were not sufficiently and continually engaged.[146] Tesla faces wrongful death multiple lawsuits, because Tesla drivers crashed after placing the car on autopilot.[147] In an initial lawsuit involving the technology in 2016, the court ruled that the crash was the driver's fault.[148] Thus, there is evidence that the organization is not necessarily responsible for the maintenance of *On-the-Loop* artificial intelligence systems.

In the third model AI autonomy, *Out-of-the-Loop*, organizations produce artificial intelligence systems that act alone and without any potential for people to intervene. GM Cruise debuted this type of autonomous vehicle—a car without

[140] *See* Citron & Pasquale, *supra* note 11 *at* 6-7; *see also generally* Lance Eliot, *Explaining Level 4 and Level 5 of Self-Driving Cars in Plain English*, FORBES (Dec. 20, 2019) https://www.forbes.com/sites/lanceeliot/2019/12/20/explaining-level-4-and-level-5-of-self-driving-cars-in-plain-english/#141f687d4709 [https://perma.cc/8BAL-Q8F3].

[141] *See* Eliot, *supra* note 140.

[142] *See* Citron & Pasquale, *supra* note 11 at 7.

[143] Harry Surden & Mary-Anne Williams, *Technological Opacity, Predictability, and Self-Driving Cars*, 38 CARDOZO L. REV. 121, 132 (2016).

[144] *Id*.

[145] NTSB, INADEQUATE SAFETY CULTURE' CONTRIBUTED TO UBER AUTOMATED TEST VEHICLE CRASH - NTSB CALLS FOR FEDERAL REVIEW PROCESS FOR AUTOMATED VEHICLE TESTING ON PUBLIC ROADS (2019).

[146] NTSB, DRIVER ERRORS, OVERRELIANCE ON AUTOMATION, LACK OF SAFEGUARDS, LED TO FATAL TESLA CRASH (2017); Sean O'Kane, *Tesla Hit With Another Lawsuit Over a Fatal Crash,* THE VERGE (Aug. 1, 2019, 5:59 PM), https://www.theverge.com/2019/8/1/20750715/tesla-autopilot-crash-lawsuit-wrongful-death.

[147] *Id*.

[148] O'Kane, *supra* note 146.

a steering wheel guided by an artificial intelligence system.[149] By design, humans cannot control the car in case of emergency because there are no mechanisms, i.e., a steering wheel, for human intervention.[150] In these types of systems, the customer—end-user or intermediary—of the AI system cannot accept responsibility. The individual cedes all control to the machine.

There are occasions when the benefits of *Out-of-the-Loop* technology outweigh the risks of human oversight. Sometimes, such as a global pandemic, it is preferable to remove humans from the process for important reasons such as their own protection. Another interesting by-product of the coronavirus precautions is the use of AI to take over jobs that were previously occupied by people. Because of the need to remove people from the equation, artificial intelligence is used in place of people, with the expectation that humans will not intervene.[151] Yet we know that the consequences of unanticipated behavior by the artificial intelligence systems will be borne by humans.

3.4 Public Interest On-the-Loop

The autonomy of artificial intelligence arises from the organizational needs and the artificial intelligence's purpose. People feel comforted by the prospect of human intervention in case of emergency,[152] both people who use the system and people who move in society with the system such as politicians, pedestrians, pilots, and passengers. This management view suggests that public interest AI systems prefer *On-the-Loop*.[153]

On-the-Loop rests in a liminal space where blame easily shifts between the company and specific individuals. Organizations, such as Boeing and Tesla, claim to deliver autonomous products that center humans "on the loop", yet those claims are practically impossible given human constraints.[154] Even if organizations technically incorporate the capability into the system, the AI system

[149] Jonathan Vanian, *GM's Cruise Unveils New-Self Driving Car Without Steering Wheels and Brake Pedals,* FORTUNE (Jan. 21, 2020, 10:49 PM), https://fortune.com/2020/01/21/gms-cruise-unveils-new-self-driving-car-without-steering-wheels-and-brake-pedals/.

[150] *Id*.

[151] Surden & Williams, *supra* note 143, at 131.

[152] Davies, *supra* note 92.

[153] Sanay Srivastava, *For All that AI Can Do Today, It Still Needs Humans in the Loop*, FORBES (Dec. 23, 2019, 7:15 AM) https://www.forbes.com/sites/forbestechcouncil/2019/12/23/for-all-that-ai-can-do-today-it-still-needs-humans-in-the-loop/#7041586ace6c [https://perma.cc/6MNK-NQK8] (concluding "AI will augment human work while also changing its focus and pushing it into new shapes. Meanwhile, humans will continue to give feedback to fine-tune the machines. No matter where the AI revolution takes us, there's one truth: There will always be humans in the loop.").

[154] BOEING, *737 Max Software Update: Overview***,** https://www.boeing.com/commercial/737max/737-max-software-updates.page [https://perma.cc/7EA9-WKX2] (stating "The pilots will continue to always have the ability to override MCAS and manually control the airplane."); NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., ODI RESUME: INVESTIGATION PE 16-

will become de facto *Out-of-the-Loop* when there are no meaningful opportunities for people to intervene.[155] Organizations that develop AI systems should accept the responsibility and put humans out of the loop or give meaningful agency to put humans in the loop.[156] To that end, more autonomous vehicle makers are seeking to get drivers out of the loop by bringing to market Society of Automotive Engineers Level 4 automated vehicles.[157]

Boeing is an example of an organization that promised an *On-the-Loop* system and delivered an *Out-of-the-Loop* system. Pilots were expected to be able to intervene in case MCAS malfunctioned[158], but if there is an expectation that pilots can intervene, then the AI must be designed to accommodate human decisions. For example, the Lion Air Flight 610 Boeing 737 MAX 8 fell at more than 10,0000 feet per minute.[159] Even if the pilots were perfectly prepared, they had only seconds to react.[160] Uber's employee, Rafaela Vasquez, had less than 2 seconds to intervene between when the car registered pedestrian Elaine Herzberg and hit and killed her.[161] Mission-critical systems that determine the loss of life need more time for a normal human response. When can someone override a system? At what point can these systems be controlled externally? Each system

007, at 7 (2016), https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF [https://perma.cc/G8TW-PR92] (stating "Tesla monitors driver engagement" such as aiding "in monitoring the driving environment and being prepared to take immediate action to avoid collisions, if necessary.").

[155] *See, e.g.,* Sinead Baker, *The Boeing 737 Max crashes have revived decades-old fears about what happens when airplane computers become more powerful than pilots*, BUSINESS INSIDER (Feb. 17, 2020, 10:15 AM), https://www.businessinsider.com/boeing-737-max-fatal-crashes-revive-fears-automation-planes-2020-2 [https://perma.cc/46JQ-LGSC] (explaining the pilots in both fatal crashes by Boeing's 737 Max planes were hindered by automation).

[156] *See* Mark A. Geistfeld, *A Roadmap for Autonomous Vehicles: State Tort Liability, Automobile Insurance, and Federal Safety Regulation*, 105 CALIF. L. REV 1611, 1619 (2017) (observing that scholars have reached "'the shared conclusion' that elimination of a human driver will shift responsibility onto manufacturers.").

[157] FORD MOTOR CO., COMMENT LETTER ON FEDERAL AUTOMATED VEHICLE POLICY (Nov. 22, 2016), https://www.regulations.gov/document?D=NHTSA-2016-0090-1128 [https://perma.cc/ EC4X-AEXE]; *see* Davies, *supra* note 96 ("We're really focused on completing the work to fully take the driver out of the loop.").

[158] *See* BOEING, *737 Max Software Update: Overview,* https://www.boeing.com/commercial/737max/737-max-software-updates.page [https://perma.cc/7EA9-WKX2] (stating "The pilots will continue to always have the ability to override MCAS and manually control the airplane.").

[159] Komite Nasional Keselamatan Transportati, AIRCRAFT ACCIDENT INVESTIGATION REPORT, 27 (2018).

[160] *Id*.; *see* Sinead Baker, *This timeline shows exactly what happened on board the Lion Air Boeing 737 Max that crashed in less than 13 minutes, killing 189 people*, BUSINESS INSIDER (Oct. 29, 2019, 1:11 PM) https://www.businessinsider.com/lion-air-crash-timeline-boeing-737-max-disaster-killed-189-2019-10 [https://perma.cc/L5A4-5VMJ].

[161] Nat'l Transp.Safety Board, PRELIMINARY REPORT HIGHWAY HWY18MH010 2-3 (2018); *see* Davies, *supra* note 92.

will need to determine at what point they are the default and at what point their trajectory can be changed. If people are considered the final defense against the machine failure, then the AI must allow for human response time among other considerations. If a human response time is infeasible, then organizations must accept liability and put other failsafe mechanisms in place.

PART 4: PUBLIC POLICY

In order to ground AI public policy, we need to understand the role of AI in the decision-making process and the larger context of AI: what are the inputs, what are the dependencies on the outputs, and what could go wrong? If the technology is designed with people as the failsafe, then the technology must be designed with human reaction times.[162] The technology must contain mechanisms to ensure that human managers are alert and monitoring the process, similar to how autonomous vehicles sense whether a driver has their hands on the wheel and eyes watching the screen.[163] If the technology is designed as self-sufficient and *Out-of-the-Loop*, then the automatic oversight is even more important because as the level of automation increases, so does the likelihood that drivers will engage in non-driving tasks and be ill-prepared to resume manual control when automation failures occur.[164] What happens when the technology fails? Does it explode, crash, drop from the air—or safely land? How can we reduce the negative consequences for people from the errant technology, which is a given in fast-paced technology development process? This Article posits that predictions in the public interest should be based 1) many sensors and signals; 2) engage with a broad range of stakeholders; and 3) be legible to the last person in the chain.

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[162] *See BMW Grp., Comment Letter on Federal Automated Vehicle Policy* (Nov. 22, 2016), https://www.regulations.gov/document?D=NHTSA-2016-0090-1111 [https://perma.cc/JFP5-LLWC] (showing how BMW takes into consideration reactions of the driver during design and development of automated functions so driving an autonomous system is intuitive).

[163] NAT'L HIGHWAY TRAFFIC SAFETY ADMIN., ODI RESUME: INVESTIGATION PE 16-007, at 7 (2016), https://static.nhtsa.gov/odi/inv/2016/INCLA-PE16007-7876.PDF [https:// perma.cc/G8TW-PR92] (stating "Tesla monitors driver engagement through the interactions with the steering wheel, turn signal, and TTACC speed setting stalk."); *How to Use Super Cruise*, CADILLAC, https://www.cadillac.com/ownership/vehicle-technology/super-cruise [https://perma.cc/PP94-6EP9] (finding GM's warning system uses sensors behind the steering wheel to scan the driver's eyes and face and if the driver is not watching the road alarms will trigger).

[164] Nancy Grugle, *Human Factors in Autonomous Vehicles*, AMERICAN BAR ASSOCIATION (Nov. 20, 2019) https://www.americanbar.org/groups/tort_trial_insurance_practice/publications/tortsource/2019/fall/human-factors-autonomous-vehicles/ [https://perma.cc/7WSS-SPUK]; Raja Parasuraman & Victor Riley, *Humans and Automation: Use, Misuse, Disuse, Abuse*, Human Factors: J. Human Factors and Ergonomics Soc'y, June 1997, at 230.

4.1 Many Sensors and Signals

Managers must design redundancy into the AI system, and this directive should not be overridden by internal management considerations. Every AI system must rely on multiple observations for a single type of data to reduce errors from a misfiring or an inaccurate reading.[165]

The artificial intelligence system which caused the Boeing flights to fall through the sky responded to one sensor.[166] These sensors constantly monitor the environment to detect changes.[167] Each observation sends a signal that the system is working properly or might need to change.[168] One sensor alone triggered the Boeing 737 Max artificial intelligence system, MCAS, to override and take control from the human pilots.[169] For any mission critical systems, more than one sensor is normally used to determine what is happening in the environment.[170] If one engineer told a CEO that all operations should stop, the executive might justifiably ask for opinions from other engineers. An AI system that relies on only one sensor is like taking advice from just one engineer. Any reasonable decisionmaker would need more than one observation. Mission critical decisions, even if they are automated, need multiple points of data. A substantial decision involving human life should be based on more than one point of information.

4.2 Engage with a Breadth of Stakeholders

Management must also include a breadth of stakeholders. Multiple different groups and/or departments should contribute to the artificial intelligence system to consider how the system may affect other, related systems. For Boeing, the management suffered from compartmentalized decisions in the rush to move the 737 Max, including the MCAS system, to market.[171] MCAS solved a single problem, the plane nose going upwards, without considering the cascade of other potential issues associated with this automated decision.[172] Although, one FAA test pilot knew about the changes to MCAS, his task was restricted to how the

[165] Nicas & Creswell, *supra* note 50; Cade Metz, *How Driverless Cars See the World Around Them,* THE N.Y. TIMES (Mar. 19, 2018), https://www.nytimes.com/2018/03/19/technology/how-driverless-cars-work.html.

[166] *See 737 Max Software Update*, BOEING, https://www.boeing.com/commercial/737max/737-max-software-updates.page?fbclid=IwAR2jYXvZlKM1qgzthI450Y8MqqBQ7Ensu6L9LBrY5AT-_3g6O9RlDj__xF0 [https://perma.cc/JRF5-KE5P].

[167] John E. Cashman, *Operational use of Angle of Attack on Modern Commercial Jet Airplanes*, 11 AERO NO. 12, 16-17 (Oct. 2000).

[168] *Id*. at 17.

[169] *See* JOINT AUTHORITIES TECHNICAL REVIEW, BOEING 737 MAX FLIGHT CONTROL SYSTEM OBSERVATIONS, FINDINGS, AND RECOMMENDATIONS (2019).

[170] *See id*.

[171] Nicas et al., *supra* note 56.

[172] *See* JOINT AUTHORITIES TECHNICAL REVIEW, *supra* note 169.

plane flew, not to considering the broader challenges associated with the new design.[173] Organizations that design artificial intelligence systems, especially those with the potential for societal consequences like loss of life, should manage the process by engaging with multiple stakeholders.

4.3 Be Legible to the Last Person in the Chain

Artificial intelligence documentation is critical, yet documentation choices are susceptible to organizational pressures. Boeing did not provide sufficient documentation for MCAS because the AI system was not deemed important to pilots.[174] It is possible that Boeing did not initially publicize the AI system to deemphasize the innovations in the 737 Max and prevent the potential for new training and certifications.[175] Boeing failed to document the AI system in a way that was known to the pilots.[176] Without an awareness of the new anti-stall feature MCAS, neither airlines purchasing the airplanes[177] nor pilots flying the aircraft would be aware that the design of the 737 Max had changed in a particularly substantial way and the pilots had no control in particular circumstances.[178] In the case of Boeing 737 Max, the FAA were unaware that things had changed so substantially after the initial review of the system.[179] With the Uber self-driving car, the car sensed problems on the road but did not have a mechanism to alert the driver.[180] With the novel coronavirus, the speed at which AI is being developed may result in that documentation not developing as quickly. Organizations may justify this decision due to the severity of the crisis or by the insignificance of the perceived AI. But as Boeing discovered, a seemingly insignificant system may yield huge consequences.

Documentation choices are organizational choices. Boeing could have made the sensors and their results transparent to pilots. Uber could produce a system to alert drivers. Without transparency of the signals, it is not possible for people to interpret signals and take them. Compound this with the fact that pilots were

[173] Kitroeff et. al., *supra* note 110.

[174] *See id.*

[175] *See* Gelles et. al., *supra* note 59.

[176] Julie Creswell et. al., *After a Lion Air 737 Max Crashed in October, Questions About the Plan Arose*, N.Y. TIMES *(Feb. 3, 2019),* https://www.nytimes.com/2019/02/03/world/asia/lion-air-plane-crash-pilots.html [https://perma.cc/H2UH-PAMR].

[177] David Shephardson, *American Airlines 'unaware' of some Boeing 737 MAX functions until last week: spokesman*, REUTERS (Nov. 14, 2018, 11:56 PM), https://www.reuters.com/article/us-indonesia-crash-boeing-american-airli/american-airlines-unaware-of-some-boeing-737-max-functions-until-last-week-spokesman-idUSKCN1NK0EF.

[178] *Id*.

[179] *See* Gelles et. al., *supra* note 59.

[180] *See* Davies, *supra* note 92.

not aware of the AI system and that airlines were told that the aircraft were similar and the result was the Boeing 737 Max crash.[181]

Artificial intelligence offers convenience but at the expense of autonomy. Boeing, by not documenting a critical feature, made no provisions for human autonomy. It is clear that Boeing did not anticipate that the AI system designed to correct a flight path could also cause a catastrophic error.

4.4 Policy Recommendations

Artificial intelligence in the public interest requires oversight that balances general welfare with business interests. Legal scholars might consider the various types of liability for the organizations involved. There are several legal avenues to consider the public interest of premature AI.

Companies may be subject to claims of negligence, and industry norms are critical to determine claims of negligence.[182] In the case of Boeing, its largest competitor, Airbus, had a norm to incorporate three or more sensors into its products.[183] For business considerations, and to maintain continuity with the 737 design, Boeing engineers refused to add more than two sensors[184] and noted that two sensors contained problems as well: if the readings did not agree, which reading was correct?[185] The lack of other safety mechanisms, such as electronic checklists and hazard indications, compounded the problem on the 737 Max compared to other airplanes, even Boeing airplanes.[186] Industry associations have a clear role in establishing appropriate norms.

Negligence claims may also rely on the tests performed by the company. Stringent tests with outside verification will assure the public that the AI systems are fairly safe. The FAA did not provide the additional stress-tests for Boeing 737 Max,[187] and after the Lion Air crash, FAA officials were reportedly stunned to find out that the MCAS system became significantly more dangerous than in the original assessment.[188]

Shareholders may also argue that the organizations carry unnecessary risk by rushing an AI system to market before adequate testing. Shareholders may question the motivations of individual managers, and depending on the payment structure, individual managers may be liable if their actions were deemed sufficiently reckless.

It is critical that organizations consider their obligations to their employees. Employees may risk their lives in these AI systems. An Uber employee testing

[181] Creswell, Glanz, Kaplan, & Wicher*, supra* note 176.

[182] Eric A. Feldman, *Blood Justice: Courts, Conflict, and Compensation in Japan, France, and the United States*, 34 LAW & SOC'Y REV. 651, 671 (2000).

[183] Nicas & Creswell, *supra* note 50.

[184] *Id.*

[185] *Id.*

[186] *Id.*

[187] Kitroeff et. al., *supra* note 110.

[188] *Id.*

a self-driving car was involved in a pedestrian fatality,[189] but a future accident could harm not only a passerby, but also the driver. After the Lion Air crash, Boeing employees' morale suffered, to the point that Boeing offered trauma counseling for engineering employees who contributed to the 737 Max.[190]

Customers that purchase the AI systems may also seek legal action against the organization for their management choices. These customers may face liability and obligations to *their* own users, such as Southwest's obligations to provide a safe air travel experience for their passengers. These companies must understand how the technology that they are purchasing works to assess its safety.

An errant AI system, especially without sufficient documentation, can cascade and lead to multiple hazards for the customers' passengers, lost wages for the customers' employees, and reduced values for the customers' shareholders.[191] Policy directions must consider the impact on all parties connected, willingly or unwillingly, to the decision to release an AI system prematurely.

PART 5: CONCLUSION

Artificial intelligence may provide products, goods, and services to meet urgent needs with appropriate oversight. Regulators, the public, and industry associations could work together to prevent premature AI from coming to market. Even in a rush to use AI in projects with society-wide impacts, organizations must exercise caution to avoid loss of human lives and economic harm. Premature AI systems can provide a great benefit to society,[192] with mechanisms for legal scrutiny. We use a cautionary tale to direct policy towards assessing premature artificial intelligence systems, such as coronavirus-related AI, by addressing the management context.

Artificial intelligence is only truly in the public interest when external verification proves the resilience of an AI system outside a laboratory. Public interest law developed to defend individuals who could not avoid the bad behavior of large organizations and that behavior's impact our social world and environment. Technology is in the midst of a similar revolution. Public interest technologists challenge the digital status quo when questionable actions compromise human life and social stability. An in-depth examination of the Boeing 737 Max provides valuable lessons in the danger of bringing artificial intelligence to market too soon.

[189] Davies, *supra* note 92.

[190] Nicas et al., *supra* note 56.

[191] *See*, *e.g.*, Nicas & Creswell, *supra* note 50.

[192] JESSICA FIELD ET AL., PRINCIPLED ARTIFICIAL INTELLIGENCE: MAPPING CONSENSUS IN ETHICAL AND RIGHTS-BASED APPROACHES TO PRINCIPLES FOR AI (2020), https://cyber.harvard.edu/publication/2020/principled-ai [https://perma.cc/U5KK-MKDV].