

12-15-2022

## Toward an Enhanced Level of Corporate Governance: Tech Committees as a Game Changer for the Board of Directors

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### Recommended Citation

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## TOWARD AN ENHANCED LEVEL OF CORPORATE GOVERNANCE: TECH COMMITTEES AS A GAME CHANGER FOR THE BOARD OF DIRECTORS

Maria LILLÀ MONTAGNANI\* & MARIA LUCIA PASSADOR\*\*

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For helpful comments and discussion on different aspects of this paper, we are grateful to Jon Chan, Matteo Gatti, Sergio Gramitto, Vikramaditya S. Khanna, Joan MacLeod Heminway, Martin Petrin, Alessandro Romano, Wolf-Georg Ringe, Kathrine Strandburg and Dirk Zetsche, as well as to the participants at the Bocconi Corporate Law Workshop, at the Master in Law and Economics Midterm Workshop at the Universität Hamburg, at the Law & Technology Workshop at the University of Minnesota, at the Information Law Institute Fellows Meeting at the New York University, at the Corporate and Securities Law in Society Workshop Series, and at the University of Michigan Junior Scholars Conference.

## ABSTRACT

*Although tech committees are increasingly being included in the functioning of the board of directors, a gap exists in the current literature on board committees, as it tends to focus on traditional board committees, such as nominating, auditing or remuneration committees. Therefore, this article performs an empirical analysis of tech committees adopted by North American and European listed companies in 2019 in terms of their composition, characteristics, and functions. The aim of the study is to understand what “technology” really stands for in the “tech committees” label within the board, or—to phrase it differently—to ascertain what tech committees do and whether, and how, they enrich the current level of corporate governance. As a result, we find that even if AI has already entered the boardroom, it has not entered the “corporate governance architecture” of companies: directors employ AI, but there is no internal procedure telling them how to effectively, efficiently, and responsibly leverage its potentials and how to minimize the risks arising from its employment. Hence, to address the current lack of AI governance at the corporate level, we propose a two-layer model that pivots around tech committees and grants them a key role. In a nutshell, the article, by providing the first empirical attempt to investigate what tech committees do, unveils what they are not doing, and outlines what they should be doing instead.*

**Keywords:** Tech committees, Artificial intelligence, AI, board of directors, board committees, corporate governance, AI governance, corporate law, diversity, transparency, accountability, trustworthy AI, tech governance, ethical AI.

**JEL Classification:** K20, K22, O30, O32, O33

*“By far the greatest danger of Artificial Intelligence*

*is that people conclude too early that they understand it.”*

*-- Eliezer Yudkowsky*

## INTRODUCTION

The increasing relevance of technology in all spheres of public and private life is mirrored in the corporate sector by the emerging trend toward the adoption of tech committees within company boards.<sup>1</sup> In the literature, most current studies on corporate board committees focus on the importance of traditional corporate boards<sup>2</sup>—such as audit committees, nominating committees, and risk committees—while only a few commentators address the specificities of tech committees.<sup>3</sup> To fill this gap, in this article we empirically analyze the composition and functions of the tech committees adopted by European Union (EU) and North American listed companies to understand what “technology” really stands for in the board committees’ label, or to phrase it differently, to ascertain whether and how they enrich the current level of corporate governance.

As a result of our analysis, we find that if, and when, tech committees deal with “technology,” their conceptions often do not account for Artificial Intelligence (AI) or the most recent technological development. This is true even when technology has entered company boards. Without entering in the debate about the definition and contours of AI, we must acknowledge that company boards can employ AI in three

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<sup>1</sup> Eliezer Yudkowsky, *Artificial Intelligence as a Positive and Negative Factor in Global Risk*, in *Global Catastrophic Risks* 308–345, 308 (Nick Bostrom & Milan M Cirkovic eds., 2008); Nancy Lankton & Jean Price, *Board-Level Information Technology Committees*, ISACA (Mar. 30, 2016), <https://www.isaca.org/resources/isaca-journal/issues/2016/volume-2/board-level-information-technology-committees>.

<sup>2</sup> Kalin D. Kolev et al., *Board Committees in Corporate Governance: A Cross-Disciplinary Review and Agenda for the Future*, 56 *J. Mgmt. Stud.* 1138, 1141 (2019).

<sup>3</sup> F.A. Dramis, *Is It Time For A Board Cyber-Security Committee?*, 36 *Corp. Bd.* 1 (2015); see also *Board Creates Tech Committees*, Fla. Bar News, June 15, 2015, at 5.

different macro-categories, “assisted, augmented, and autonomous artificial intelligence.”<sup>4</sup> First, assisted AI systems can make activities, such as corporate and financial reporting more efficient<sup>5</sup> because they grant enhanced transparency and a consistent level of automation—thereby reducing the risk of errors—and enable the use of sophisticated technologies (e.g., natural language processing and eXtensible Business Reporting Language (XBRL) tagging), which facilitates accessibility, analysis, and comparison of financial data.<sup>6</sup> Second, augmented AI tools help decisionmakers make better informed decisions because they ease digesting and extracting information from gigantic amounts of data<sup>7</sup> by identifying patterns and using them to carry out a series of tasks, including those of predictive nature.<sup>8</sup> Third, a well-known development is the autonomous AI that consists of robo-directors in the position of board

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<sup>4</sup> Florian Mölslein, *Robots in the Boardroom: Artificial Intelligence and Corporate Law*, in Research Handbook on the Law of Artificial Intelligence 649, 657 (Woodrow Barfield & Ugo Pagallo eds., 2018); Anand Rao, AI: Everywhere and Nowhere (Part 3), Ins. Thought Leadership (June 8, 2016), <https://www.insurancethoughtleadership.com/ai-machine-learning/ai-everywhere-and-nowhere-part-3>.

<sup>5</sup> Fin. Reporting Council, *Artificial Intelligence and Corporate Reporting: How Does It Measure Up?* (2019), <https://www.frc.org.uk/getattachment/e213b335-927b-4750-90db-64139aee44f2/AI-and-Corporate-Reporting-Jan.pdf>. This could also help to avoid the situations that gave rise to former well-known scandals. See Zachary Karabell, The Myth of Transparency: Both Enron and Parmalat Disclosed Massive Amounts of Data as Required but Were Still Able to Deceive the Public, 152 Newsweek (July 14, 2008). See John C. Coffee, Jr., Understanding Enron: “It’s About the Gatekeepers, Stupid,” 57 Bus. Law. 1403 (2002) (discussing more generally the Enron scandal); Andrea Melis, *Corporate Governance Failures: To What Extent Is Parmalat a Particularly Italian Case?*, 13 CORP. GOVERNANCE 478 (2005) (discussing the Parmalat scandal).

<sup>6</sup> See FIN. REPORTING COUNCIL, *supra* note 5, at 10. See also Inline XBRL, SEC (Apr. 9, 2020), <https://www.sec.gov/structureddata/osd-inline-xbrl.html> (discussing that XBRL represents a standard for reporting financial data thanks to labels (or tags) computers can easily interpret).

<sup>7</sup> Luca Enriques & Dirk A. Zetzsche, *Corporate Technologies and the Tech Nirvana Fallacy*, 72 HASTINGS L.J. 55, 65–66 (2020); Dirk Zetzsche, *Corporate Technologies—Zur Digitalisierung im Aktienrecht*, 64 AKTIENGESELLSCHAFT 1 (2019).

<sup>8</sup> In this context, predictive capacity consists of the ability to use already-possessed information to generate information not possessed—in other words, “filling in missing information.” AJAY AGRAWAL ET AL., PREDICTION MACHINES: THE SIMPLE ECONOMICS OF ARTIFICIAL INTELLIGENCE (2018).

members,<sup>9</sup> which is currently mere speculation rather than concrete reality.<sup>10</sup> The feasibility and challenges of autonomous AI has been debated throughout scholarship. For example, Kindylidi points out the legal issues of robo-advisors related to the personhood problem, and the extent of AI managing, and perhaps owning firms, depending on their form of incorporation.<sup>11</sup> Although AI has entered the boardroom, it has not entered the corporate governance architecture of firms;<sup>12</sup> because there is no internal procedure telling them how to effectively, efficiently, and responsibly take advantage of AI potentials while minimizing the risks deriving from its employment.<sup>13</sup>

Hence, to address the current lack of AI governance at the corporate level, we propose a two-layer model that pivots around tech committees and grants them a key role. At a more operational level, these board committees must—to perform such a role—meet certain conditions regarding their composition and diversity.<sup>14</sup> At a second, more systemic level, tech committees should become safeguarding venues that adopt AI

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<sup>9</sup> Nicky Burrige, *Artificial Intelligence Gets a Seat in the Boardroom*, NIKKEI ASIA (May 10, 2017, 10:52 PM), <https://asia.nikkei.com/Business/Artificial-intelligence-gets-a-seat-in-the-boardroom>. The debate around the robo-directors is centered on the lack of legal personality that AI presents and the impossibility to address potential liability claims. See Möslin, *supra* note 4. Compare Ismael Peralta-Valdivieso, *AI and Corporate Law: Can an AI Replace a Director of a Company?*, TECHNOLAWGIST (Mar. 25, 2020), <https://www.thetechnolawgist.com/2020/03/25/ai-and-corporate-law-can-an-ai-replace-a-director-of-a-company/> (arguing that corporate law is not ready for AI directors because they are not legal entities); Will Pugh, *Why Not Appoint an Algorithm to Your Corporate Board?*, SLATE (Mar. 24, 2019, 8:00 AM), <https://slate.com/technology/2019/03/artificial-intelligence-corporate-board-algorithm.html> (arguing the need for more transparent algorithms and noting that directors must be “natural persons” under U.S. corporate law).

<sup>10</sup> *E.g.*, Thomas Belcastro, *Getting on Board with Robots: How the Business Judgment Rule Should Apply to Artificial Intelligence Devices Serving as Members of a Corporate Board*, 4 GEO. L. TECH. REV. 263, 272 (2019); Sergio Alberto Gramitto Ricci, *Artificial Agents in Corporate Boardrooms*, 105 CORNELL L. REV. 869, 873 (2020).

<sup>11</sup> See Iakovina Kindylidi, *Smart Companies: Company & Board Members Liability in the Age of AI*, 6 UNIO—EU L.J. 115–141 (2020).

<sup>12</sup> Enriques & Zetsche, *supra* note 7.

<sup>13</sup> *Id.*; Chiara Picciau, *The (Un)Predictable Impact of Technology on Corporate Governance*, 17 HASTINGS BUS. L.J. 67 (2021).

<sup>14</sup> See *infra* Section III.

systems which satisfy the ethical principles necessary for responsible innovation.<sup>15</sup> In particular, we refer to the Ethics Guidelines for Trustworthy AI,<sup>16</sup> developed by the High-Level Expert Group on Artificial Intelligence set up by the European Commission in June 2018,<sup>17</sup> as part of the AI strategy announced earlier that year.<sup>18</sup> We argue, compliance with the above principles would require tech committees to develop a set of best practices that could and should be incorporated into the Code of Corporate Governance.

We believe in the urgency of engaging tech committees to develop a sound AI governance at the corporate level for several reasons.<sup>19</sup> First, this may help companies make more profitable use of the latest technological developments. Not only can AI facilitate more detailed corporate reporting, which overcomes traditional difficulties encountered,<sup>20</sup> but it can also increase the frequency, value, and role of

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<sup>15</sup> See *infra* Section III.

<sup>16</sup> INDEPENDENT HIGH-LEVEL EXPERT GROUP ON ARTIFICIAL INTELLIGENCE, ETHICS GUIDELINES FOR TRUSTWORTHY AI (2019), <https://ec.europa.eu/futurium/en/ai-alliance-consultation.1.html>. Among the proliferation of principles that have been adopted, we believe that the European principles represent the most comprehensive set so far elaborated and encompass all the values that have emerged in the similar initiatives. For a comparison of the ethical principles so far adopted, see JESSICA FJELD ET AL., PRINCIPLED ARTIFICIAL INTELLIGENCE: MAPPING CONSENSUS IN ETHICAL AND RIGHTS-BASED APPROACHES TO PRINCIPLES FOR AI (2020), [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3518482](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3518482).

<sup>17</sup> The High-Level Expert Group on AI is an independent expert group that the European Commission SET up in June 2018. For the list of its deliverables, see *Expert Group on AI*, EUROPEAN COMMISSION, <https://digital-strategy.ec.europa.eu/en/policies/expert-group-ai> (Feb. 24, 2022).

<sup>18</sup> See *Communication from the Commission to the European Parliament, the European Council, the Council, THE European Economic and Social Committee and the Committee of the Regions: Artificial Intelligence for Europe*, COM (2018) 237 final (Apr. 25, 2018).

<sup>19</sup> See Luca Enriques, *Time for Boards to Take Control of Tech Governance*, FINANCIER WORLDWIDE (May 2019), <https://www.financierworldwide.com/time-for-boards-to-take-control-of-TECH-governance#.YEyfhGhKg2w>.

<sup>20</sup> Such DIFFICULTIES that AI can potentially overcome are:

◦ The efficiency of recording and aggregating transactions, across multiple entities, and then turning that data into an external communication;

M&A events across multiple markets.<sup>21</sup> It can also play a significant role within large equity corporations to innovate<sup>22</sup> and manage risk more efficiently—especially in those industries where it serves as an essential feature of business activity, like finance or insurance.<sup>23</sup> Second, due to its ability to refine the predictive models needed to improve the information provided to directors and senior executives, AI may eliminate a profit-only model of capitalism,<sup>24</sup> enable large public companies to attach a key role to shareholder value,<sup>25</sup> and ultimately improve corporate social

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- The efficiency and effectiveness of providing internal or external assurance over the resulting communication; and
  - The effectiveness of consuming the information reported by, and about, the company and translating information into insight and ultimately into action.

FIN. REPORTING COUNCIL, *supra* note 5, at 2. See also Sean Cao et al., *How to Talk When a Machine Is Listening?: Corporate Disclosure in the Age of AI* (Nat'l Bureau of Econ. Rsch., Working Paper No. 27950, 2020), <https://www.nber.org/papers/w27950>.

<sup>21</sup> John SHACKLADY, J. Neely & Donald Dawson, *M&A: From Art To Science*, ACCENTURE STRATEGY (2018), [https://www.accenture.com/\\_acnmedia/PDF-117/Accenture-AS-Tech-Led-MA-Art-Science-POV.pdf](https://www.accenture.com/_acnmedia/PDF-117/Accenture-AS-Tech-Led-MA-Art-Science-POV.pdf). See also Bernard Marr, *The 10 Best Examples Of How Companies Use Artificial Intelligence In Practice*, FORBES (Dec. 9, 2019, 12:26 AM), <https://www.forbes.com/sites/bernardmarr/2019/12/09/the-10-best-examples-of-how-companies-use-artificial-intelligence-in-practice/?sh=1c7abedc7978> (discussing different implementations of AI in corporate settings).

<sup>22</sup> *Boost Your Aiq Transforming Into An Ai Business*, ACCENTURE (2017), <https://www.citizen-entrepreneurs.com/wp-content/uploads/2018/07/Brlin-report-Accenture-Boost-Your-AIQ.pdf>.

<sup>23</sup> Irfan Saif & Beena Ammanath, *'Trustworthy AI' is a framework to help manage unique risk*, MIT TECH. REV. (Mar. 25, 2020), <https://www.technologyreview.com/2020/03/25/950291/trustworthy-ai-is-a-framework-to-help-manage-unique-risk>.

<sup>24</sup> *What AI Can Teach Us About Corporate Law and the Dangers of Shareholder Capitalism. It's Time to Reform the System and Stop the Race to the Bottom*, S'HOLDER COMMONS (Mar. 25, 2019), <https://bthechange.com/what-ai-can-teach-us-about-corporate-law-and-the-dangers-of-shareholder-capitalism-6c8e42f49910>; Sergio Alberto Gramitto Ricci, *Artificial Agents in Corporate Boardrooms*, 105 CORNELL L. REV. 869, 889 (2020).

<sup>25</sup> See Mark Purdy & Paul Daugherty, *How AI Boosts Industry Profits and Innovation*, [https://www.accenture.com/fr-fr/\\_acnmedia/36dc7f76eab444cab6a7f44017cc3997.pdf](https://www.accenture.com/fr-fr/_acnmedia/36dc7f76eab444cab6a7f44017cc3997.pdf) (defining the role of AI). See also LYNN A. STOUT, *THE SHAREHOLDER VALUE MYTH: HOW PUTTING SHAREHOLDERS FIRST HARMS INVESTORS, CORPORATIONS, AND THE PUBLIC*



responsibility.<sup>26</sup> In other words, employing AI within boards may lead to more informed choices that maximize shareholder and stakeholder value.<sup>27</sup> Third, exploring the role of tech committees as venues for robust AI governance can contribute to the broader debate on AI and provide insights into how to improve it.<sup>28</sup> Indeed, the development of AI governance at the corporate level can produce spill-over effects in the broader AI debate.<sup>29</sup> By acknowledging that the issue is not just related to the structure of the board, but to AI liability- and accountability-related matters, we can test the principles developed in theory and encourage AI trustworthiness outside company boards.<sup>30</sup>

In a nutshell, this paper, by providing one of the first, and as far as the authors' research has revealed—the first—empirical attempt to investigate what tech committees do, unveils their unexploited potential in addressing the most disruptive technological development of our times and proposes a system to make them central in governing it.<sup>31</sup> In doing this, we proceed as follows. Section I investigates the status of tech committees in the EU and North America thanks to data retrieved from BoardEx, provided by the Wharton Research Data Services (WRDS) platform.<sup>32</sup> After describing the trend in the adoption of tech committees

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(SAN FRANCISCO, CA, 2012); *The Social Responsibility of Business Is to Increase Its Profits*, NY TIMES (Sept. 13, 1970), <https://www.nytimes.com/1970/09/13/archives/a-friedman-doctrine-the-social-responsibility-of-business-is-to.html> (detailing a comprehensive study of the shareholder value); Luca Enriques, *Missing in Today's Shareholder Value Maximization Credo: The Shareholders* (Sept. 22, 2020), <https://promarket.org/2020/09/22/milton-friedman-value-maximization-credo-is-missing-the-shareholders/> (detailing the latest re-reading offered on the concept of shareholder value, fifty years after Milton Friedman's manifesto).

<sup>26</sup> Wei-Wei Zhao, *How to improve corporate social responsibility in the era of artificial intelligence?* 186 EARTH AND ENVIRONMENTAL SCIENCE. IOP CONFERENCE SERIES 12036 (2018).

<sup>27</sup> Oliver Hart & Luigi Zingales, *Companies Should Maximize Shareholder Welfare Not Market Value*, 2 J. LAW, FIN. & ACCT. 247 (2017).

<sup>28</sup> See *infra* Section III.

<sup>29</sup> See *infra* Section III.

<sup>30</sup> See Ricci, *supra* note 24 (defining a first attempt to explore the issue of AI accountability within boards).

<sup>31</sup> See *supra* notes 19–26 and accompanying text (explaining the potential of AI); see also *infra* Section III (explaining the system of AI governance).

<sup>32</sup> See *infra* Section I (investigating the extracted BoardEx data retrieved from the authors within the journal). The data extracted from BoardEx

by European and North American listed companies from January 2000 to December 2019, this section focuses on tech committees' composition and distribution among various industrial sectors in 2019.<sup>33</sup> Section II explores the role of tech committees through documents describing their functions to verify whether they deal with tech-related issues in practice and, if so, how.<sup>34</sup> The hand-picked excerpts from the previously-mentioned database are then examined through content analysis and results in the identification of five main activities . . . , i.e. "Strategy", "Monitoring", "Innovation", "Risk Management" and "Security". The empirical analysis is completed by merging quantitative methods with a qualitative analysis of textual sources (*i.e.* the documents of tech committees) through a qualitative comparative analysis (QCA). In light of the empirical evidence gathered, Section III proposes a model of governance that empowers tech committees and provides them with a truly "tech" role.<sup>35</sup> Section IV concludes.<sup>36</sup>

## I. TECH COMMITTEES IN EUROPE AND NORTH AMERICA

In literature there is little, if any, research on tech committees. The majority of studies conducted so far focus on the importance of the role of committees<sup>37</sup> and, more recently—as a result of the global pandemic—on the optimal characteristics that a board must have in order to prevent such crisis more effectively.<sup>38</sup> This strand of research comprises the analysis of "traditional" board committees—such as audit committees, nominating committees and risk committees—but only few commentators examine tech committees.<sup>39</sup>

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(<https://www.boardex.com>) (last accessed October 2nd, 2020) is in a database that is on file with the authors.

<sup>33</sup> See *infra* Section I.

<sup>34</sup> See *infra* Section II.

<sup>35</sup> See *infra* Section III.

<sup>36</sup> See *infra* Section IV.

<sup>37</sup> Kalin D. Kolev *et al.*, *Board Committees in Corporate Governance: A Cross-Disciplinary Review and Agenda for the Future*, 56 J. MGMT STUD. 1138 (2019).

<sup>38</sup> Ettore Croci *et al.*, *The Advisory and Monitoring Roles of the Board Evidence from Disruptive Events* (Apr. 23, 2020), <https://ssrn.com/abstract=3581712>.

<sup>39</sup> See Dramis, *supra* note 3. See also *Board Creates Tech Committees*, *supra* note 3 (showing an example of a board creating a tech committee in the same year that F.A. Dramis's article questioned whether or not it was time to make one).

However, some authors already emphasize that a tech-savvy board is needed now, and will be vital in the future.<sup>40</sup> Among companies with over \$1 billion in revenues, 24% of them that have digitally savvy boards significantly outperform others on key metrics—such as revenue growth, return on assets, and market cap growth.<sup>41</sup> This apparently derives from the fact that a tech savvy board is made of individuals with outstanding backgrounds who are capable of asking critical questions, are good at prioritizing the board agenda, and are motivated to keep learning.<sup>42</sup> Moreover, corporations with tech committees (like ones with IT expert CEOs) tend to file one of the most well-known corporate disclosure forms, Form 8-K,<sup>43</sup> in a more timely manner, even when complicated or surprising events occur.<sup>44</sup> Despite the general consensus that tech committees—and tech capabilities—constitute a fundamental resource for companies, a detailed analysis of such committees has not yet been carried out, either in general or with respect to the technology-related matters that they address.<sup>45</sup> In the following sections, we attempt to fill this gap in the literature by providing a thorough analysis of tech committees currently adopted by listed companies in the EU and in North America.<sup>46</sup>

#### A. *Sample and Methodology*

In the quantitative part of the study, we employ the empirical strategy of retrieving data on corporations and their tech committees and

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<sup>40</sup> Peter Weill, Thomas Apel, Stephanie L. Woerner & Jennifer S. Banner, *It Pays to Have a Digitally Savvy Board Having board members with experience in digital business is the new financial performance differentiator*, MIT SLOAN MGMT. REV. (Mar. 12, 2019), <https://sloanreview.mit.edu/article/it-pays-to-have-a-digitally-savvy-board>.

<sup>41</sup> *Artificial Intelligence and Corporate Reporting. How Does It Measure Up?* FIN. REPORTING COUNCIL, (Jan. 2019), <https://www.frc.org.uk/getattachment/e213b335-927b-4750-90db-64139aee44f2/AI-and-Corporate-Reporting-Jan.pdf>.

<sup>42</sup> Julie Garland-McLellan, *How To Beef Up Your Board's Tech Savvy*, ALTO PARTNERS, <https://altopartners.com.au/how-to-beef-up-your-boards-tech-savvy/> (last visited June 12, 2022).

<sup>43</sup> *FORM 8-K*, SEC, <https://www.sec.gov/files/form8-k.pdf>.

<sup>44</sup> Jacob Z. Haislip, Khondkar Karim, Karen Jingrong Lin & Robert Pinsker, *The Influences of CEO IT Expertise and Board-Level Technology Committees on Form 8-K Disclosure Timeliness*, 34 J. INFO. SYST. IN-PRESS 167 (2019) (noting the form is submitted a full-day and a half-day sooner).

<sup>45</sup> Dramis, *supra* note 3, at 4.

<sup>46</sup> See discussion *infra* Sections I.A–I.E.

analyzing them using statistical software (Excel filtering<sup>47</sup> and Stata<sup>48</sup>). We analyzed the tech committees adopted from 2000 to 2019 in continental Europe and North America (United States and Canada) by relying on the WRDS and BoardEx databases.<sup>49</sup> We also examined their annual reports<sup>50</sup>—excluding the UK from the entire assessment.<sup>51</sup> BoardEx provides data on companies adopting committees in the chosen geographical scenarios and indicates who actually sits on those committees.<sup>52</sup> Besides extracting the data on tech committees, we enriched the analysis by linking it to more general data on boards and directors derived from BoardEx. This enabled us to build a custom dataset that not only includes information on tech committees’ composition and directors, but also provides an “identikit” (or “portrait”) of the companies that have adopted such a committee.<sup>53</sup>

Before describing the sample and the methodology employed, a premise is necessary. When we refer to “tech committees,” we include all the diverse types of committees dealing with technology. The BoardEx

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<sup>47</sup> Figures 1–18.

<sup>48</sup> Figure 18 and Tables 1–5.

<sup>49</sup> See *supra* note 32 and accompanying text. We extracted data related to the period from January 2000 to December 2019 from BoardEx. We disregarded data from 2020, as the whole year was not available and what was available was only related to U.S. firms at the time of the dataset construction. *Id.* Geographically, we selected data for the whole of continental Europe and the U.S. pertaining to companies that adopted a tech committee in the time frame, as well as to the directors sitting on these committees. *Id.*

<sup>50</sup> See *infra* the illustration of the methodology in Section III.

<sup>51</sup> See *supra* note 32. Although excluded from the dataset, it is worth mentioning that in the United Kingdom, the only company having appointed a tech committee, according to data available as of December 2019, is International Personal Finance PLC, where the tech committee consists of a senior independent Non-Executive Director (NED), an independent designated NED, and two independent NEDs (one of whom is the Chairman of the tech committee). *Id.* As of March 2020, BT Group PLC adopted this committee, replacing International Personal Finance PLC, BT Group PLC, but the committee consisted of two members only (independent NEDs). *Id.* In the past, however, Dwr Cymru Cyfyngedig Ltd, Hydrodec Group PLC, National Association of Citizens Advice Bureaux, Psion PLC, Simec Atlantis Energy LTD, and UK Department for Work and Pensions also relied on this committee. *Id.* In the latter case, the Chairman of the Committee was a particularly qualified figure (in March 2017): Mayank Prakash, who served as Chief Information and Digital Officer on the Board. *Id.*

<sup>52</sup> *Id.*

<sup>53</sup> See *infra* Sections I.B, I.C, I.D, I.E.

classification reports the specific titles that companies use to indicate committees dealing with technology, such as the “Technology and Value Creation” committee, the “Technology Data and Information Security” committee, or the “Technology Innovation and Operations” committee, where “Technology” committee is just *one* of them.<sup>54</sup> We have taken all of the various tech-related committees into account.

Our main sample aims to highlight the trends that developed, not only in the adoption of the committee itself, but also in its composition and adoption in the various industrial sectors.<sup>55</sup> In the chosen period, 21,997 companies adopted a tech committee, namely 5,313 listed companies in the EU and 16,684 in the U.S..<sup>56</sup> From the main sample, we extracted the 2019 data and created a subsample that enables us to provide a picture of what tech committees currently look like. While the main sample is used to elicit trends across the 2000–2019 period, the subsample (2019 Sample) is analyzed using descriptive statistics on the current state of tech committee adoption.<sup>57</sup> Of the eighty-four companies in the 2019 Sample, twenty-eight are located in the EU and fifty-six are located in North America, amounting to 1.013% of the listed companies in the EU and to 1.1365% of listed companies in North America, respectively.<sup>58</sup>

Given that the absolute comparison of percentage composition produces almost identical results (percentage difference is negligible), we augmented the analysis with relative comparison of companies, considering their market capitalization and impact on the national stock index.<sup>59</sup> Market data were then used to produce market capitalization, which is a measure of the total market value of each publicly listed company.<sup>60</sup>

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<sup>54</sup> See *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>55</sup> *Id.*

<sup>56</sup> *Id.*

<sup>57</sup> *Id.* The 2019 Sample is also on file with the authors.

<sup>58</sup> See *id.*

<sup>59</sup> See *infra* Figure 1. Note, all Figures and Tables *infra* were composed by the authors using the data and methodology described *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>60</sup> See *infra* Figure 1. For a definition of market capitalization, see Jason Fernando, *Market Capitalization*, INVESTOPEDIA,

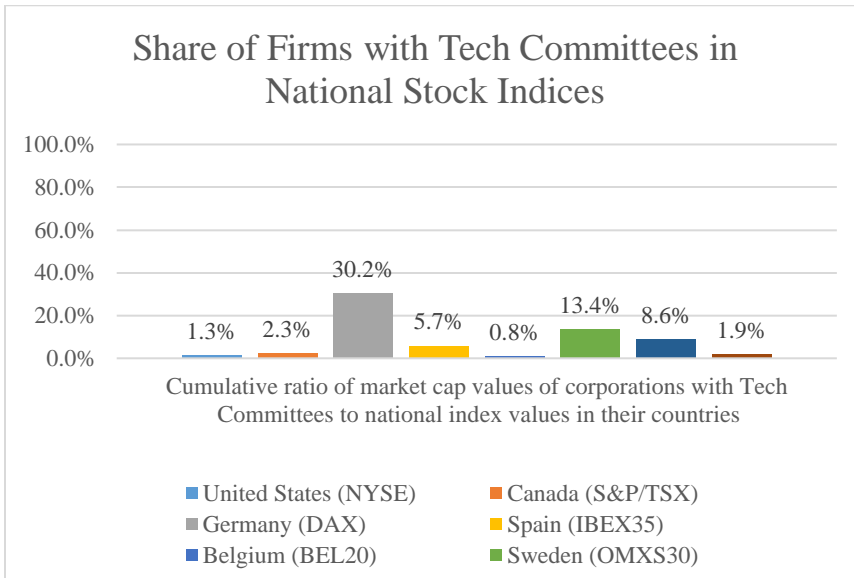


Figure 1

Finally, each market capitalization figure was compared to the cumulative value of the national blue-chip index in the country where the company is listed.<sup>61</sup> The ratio of market capitalization to the total value of the national index expresses the company's market share, which we then compared across countries and sectors.<sup>62</sup> In the majority of cases, the total share of firms with tech committees is affected by a few large players, apart from Germany where there are many firms with tech committees affecting the market.<sup>63</sup> Although in this case companies are individually smaller, together they have a greater effect than in other countries.<sup>64</sup>

<https://www.investopedia.com/terms/m/marketcapitalization.asp>, (last updated May 26, 2022).

<sup>61</sup> Market *data* was extracted from Refinitiv's Datastream database, and is on file with the authors.

<sup>62</sup> See *infra* Figure 2.

<sup>63</sup> *Id.*

<sup>64</sup> *Id.*

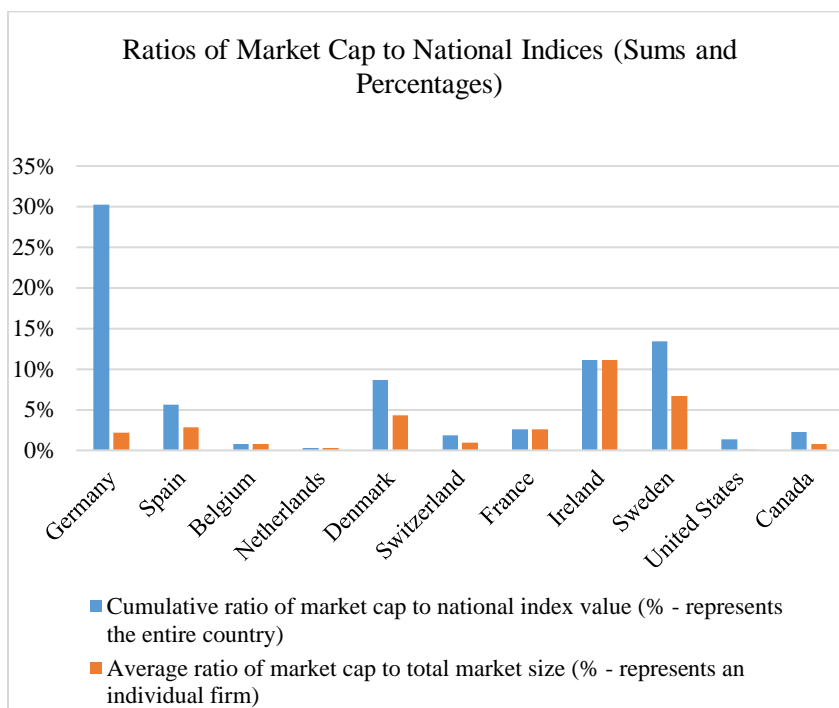


Figure 2

The graphs above show the overall conclusion of the quantitative analysis differentiating companies with tech committees by their origin (i.e. whether in the EU or in North America).<sup>65</sup> The EU has a far greater prevalence of tech committees in the boards of public companies despite being a smaller market in terms of number of companies, their actual market size, and their market share.<sup>66</sup> For example, as of October 3, 2020, the German index, Deutsche Aktienindex 30 (DAX 30), which is a blue-chip stock market index consisting of the thirty major German companies

<sup>65</sup> See *supra* Figures 1, 2.

<sup>66</sup> See *id.*; see also *infra* Figure 3. This ratio is different from the weight of a stock in the national index. Some companies in the research are so small that they do not appear in the national blue-chip index. Each national blue-chip index tracks the stocks of the largest companies in the country, and hence gives an indication of the overall market size, to which each company is compared. *But see* James Chen, *Blue-Chip Index*, INVESTOPEDIA, <https://www.investopedia.com/terms/b/blue-chip-index.asp#:~:text=A%20blue%2Dchip%20index%20is,of%20an%20industry%20or%20economy> (last updated July 26, 2021) (explaining why the ratio is different from the weight of the stock in a national index).

trading on the Frankfurt Stock Exchange, had an overall market capitalization of €1,240,673,555,043.<sup>67</sup> Additionally, SAP SE, the largest enterprise management software company in Europe, had a market cap value (that day) of €158,477,016,000, making it 12.8% of the whole index.<sup>68</sup> Public companies like SAP SE have tech committees, and therefore, appear in our comparison where we analyze their market capitalization figures to national indices (used as a proxy for national market size). Therefore, we infer the actual market share of each corporation by looking at the ratio of its market capitalization to its respective national index in the country where its stock is traded. As shown in Figure 2, the result is true not only on average, but also in cumulative terms when comparing the national EU markets to the North American ones.<sup>69</sup>

### B. *Tech Committees as an Increasing Trend*

Over the 2000–2019 time frame, the number of listed corporations adopting tech committees increased in both the EU and North America.<sup>70</sup> While in the EU the curve has constantly increased (but for 2019), there has been no similar trend in North America as tech committees seem to be less constant and have faced setbacks like during the years of the financial crisis (2007–2009).<sup>71</sup> In the EU, instead, the number remains essentially steady—or increases almost unnoticeably—but less from 2010 to 2013 and from 2014 to 2016.<sup>72</sup> Most corporate governance codes recommend the creation of audit, nominating, and remuneration committees over other types of committees; thus, tech committees are often abolished when companies need to cut extra costs by simplifying the internal structure of the company.<sup>73</sup>

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<sup>67</sup> Authors' own analysis based on Datastream International.

<sup>68</sup> Authors' own analysis based on Datastream International.

<sup>69</sup> *See supra* Figure 2.

<sup>70</sup> *See infra* Figure 3.

<sup>71</sup> *See infra* Figure 3.

<sup>72</sup> *See infra* Figure 3.

<sup>73</sup> Any decrease in the numbers of tech committees can be in part due to budget cuts that required *companies* to simplify their internal structure.



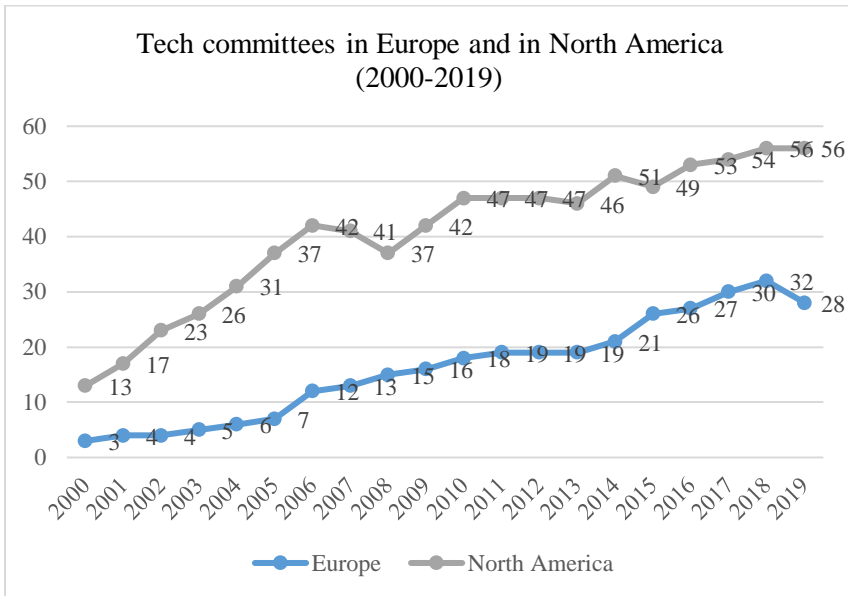


Figure 3

In more detail, in 2000, the first companies to have a tech committee in the EU were Banco Santander SA (previously known as Banco Santander Central Hispano SA), Medtronic Plc (previously known as Medtronic Inc.) and SAP SE (previously known as SAP AG).<sup>74</sup> The respective committee were composed of eight directors (Banco Santander SA), six directors (Medtronic PLC), and three directors (SAP SE).<sup>75</sup> Medtronic initially created a small committee (composed of two members only) in December 1998 (enlarged to six in January 1999), while Banco Santander introduced this committee as early as January 1999 and SAP only joined the Spanish credit institution in 2000.<sup>76</sup> The leading case of Banco Santander comprises a committee composed of a Chairman, who was also the Chairman of the board of directors, as well as ‘ordinary’ members who serve as Vice-Chairman/CEO, independent directors, and non-independent directors; by contrast, SAP’s tech committee consists of two employee representatives (one of whom is also the Deputy Chairwoman), a member of the board of directors, alongside another

<sup>74</sup> See *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and *method* of data collection). All original data is on file with the authors.

<sup>75</sup> *Id.*

<sup>76</sup> *Id.*

employee representative, and two independent directors as of May 2002.<sup>77</sup> Such experience was followed, *inter alia*, by Deutsche Boerse AG in 2004, ASML Holding NV in March 2005, and Nordex SE (then Nordex AG) in June 2005.<sup>78</sup>

The number of tech committees gradually increased in the following years. Although Banco Santander abandoned its committee in 2015 (as other companies did too after experiencing it), other companies, including Barco NV, DMG Mori AG, Engie SA, H&R GmbH, Kuka AG, Saft Groupe SA, adopted technology committees, technology and strategy committees, technology and development committees, with the increasing involvement of independent directors as Committee Chairmen.<sup>79</sup> Of the EU companies that had a tech committee in December 2015, only 5 of the committee Chairman were non-independent members of the board.<sup>80</sup> In the following years, the number of companies benefiting from tech committees further increased, with the exception of 2019, where the number of tech committees lowered to 28 companies out of the 2,763 listed companies in Europe.<sup>81</sup>

In North America, the situation is much more articulated and multifaceted. By 2000, companies across a variety of industries (*e.g.*, mining, real estate, chemicals, banking, and insurance) adopted tech committees.<sup>82</sup> This diversity in the variety of industries is mirrored in the diversity in the specific names adopted to designate such committees: from pure technology to technology advisory ones, from technology and environment to technology and science, and, again, technology and quality ones.<sup>83</sup> However, all committees were essentially headed by independent

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<sup>77</sup> *Id.*

<sup>78</sup> *Id.*

<sup>79</sup> *Id.*

<sup>80</sup> *Id.*

<sup>81</sup> *Id.* Among the 28 companies, Allianz SE, ASML Holding NV, Barco NV, BBVA - Banco Bilbao Vuzcaya Argentaria SA, Comet Holding AG, Deutsche Bank AG, Deutsche Boerse AG, Engie SA, Ericsson, FLSMIDTH & Co A/S, H&R GmbH & Co. KGAA, Holidaycheck Group AG, Kuka AG, Nokia OYJ, Sap SE, Schaeffler AG, Schaltbau Holding AG, Vat Group AG, Vestas Wind System A/S and Volvo AB), mainly located in Germany. *Id.*

<sup>82</sup> See *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>83</sup> *Id.*

directors and, less frequently, by either the Chairman of the board or non-independent directors.<sup>84</sup>

Notwithstanding the crisis, and the perhaps contingent differences among years, it is undeniable that the attention to tech issues has grown progressively in both the jurisdictions considered.<sup>85</sup> Moreover, in this scenario, where recent technological developments are prompting companies to address related issues, the number of tech committees is expected to grow, making it urgent to start pondering the point.<sup>86</sup>

### C. *Tech Committees' Composition*

Moving to the composition of tech committees in 2019, there were 411 directors who were members of a tech committee: 159 of them in the EU and 252 of them in North America.<sup>87</sup> As to the 159 EU, they generally serve on the tech committee for an average of 9 years, the same period of time in which they served as committee members and held any position in the same company, while also spending an average of 5.5 years in a different company.<sup>88</sup> These directors also held a role in other listed (14 companies on average) and unlisted (20 companies on average) companies.<sup>89</sup> Directors have an average “time to retirement” of 7.8 years according to BoardEx, which determines the retirement age to be 70 years.<sup>90</sup> This means that in the EU, tech committee members are, on average, 62 years old.<sup>91</sup> The boards of directors of the companies featuring a tech committee seem to be quite numerous, as their average composition is equal to 28 members, and mainly consists of male directors (gender ratio on average, *i.e.* the proportion of male directors provided for each annual report date under consideration: 0.75) originating from the same country (nationality mix on average, *i.e.* the proportion of directors from different countries provided for each annual report date under consideration: 0.3), with a modest network size (*i.e.* the number of overlaps through employment, other activities, and education) of each member of the tech committee.<sup>92</sup> Comparing the 2000–2019 dataset data on gender ratio and

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<sup>84</sup> *Id.*

<sup>85</sup> *See id.*

<sup>86</sup> *See supra* Section I.B.

<sup>87</sup> *Id.*

<sup>88</sup> *See infra* Figure 4.

<sup>89</sup> *See infra* Figure 4.

<sup>90</sup> *See infra* Figure 4.

<sup>91</sup> *See infra* Figure 4.

<sup>92</sup> *See infra* Figures 5a, 5b.

nationality mix, we notice a slightly different average (respectively at 0.7115 and 0.25). This shows that, over time, boards in the EU have slowly diversified in terms of both gender and nationality.<sup>93</sup>

As to the 252 North American directors who also were members of a tech committee in 2019, each director served on the tech committee for an average of 12 years (and were often on the board for more than 15 years while spending almost 20 years with the particular company).<sup>94</sup> Their commitment is mostly devoted to that firm since the average time spent in other companies is never more than 2.4 years.<sup>95</sup> The members of a tech committee in North America often tend to sit in very few additional boardrooms: on average in 1 listed and 0.5 unlisted companies' boards. Contrary to the EU, North American tech committees are also comprised of considerably smaller boards (with an average of 9.5 members).<sup>96</sup> Directors who sit on tech committees in North America tend to be older (with an average "time to retirement" of -3.65) according to BoardEx, meaning that their average age is almost 74.<sup>97</sup>

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<sup>93</sup> See *infra* Figures 5a, 5b.

<sup>94</sup> See *infra* Figure 4.

<sup>95</sup> See *infra* Figure 4.

<sup>96</sup> See *infra* Figure 4.

<sup>97</sup> See *infra* Figure 4.

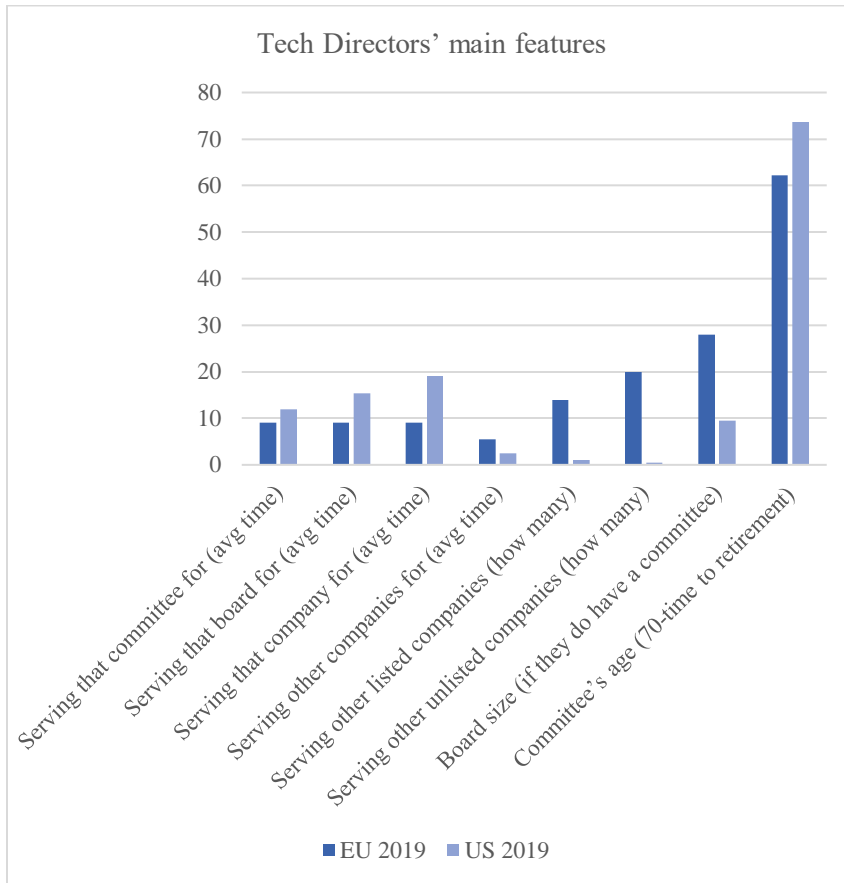


Figure 4

Both EU and North American tech committees seem to be comprised predominantly of men from the exact same geographical context.<sup>98</sup> In 2000, in the EU, although there were just a few tech committees, the average gender ratio value was 0.8.<sup>99</sup> In 2019, the number of men had decreased, in line with the trend that increasingly welcomes more women on the boards of directors and, arguably, in board

<sup>98</sup> See *infra* Figure 5a.

<sup>99</sup> See *infra* Figure 5a.

committees,<sup>100</sup> to 0.75.<sup>101</sup> Nevertheless, the average gender ratio of all directors who sit on a tech committee over the period under review is quite significant (0.81), suggesting that in the 2000–2019 time period, even if there were fluctuations, on average tech committees have presented a predominantly male presence (above 0.8).<sup>102</sup>

In North America, the value of the gender ratio in 2000 and 2019 is essentially unchanged (0.822775 and 0.8295). Here, though the average value of the twenty-year period is definitively higher (0.875) than in the EU, suggesting an even more irregular trend, with peaks in which the tech committees were heavily male dominated.<sup>103</sup>

The analysis of the average values and the gender ratios in 2000 and 2019 are worth a couple of additional remarks. As the EU average value in the twenty years (0.81) combined with the current value in 2019 (0.75) shows an increasing female presence on the boards, it seems that gender equality provisions have been effective within the tech committees as in general with all board of listed companies.<sup>104</sup> The analysis of the same data in North America calls for attention to the ground-breaking California law requiring publicly-held corporations headquartered in the Golden State to have at least one woman on the Board by the end of 2019 (SB 826).<sup>105</sup> Apparently, this would be particularly beneficial for those

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<sup>100</sup> On the (increasing) representation number of women in the boards and the state of the art of the European regulation in this field: EUROPEAN COMMISSION, 2019 REPORT ON EQUALITY BETWEEN WOMEN AND MEN IN THE EU 27–30 (2019), [https://ec.europa.eu/info/sites/info/files/aid\\_development\\_cooperation\\_fundamental\\_rights/annual\\_report\\_ge\\_2019\\_en\\_1.pdf](https://ec.europa.eu/info/sites/info/files/aid_development_cooperation_fundamental_rights/annual_report_ge_2019_en_1.pdf). See also *Women in the Boardroom: Progress inches forward at a snail's pace*, DELOITTE <https://www2.deloitte.com/global/en/pages/risk/articles/women-in-the-boardroom-seventh-edition.html> (last visited Apr. 15, 2022).

<sup>101</sup> See *infra* Figure 5a.

<sup>102</sup> See *infra* Figure 5a.

<sup>103</sup> See *infra* Figure 5a.

<sup>104</sup> Sharon Thorne & Dan Konigsburg, *Gender Parity in the Boardroom Won't Happen on Its Own*, HARV. BUS. REV. (Feb. 12, 2020), <https://hbr.org/2020/02/gender-parity-in-the-boardroom-wont-happen-on-its-own>. See generally Giulia Ferrari, Valeria Ferraro, Paola Profeta & Chiara Pronzato, *Do Board Gender Quotas Matter? Selection, Performance and Stock Market Effects.*, IZA INST. ON LABOR ECON. (2018).

<sup>105</sup> For a skeptical view on the effectiveness of this provision, see Vanessa Fuhrmans, *California Becomes First State to Mandate Female Board Directors*, WALL ST. J. (Sept. 30, 2018, 6:13 PM),

companies that aspire to be recognized as innovators in their sectors,<sup>106</sup> as companies with greater gender diversity are associated with higher R&D intensity<sup>107</sup> and are likely to obtain more patents.<sup>108</sup>

As to the nationality mix,<sup>109</sup> the 2019 data show EU tech committees' greater openness to individuals from geographical contexts other than North America (0.3 v. 0.15).<sup>110</sup> In the EU, however, the extent of such an open approach/environment decreased over time (in 2000 it was 0.81), while in North America there has been a (minor) increase that can be perceived looking at the average value in the twenty-year period (0.072) rather than at the 2000 value (which was identical).<sup>111</sup>

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<https://www.wsj.com/articles/california-becomes-first-state-to-mandate-female-board-directors-1538341932>. In the aftermath of decision of the Senate, *see* Joseph A. Grundfest, *Mandating Gender Diversity in the Corporate Boardroom: The Inevitable Failure of California's SB 826*, STANFORD UNIV. ROCK CENTER FOR CORPORATE GOVERNANCE WORKING PAPER SERIES NO. 232 (2018); *see also* Stephen M. Bainbridge, *California Corporate-Board Quota Law Unlikely To Survive A Constitutional Challenge*, WLF LEGAL PULSE (Oct. 2, 2018), <https://www.wlf.org/2018/10/02/wlf-legal-pulse/california-corporate-board-quota-law-unlikely-to-survive-a-constitutional-challenge/>.

<sup>106</sup> J. Yo-Jud Cheng & Boris Groysberg, *Gender Diversity at the Board Level Can Mean Innovation Success. Improving recruitment on corporate boards can boost innovation and creativity*, MIT SLOAN MGMT. REV. (Jan. 20, 2020), <https://sloanreview.mit.edu/article/gender-diversity-at-the-board-level-can-mean-innovation-success>.

<sup>107</sup> *See generally* Toyah Miller & María Del Carmen Triana, *Demographic Diversity in the Boardroom: Mediators of the Board Diversity–Firm Performance Relationship*, 46 J. MGMT. ST. 755 (2009).

<sup>108</sup> Jie Chen, Woon Sau Leung & Kevin P. Evans, *Female board representation, corporate innovation and firm performance*, 48 J. EMP. FIN. 236–54 (2018).

<sup>109</sup> *See* Szymon Kaczmarek & Winfried Ruigrok, *In at the Deep End of Firm Internationalization: Nationality Diversity on Top Management Teams Matters*, 53 MGMT. INT'L REV. 513 (2013) (discussing the importance of considering these values in the composition of the board).

<sup>110</sup> *See infra* Figure 5b.

<sup>111</sup> Korn Ferry, *Diversity of non-executive directors differs widely across Europe*, CONSULTANCY.EU (Mar. 25, 2019), <https://www.consultancy.eu/news/2501/diversity-of-non-executive-directors-differs-widely-across-europe> Ferry notes:

Listed companies in Switzerland, Belgium and the UK have the most diverse backgrounds in non-executive positions. In Switzerland, around 25% of executives originally come from

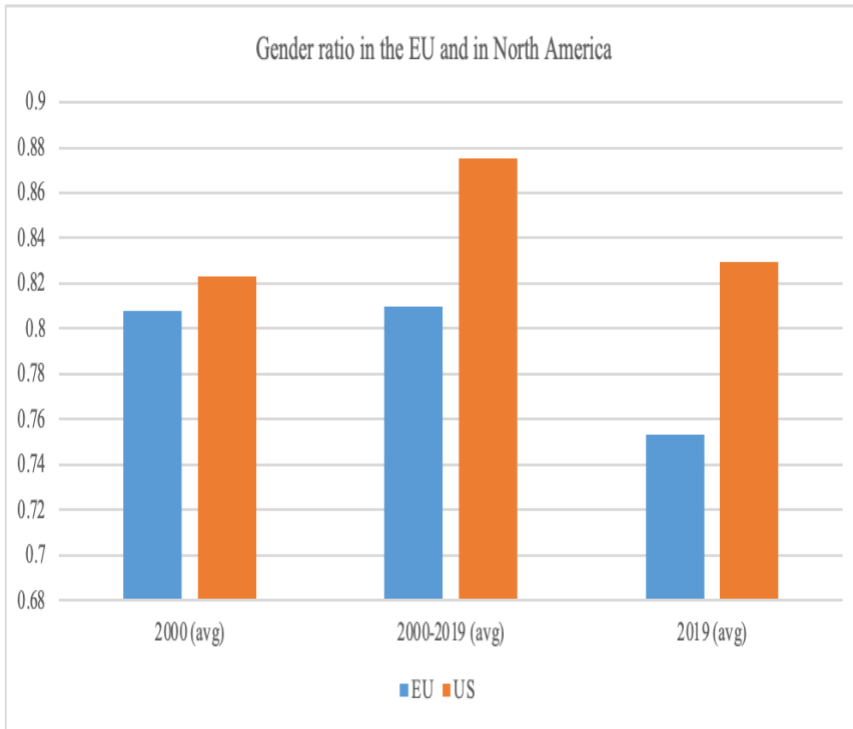


Figure 5a

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outside of Europe, with 30% of the Europeans coming from a different country than where the company is headquartered. Not surprisingly, Germany and France (both above 70%) are inclined to have the most country national on their boards, a situation mostly explained by local management heritage and local language preferences.”). *Id.* See also Kaczmarek & Ruigrok, *supra* note 109.



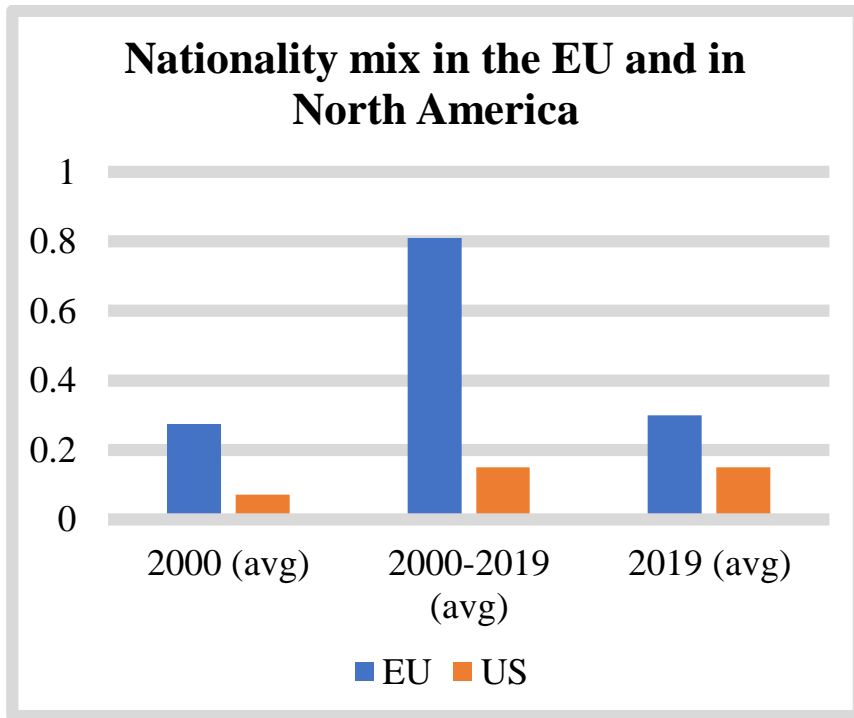


Figure 5b

Finally, as expected, independent directors are the ones that predominantly operate in tech committees.<sup>112</sup> As to “independence” (and, generally, as to board roles), BoardEx is incredibly detailed, but it is often difficult to fully understand the meaning of each shade of independence it provides, so, for the purpose of this analysis, we consider as “independent directors” the following roles: Chairman (Independent Board Member), Deputy Chairman (Independent Employee Representative), Employee Representative (Independent Board Member), Employee Representative (Independent), Independent Board Member, Independent Chairman, Independent Chairman (Shareholder Representative), Independent Chairman Emeritus, Independent Co-Chairman, Independent Corporate Director, Independent Deputy Chairman, Independent Deputy Chairman (Employee Representative), Independent Director, Independent Director/Secretary, Independent Shareholder Representative, Independent Vice Chairman, Lead Independent Chairman, Lead Independent Director, President Independent Director, Presiding Independent Chairman,

<sup>112</sup> See *infra* Figure 6.

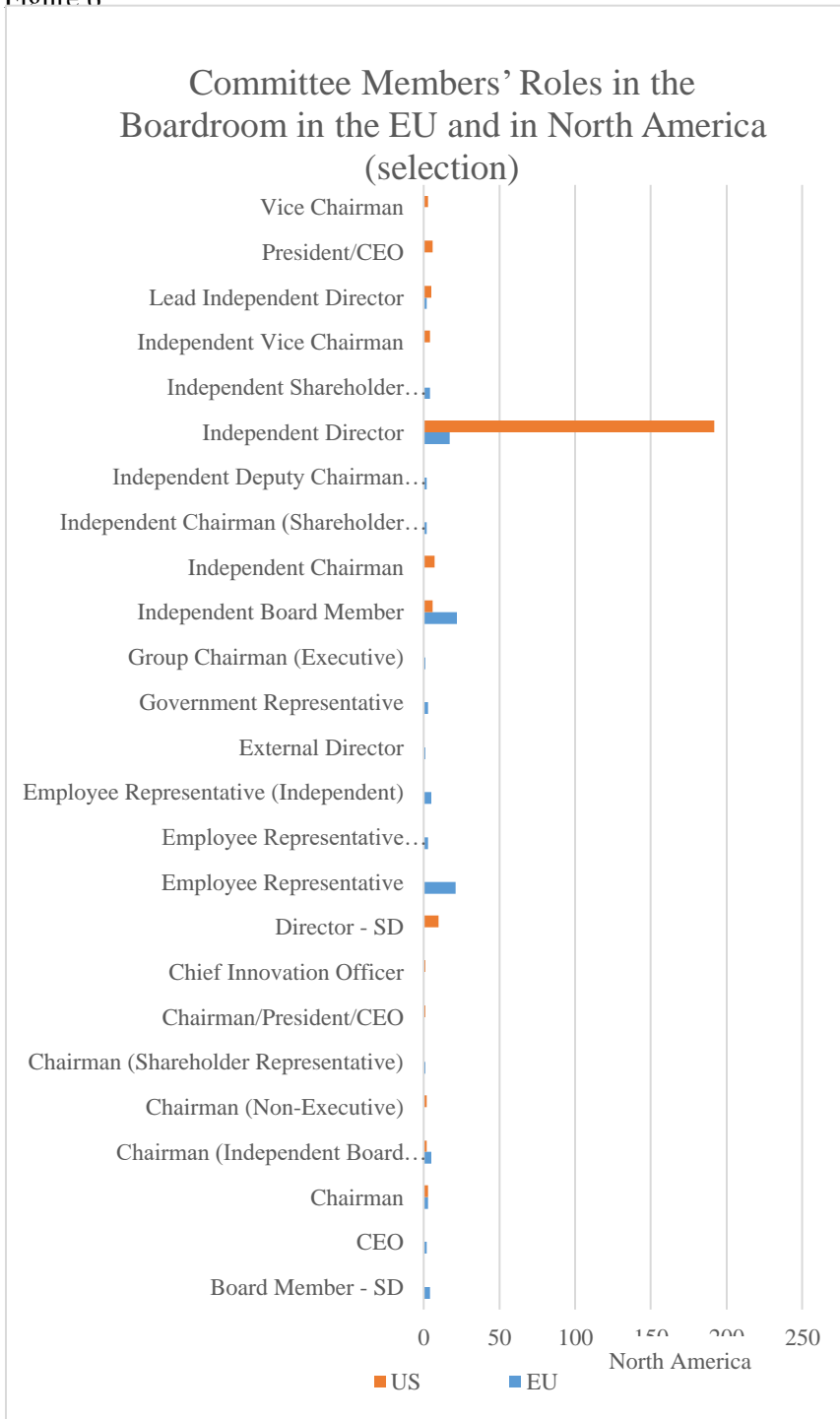
Presiding Lead Independent Director, Shareholder Representative (Independent Board Member), and the Vice Chairman (Independent Board Member).

In the EU, in 2019, we then have ninety-five independent directors among the tech committees' members (59%), but also twenty-six employee representatives, five Chairmen, two CEOs, and three government representatives).<sup>113</sup>

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<sup>113</sup> See *infra* Figure 6.

Figure 6



D. Tech Committees and Industrial Sectors

The last element of the analysis that sheds light on the nature of the companies adopting a tech committee relates to the industrial sector in which they operate. In 2019, in the EU, the majority of companies that had a tech committee were active in the Software and Computer Services sector (twenty-four), the Electronic and Electrical Equipment sector (twenty), Engineering and Machinery sector (seventeen), and the Banking sector (thirteen).<sup>114</sup> In North America, companies are involved in the same fields as those in Europe, but the North American banking sector is much more tech-sensitive (forty-four cases), ranking second in the list of sectors where tech committee are active.<sup>115</sup>

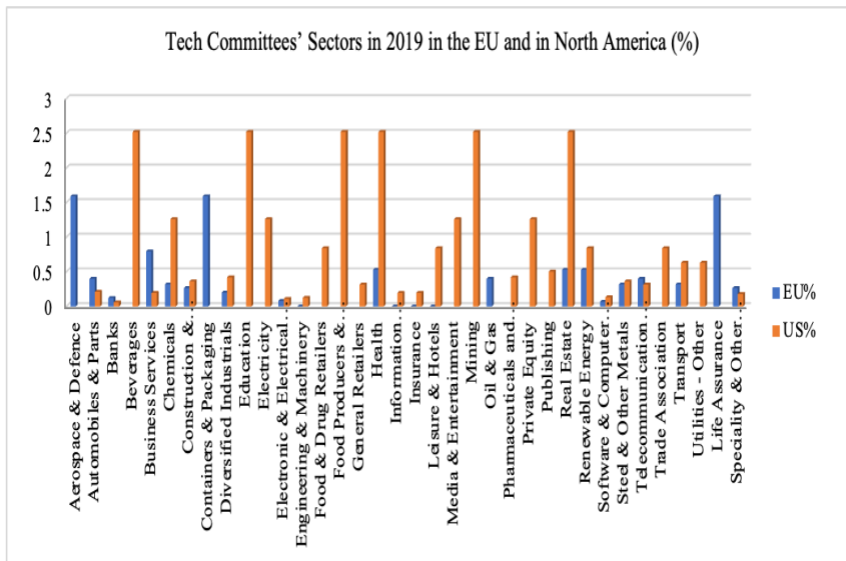


Figure 7

However, to fully understand which are the industries where tech committees are more employed, we have matched the above data within each specific sector,<sup>116</sup> while advanced data technologies are, instead, less

<sup>114</sup> See *infra* Figure 7.

<sup>115</sup> See *infra* Figure 8.

<sup>116</sup> THOMSON REUTERS EIKON (2020) [SECTORAL CLASSIFICATION OF CORPORATIONS, 2019] [DATASET].

relevant in sectors such as biomedical, electricity utilities, and telecommunication.<sup>117</sup>

However, corporations from sectors without technology at the core of their business activity but who still have a tech committee, employ, on average, a considerably high number of personnel.<sup>118</sup> The high average number of employees (represented by the blue bars in Figure 9) contrasts with the fact that within their sectors, these corporations do not have a strong market share (as shown by a low placement of orange dots still in Figure 9, indicating the percentage ratio of market cap to national index values).<sup>119</sup> Although further research is needed to demonstrate causality in terms of the impact of tech committees on the adoption of AI and the subsequent replacement of a company's personnel that such adoption may entail, the preliminary data analysis suggests that companies with AI at the core of their business activities tend to derive increasing returns from AI implementation under the supervision of their tech committees. The market share of these corporations is greater than suggested by their number of employees, which typically correlates with market influence, as indicated by the positive relationship between employee number and market share in Figure 9.<sup>120</sup>

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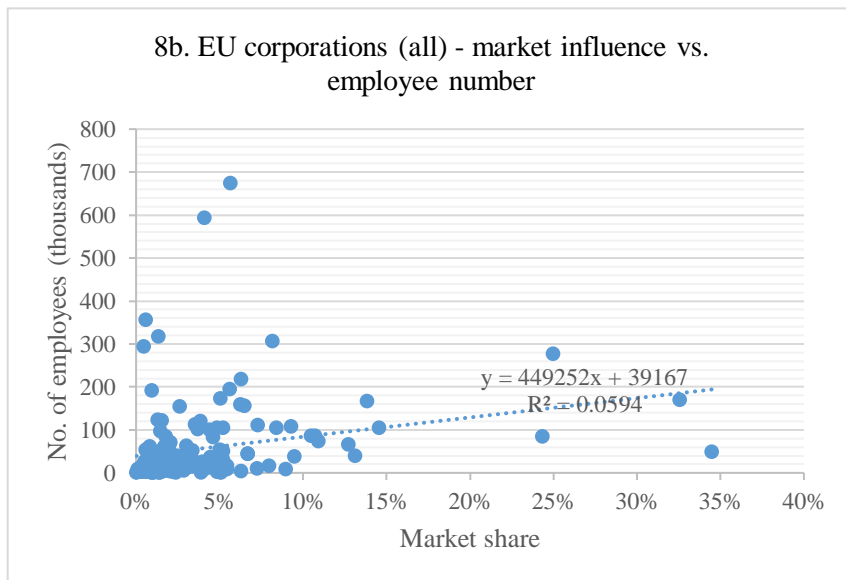
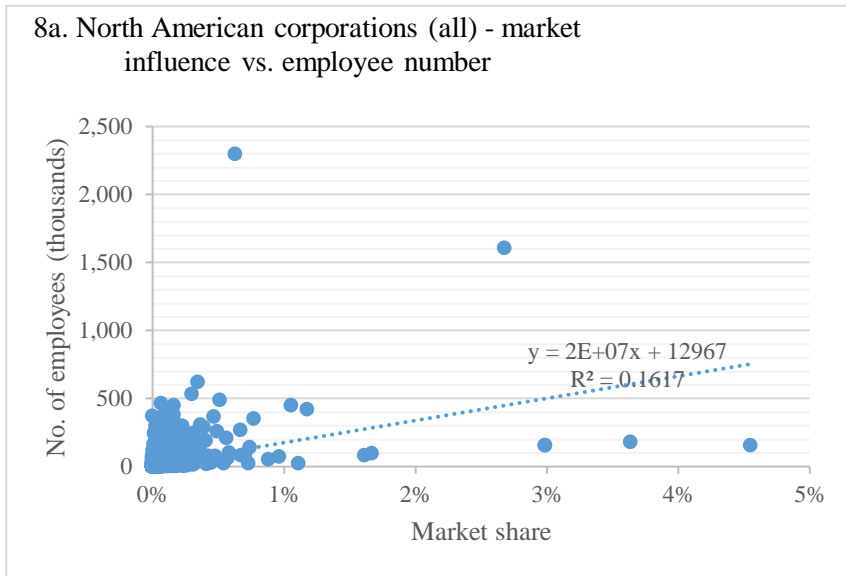
<sup>117</sup> See *infra* Figure 8. The extent of relevance of high-tech sectors is assumed from the qualification of North American Industry Classification System (NAICS), and the 2010 Standard Occupational Classification (SOC) system, according to the share of STEM workers in the sub-industry employment. See, U.S. BUREAU OF LABOR STATISTICS, DETAILED 2010 SOC OCCUPATIONS INCLUDED IN STEM, sub-domain 1 (2012) (defining sub-domain 1) [https://www.bls.gov/soc/Attachment\\_C\\_STEM.pdf](https://www.bls.gov/soc/Attachment_C_STEM.pdf).

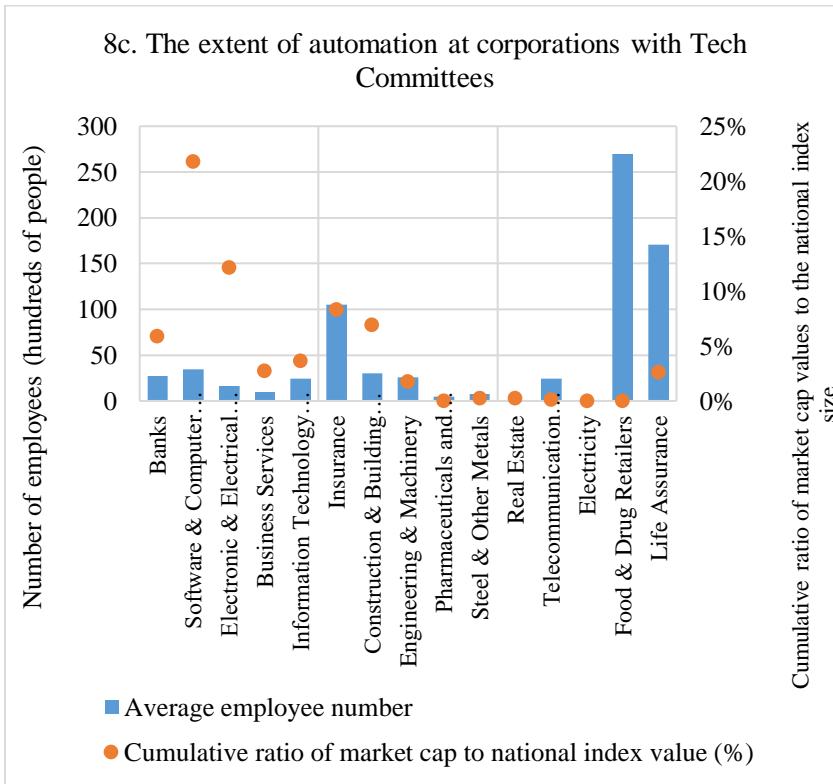
<sup>118</sup> See *infra* Figure 9.

<sup>119</sup> See *infra* Figure 9.

<sup>120</sup> See *infra* Figure 9 (panels a. and b.).

Figures 8a, 8b, 8c.





Simultaneously, companies that established tech committees and that represent sectors without advanced data processing as a core business activity, derive diminishing returns from the attempts to automate their business operations through the adoption of an AI, when under the supervision of a tech committee (i.e., the market share of these corporations is lower than suggested by their number of employees).<sup>121</sup> For both European and North American corporations, the market value per employee, derived from market capitalization rate, is greater for corporations without a tech committee, as for those that established one.<sup>122</sup> The market value per employee is four times greater in North America, and 2.5 times greater in Europe.<sup>123</sup> Market value per employee is a ratio indicating the value of a company created by each employee, and thus the

<sup>121</sup> See *infra* Figure 9.

<sup>122</sup> See *infra* Figure 9; *infra* Figure 10.

<sup>123</sup> See *infra* Figure 9; *infra* Figure 10.

“efficiency” of their work in making the corporation more valuable on the market.

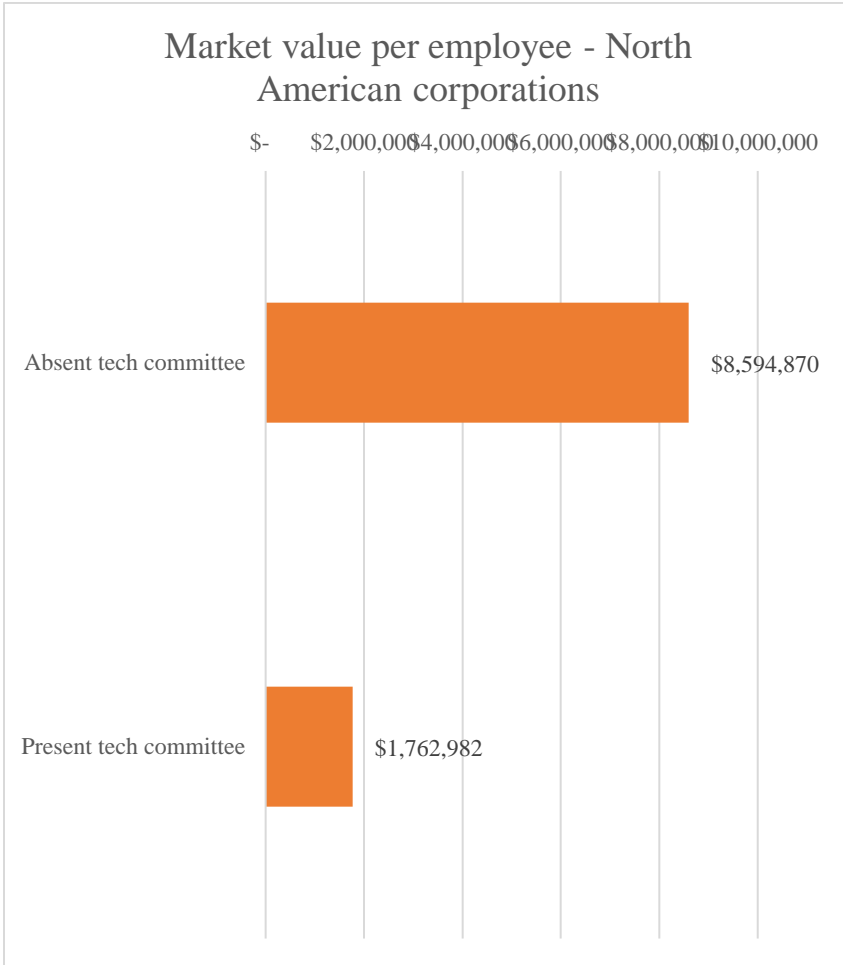


Figure 9



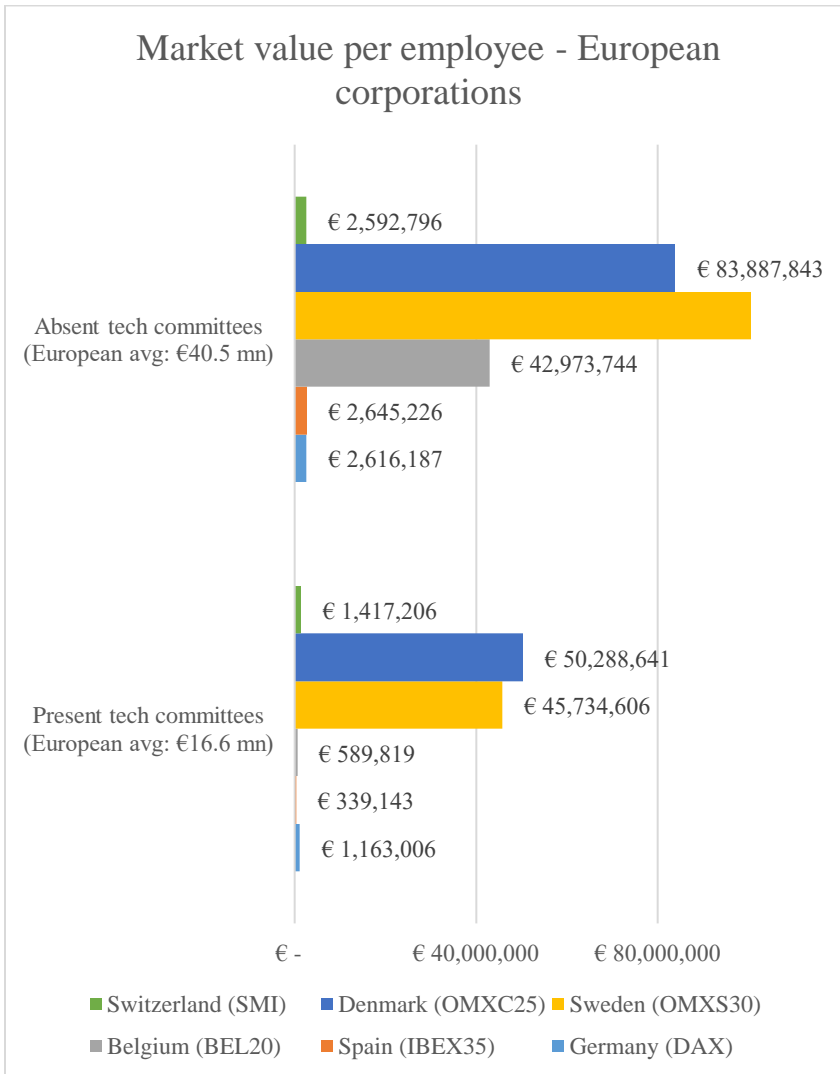


Figure 10

An interesting conclusion stems from the cross-sectorial analysis of market share values between EU and North American listed companies. Figure 11 compares absolute ratios of market capitalization to national indexes values, through the lenses of both sectorial association and geographical location.<sup>124</sup> EU companies with tech committees make up a greater proportion of their national market in sector-by-sector

<sup>124</sup> See *infra* Figure 11.

comparison.<sup>125</sup> In other words, although financial markets in Europe are considerably smaller in terms of market capitalization figures, within European markets, on average, companies with tech committees make up a greater proportion of national markets, as the ratio of their market capitalization to national indexes is greater.<sup>126</sup>

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<sup>125</sup> See *supra* Figure 9 (The graphs contain average ratios of market capitalization per employee, produced for each corporation from the ticker symbol. This data is a summary statistic, averaging the ratios across two categories of corporations: those without and with a tech committee, in their respective national markets.)

<sup>126</sup> See *supra* Figure 10.

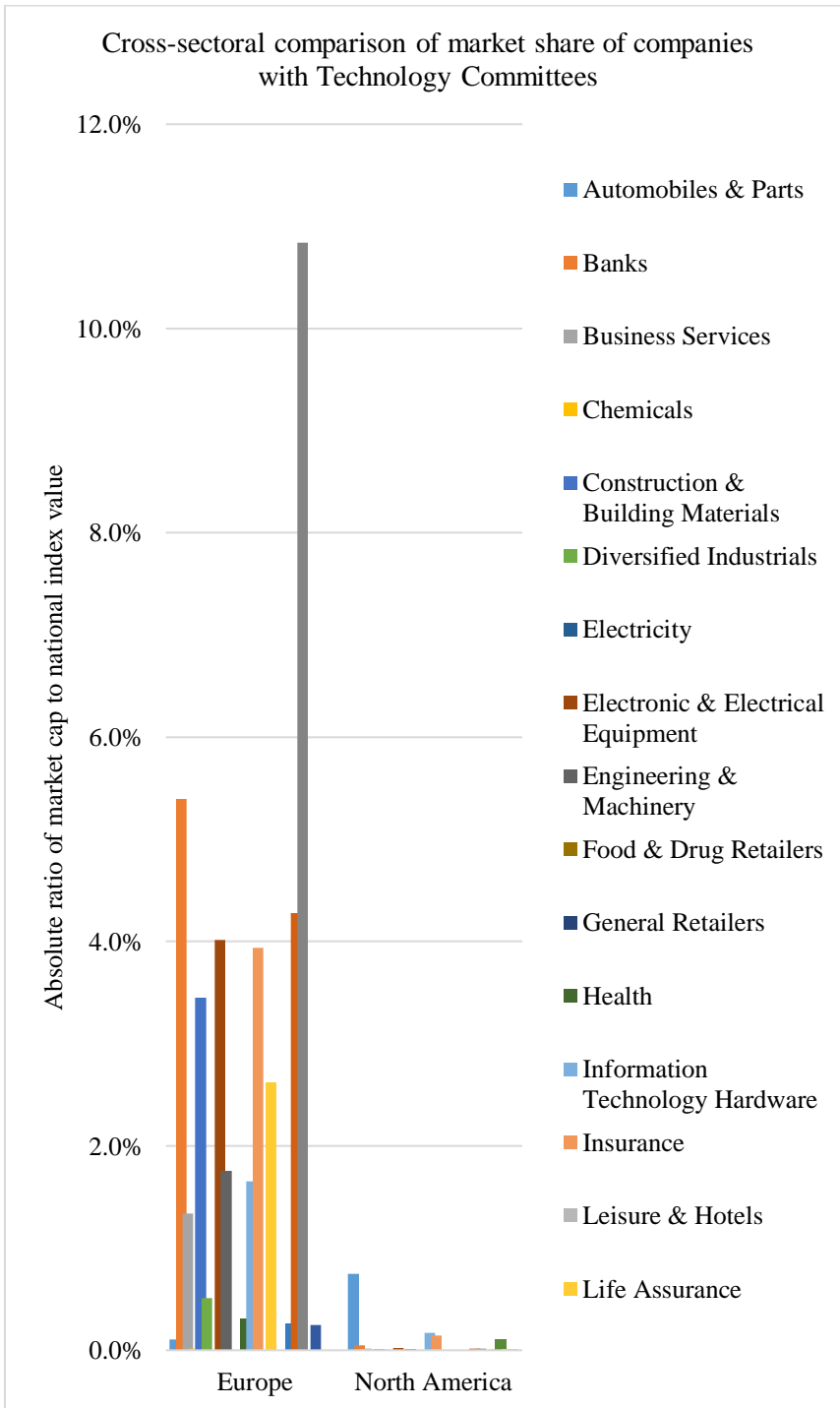


Figure 11

Moreover, as Figure 12 demonstrates, among European companies with tech committees there is greater diversity, as more sectors are represented, and not a single one dominates the entire distribution.<sup>127</sup> This is contrary to the North American market, where, given their sector-specific market impact, over 50% of all companies with technology committees come from the Automobiles & Parts sector.<sup>128</sup>

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<sup>127</sup> See *infra* Figure 12.

<sup>128</sup> See *supra* Figure 11.

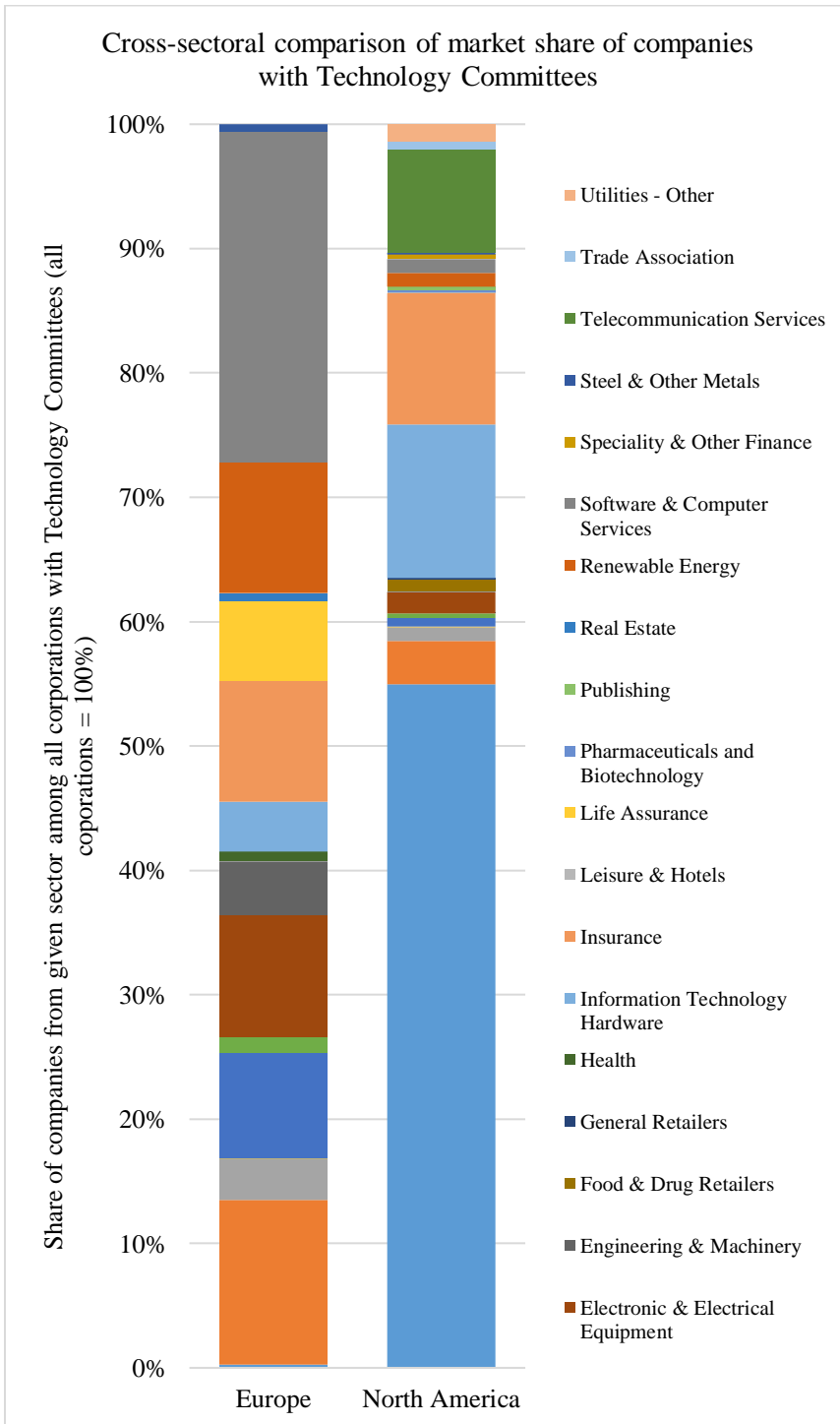


Figure 12

E. *Tech v. Non-Tech Committees*

To fully understand whether the above data analysis on tech committees is meaningful, it is essential to mirror such data with that of non-tech committees during the same time frames and geographic landscapes. To this end, we have also extracted from BoardEx data needed to draw a comparison between companies with and without tech committees in 2019.<sup>129</sup> Indeed, companies that have adopted tech committees are just a minority of the listed companies; a majority of listed companies, instead, tend to adopt more traditional committees highly recommended in the Corporate Governance Codes, as shown by the most significant committees represented in Figure 14 (where at least fifteen directors serve).<sup>130</sup>

In both North America and the EU, the majority of directors on a board committee sit on an audit or a compensation/remuneration committee (the latter is the usual EU label), or on a nominating committee.<sup>131</sup> Nonetheless, there are some cases that are worth mentioning as in North America they are “significant” (greater than 15), while in the EU those committees do not even exist, namely the “stock option,” “capital,” “risk oversight,” and “asset and liability” committees (which are respectively 15, 23, 51 and 65).<sup>132</sup> We preferred to include the number of directors who sit on tech committees, but as a cumulative value, regardless of the label used so far. Similarly, in light of the above, we deemed it appropriate to group remuneration and compensation committees, as well as audit, audit finance and risk, audit and risk, audit and finance.

As to the other, non-tech committees, looking at the number of directors that sit on the, we observe the following: risks seem to matter considerably to companies both in the EU and in North America;

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<sup>129</sup> See *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>130</sup> See *infra* Figure 13. Corporate Governance Codes suggest the adoption of committees. See, for example, The UK Corporate Governance Code, 2018, 10, <https://www.frc.org.uk/getattachment/88bd8c45-50ea-4841-95b0-d2f4f48069a2/2018-UK-Corporate-Governance-Code-FINAL.PDF>.

<sup>131</sup> See *infra* Figure 13.

<sup>132</sup> See *infra* Figure 13.

governance is more of a concern in North American than in the EU; strategy is more important to EU companies when compared to North American companies; and sustainability is scarcely considered in both jurisdictions.<sup>133</sup>

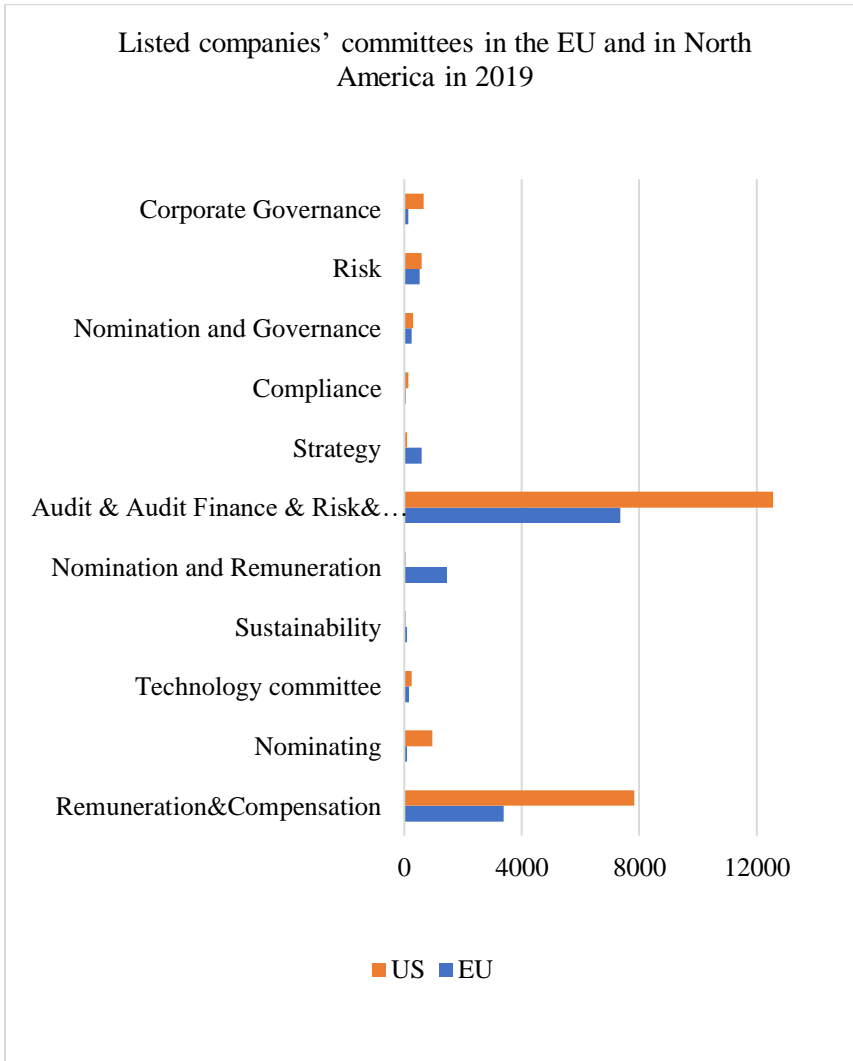


Figure 13

<sup>133</sup> See *infra* Figure 13.

Directors serving on non-tech committees of listed companies in 2019 totaled 28,891 in the EU and 51,496 in North America.<sup>134</sup> As for 2019, 28,854 directors (out of a total of 28,891), who hold a position in a non-tech committee in the EU, have available data. While directors serve on a tech committee for an average of nine years, directors serving on other committees have done so for approximately 4.5 years (4.57), and on that board (and in that company in general) for five years (5.38), also spending six years on average (6.16) in a different company.<sup>135</sup> These directors also held a role in other listed (three companies on average; 2.88) and unlisted (three companies on average; 3.18) companies.<sup>136</sup> Directors have an average “time to retirement” of 10.33 years according to BoardEx, which sets the retirement age at seventy years.<sup>137</sup> This means that the director members of EU companies’ non-tech committees are slightly younger (sixty years old on average) than the directors sitting on a tech committee (sixty-two years old on average).<sup>138</sup> On the other hand, boards of the companies featuring a non-tech committee seem to be less numerous than the ones that have a tech committee, as their average composition is equal to eleven members (11.37).<sup>139</sup>

As to the 51,496 directors holding a position in a non-tech committee in North America in 2019, they serve on that committee for an average of six years (5.92), while directors serving on a tech committee sit on them for twelve years, on average, and on the board for slightly more than six months (6.39).<sup>140</sup> This mirrors the EU proportion—in both cases, the appointment of directors on tech committees on average doubles that of non-tech ones.<sup>141</sup> This is even more striking when we think about how rapidly technology changes occur and how promptly people should react on boards. However, this might be explained by considering the tech expertise and skills that sitting directors should have.<sup>142</sup>

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<sup>134</sup> See *infra* Figure 14.

<sup>135</sup> See *infra* Figure 14.

<sup>136</sup> See *infra* Figure 14.

<sup>137</sup> See *supra* note 32 and accompanying text; discussion *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>138</sup> See *infra* Figure 15.

<sup>139</sup> See *infra* Figure 15.

<sup>140</sup> See *infra* Figure 15.

<sup>141</sup> See *infra* Figure 15.

<sup>142</sup> See *The Board’s Agenda: The Role of the Board in an Age of Exponential Change*, WALL ST. J. (Mar. 22, 2017), <https://deloitte.wsj.com/articles/the-boards-agenda-the-role-of-the-board-in-an->



Non-tech committees' directors spent on average four years (4.24 years) with other companies, so they turn out to be pretty much committed to the boards of the companies where they are currently sitting.<sup>143</sup> They often tend to sit, on average, in four listed (3.9) and five unlisted (5.15) companies' boards.<sup>144</sup> North American non-tech committees are comparable to companies with tech committees (with an average of 8.65 members).<sup>145</sup> Directors who sat on non-tech committees in North America in 2019 tended to be younger (with an average "time to retirement" of 6.53), according to BoardEx, than those sitting on a tech committee, as their average age is sixty-three instead of seventy-four.<sup>146</sup> Although, in both the EU and North America, people sitting on a tech committee are older than the others—which, in light of the nature of the committee and of their predictable functions, would not be expected—in the latter, the average age of tech directors is definitely surprising (Figure 14).<sup>147</sup>

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age-of-exponential-change-1490155331;Khalid Kark, et al., *Technology and the Boardroom: A CIO's Guide to Engaging the Board*, HARV. L. SCH. F. ON CORP. GOVERNANCE (Mar. 11, 2019), <https://corpgov.law.harvard.edu/2019/03/11/technology-and-the-boardroom-a-cios-guide-to-engaging-the-board/>.

<sup>143</sup> See *infra* Figure 14.

<sup>144</sup> See *infra* Figure 14.

<sup>145</sup> See *infra* Figure 14.

<sup>146</sup> See *infra* Figure 15.

<sup>147</sup> See *infra* Figure 15.

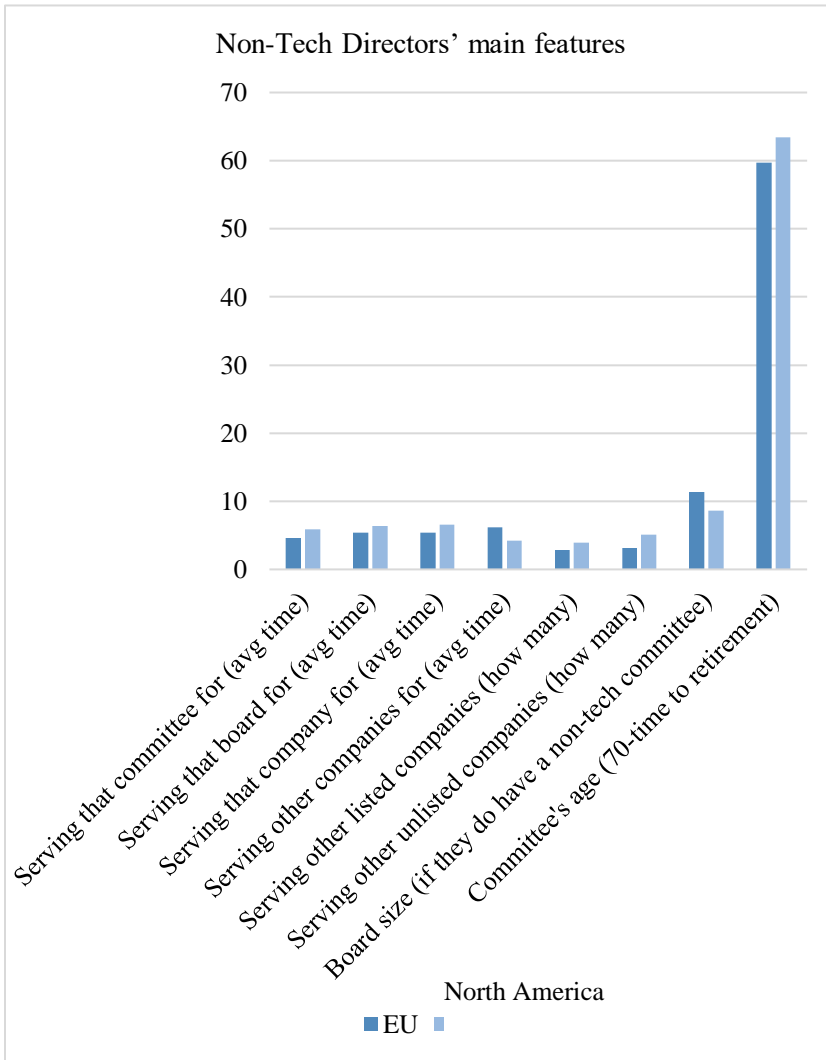


Figure 14

Non-tech EU committees, as usual, mainly consist of male directors (gender ratio on average, *i.e.*, the proportion of male directors provided for each annual report date under consideration: 0.77) originating from the same country (nationality mix on average, *i.e.*, the proportion of directors from different countries provided for each annual report date under consideration: 0.3).<sup>148</sup> Even North American boards featuring a non-

<sup>148</sup> See *infra* Figure 15.

tech committee seem to be comprised predominantly of men (gender ratio on average: 0.812) from the very similar geographical context (nationality mix on average: 0.098).<sup>149</sup> Instead, EU boards that have at least one committee seem, as is the case in companies with tech committees, to be more welcoming to people of different nationalities.<sup>150</sup>

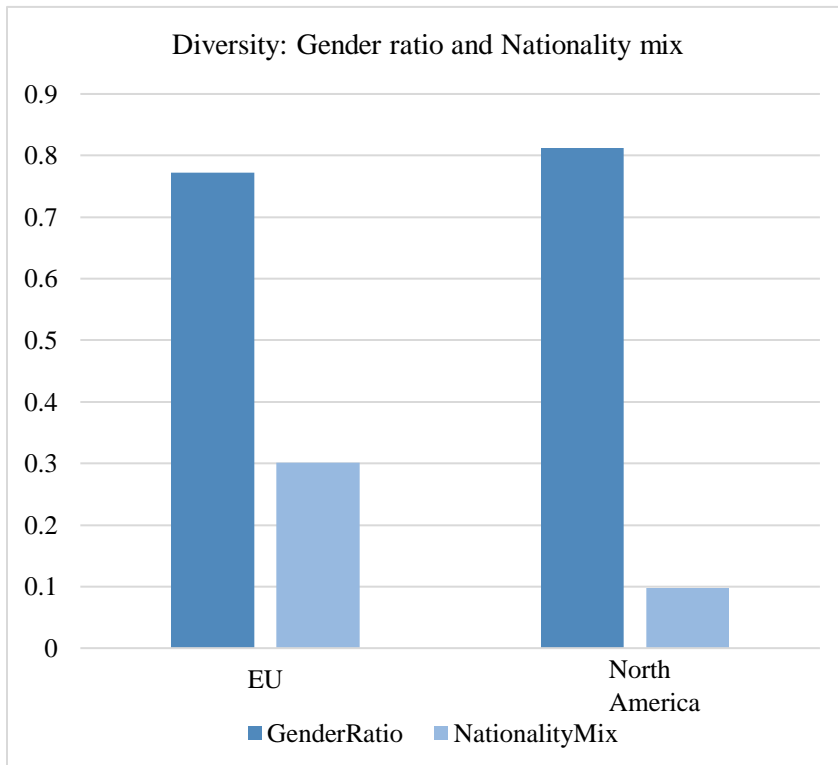


Figure 15

To understand whether the fact that tech committees are mostly adopted in certain sectors correlates with a real need for those companies, we compared the distribution per sectors of companies featuring a tech committee with that of listed companies featuring a non-tech committee.<sup>151</sup>

<sup>149</sup> See *infra* Figure 15

<sup>150</sup> See *infra* Figure 15.

<sup>151</sup> See *infra* Figure 16. Here, the directors did not sit on tech committees, but instead on other committees. We repeated the same analysis as above.

As expected, the distribution per sector of listed companies with at least one non-tech committee appears extremely diversified.<sup>152</sup> Therefore, the data above on tech committees confirms their specificities, as well as their need in certain sectors.<sup>153</sup>

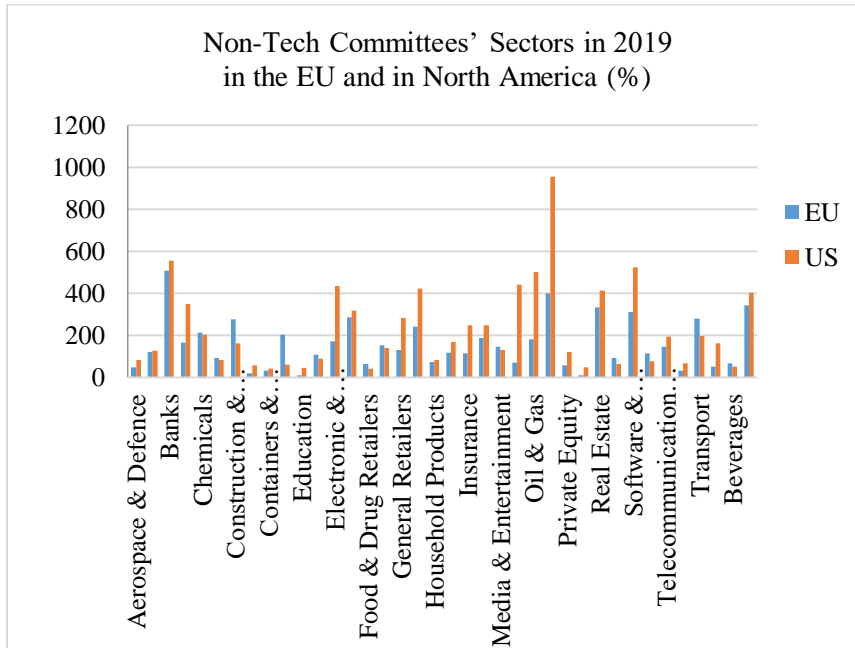


Figure 16

However, surprisingly enough, the EU and North America differ concerning which sectors use tech committees.<sup>154</sup> In the EU, the banking industry frequently uses tech committees; in North America, however, software and tech-related corporations often employ them.<sup>155</sup> This difference raises several questions as to the real attributions given to tech committees, which we will delve into in the following section.

## II. What Tech Committees Do...

The descriptive–statistical analysis of tech committees adopted by listed companies in the EU and in North America, while providing a lot of

<sup>152</sup> See *infra* Figure 16.

<sup>153</sup> See *infra* Figure 16.

<sup>154</sup> See *supra* Figure 16.

<sup>155</sup> See *supra* Figure 16.

previously unknown information, still does not shed light on the functions of these specific committees.<sup>156</sup> In particular, it does not explain what—if any—“tech governance” they actually perform. Thus, to understand the concrete activities carried out by tech companies, we created an ad hoc database comprising of the technology committees’ charters available on companies’ websites<sup>157</sup> and, if not available, the companies’ website description of tech committee’s activity.<sup>158</sup> Although the charters are more detailed, a proper understanding of the activities of tech committees can be retrieved from the companies’ website as well.

The dataset collects information regarding 23 EU tech committees and 41 North American tech committees, out of the 28 and 56 committees analyzed in the EU and North America, respectively, in the previous section.<sup>159</sup> We excluded from the current dataset the tech committees for which we had data on the company but not enough information on its relevant functions.<sup>160</sup>

The reason for this difficulty in retrieving information is that, in the EU, charters are not an established practice—or, at least they are not accessible on corporate websites. In some cases an adequate level of information on committees—comparable to that provided by North American companies’ charters—is just not available. In North America, instead, several companies have been delisted, changed their corporate names, or do not provide more specific information.

From a methodological point of view, first, we reviewed the corporate documentation of companies in the overall sample and selected ten tech committees (five in the EU and five in North America) whose corporate structures were explained in the most comprehensive manner.<sup>161</sup> We determined comprehensiveness of corporate documentation by scope and detail in explaining established governance practices at each firm with respect to delegating tasks to a tech committee. We systematically reviewed the content of the selected documents to identify the technology-related aspects of tech committee activities. Second, we classified five

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<sup>156</sup> See *supra* Sections I.C, I.D and I.E.

<sup>157</sup> See *infra* Appendix.

<sup>158</sup> See *infra* Appendix.

<sup>159</sup> See discussion *supra* Section I.

<sup>160</sup> *Namely*, in Europe: Holidaycheck Group, Schaltbau Holding, Aurubis, Comet Holding, Kuka; in North America: *inter alia*, Immunic, MB Financial (delisted in March 2019), and Essendant (delisted in January 2019).

<sup>161</sup> See *infra* Appendix (reporting the ten selected companies).

functions that tech committees frequently perform, and named them “strategy,” “monitoring,” “risk management,” “security,” and “innovation.”

Before delving into the specific functions that such committees perform, a premise is needed as to the different functions that board committees in general perform in North America (as in Canada and in Australia) and in the EU.<sup>162</sup> While in the former, their role is much more related to compliance, in the latter, they do have an advisory nature.<sup>163</sup> In terms of tech committees, when referring to the abovementioned functions, those should be read in a different light in the two geographical contexts at hand.

As to the meaning of each function, a couple of additional remarks are needed. First, a committee performs a “strategic” task when it takes on a preliminary or consulting role on the strategic choices of the board, or otherwise suggests decisions that impact the long-term strategic goals of the company.<sup>164</sup> In the case of a tech committee, the activity is then likely to be addressed towards technology, research, and development fields. Second, the activities performed by a committee are usually categorized as “monitoring” when they involve a duty of overview (and assessment) of the whole industry trends as the committee is called to evaluate (and accordingly to suggest adjustments to) the board’s activity in relation to various activities.<sup>165</sup>

In the case of a tech committee, the monitoring function will therefore predominantly occur in areas such as technology partnerships, joint projects and other collaborative activities, in the field of research, as well as in analyzing investments and progress against key metrics. The monitoring function may also encompass oversight and guidance duties with respect to the company’s overall capabilities. This includes the power to oversee and dismiss any consultants, research firms, counsel and other advisers that assist the committee in carrying out its activities—these individuals shall be accountable ultimately to the tech committee,

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<sup>162</sup> Kalin D. Kolev, David B. Wangrow, Vincent L. Barker & Donald J. Schepker, *Board Committees in Corporate Governance: A Cross-Disciplinary Review and Agenda for the Future*, 56 J. MGMT. ST. 1138, 1138 (2019).

<sup>163</sup> *Id.* at 1141.

<sup>164</sup> See Faith Stevelman & Sarah C. Haan, *Boards in Information Governance*, 23 U. OF PA. J. OF BUS. L. 179, 185 (2020).

<sup>165</sup> Lixiong Guo & Ronald W. Masulis, *Board Structure and Monitoring: New Evidence from CEO Turnover*, 28 REV. OF FIN. STUD., 2770, 2271 (2015).

provided that oversight of the company's internal controls over financial reporting and disclosure is left to the responsibility of the audit committee.<sup>166</sup> Third, the "risk management" function comprises all the activities related to the minimization of risks,<sup>167</sup> which in the case of tech committees will become tech-related risks and amount to the managing of the consequences deriving from the progressive use of increasingly sophisticated technologies in all industrial sectors.

The three activities described above are traditionally board functions which, in the case of the adoption of a tech committee, are likely—but not necessarily—to be delegated to the tech committee because of its competencies in technology-related areas. Additionally, other activities, such as security and innovation, are most likely to fall within the scope of a tech committee's activity. Indeed, "security" involves the managing of a specific category of technological risk, particularly risk deriving from cyber-attacks. Generally, information security incidents have become so threatening, they require a space specifically dedicated to address the challenge.<sup>168</sup> To this end, tech committees should propose and periodically review with management the cyber-security policies, controls, and procedures. This will help with the following: to avoid cyber-attacks, unauthorized access, or other malicious acts and risks; to detect, respond to, and mitigate negative effects from and recover from cyber-security attacks; and to fulfill applicable regulatory reporting and disclosure obligations related to cyber security risks, costs and incidents. Under "innovation" we group all the initiatives implemented by tech committees to strengthen both their technological and their innovative approach, encompassing research and development and other tech initiatives.

Once we classified the functions emerging from the subset of selected documents, we next proceeded to manual code each of the documents to verify the tech committees that performed one-to-five of the previously-identified activities.<sup>169</sup> Whenever the corporate documentation

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<sup>166</sup> R Linette M. Rousseau, *Why it Matters: The Key Role of the Audit Committee in Expanded Audit Reporting Quality* (Apr. 2022) (Ph.D dissertation, University of Wisconsin, Madison), <https://ssrn.com/abstract=4013041>.

<sup>167</sup> See Stelman & Haan, *supra* note 164, at 249.

<sup>168</sup> See Lawrence J. Trautman, Seletha R. Butler, Frederick Chang, Michele Hooper, Ron McCray & Ruth Simmons, *Corporate Directors: Who They Are, What They Do, Cyber Risk and Other Challenges*, 70 *BUFF. L. REV.*, 459, 514 (2022).

<sup>169</sup> See *infra* Figure 17.

indicated the presence of a particular function, the value of one was recorded in the database. The absence of a function was indicated with the value of zero. The coding required a technical understanding of both company law and corporate governance and was carried out by the authors themselves. It was reviewed jointly, and the authors discussed problematic cases throughout the process to increase reliability. The outcome of the content analysis is shown in the following figure, which explains the frequency with which each activity was counted during the coding of the documents.<sup>170</sup>

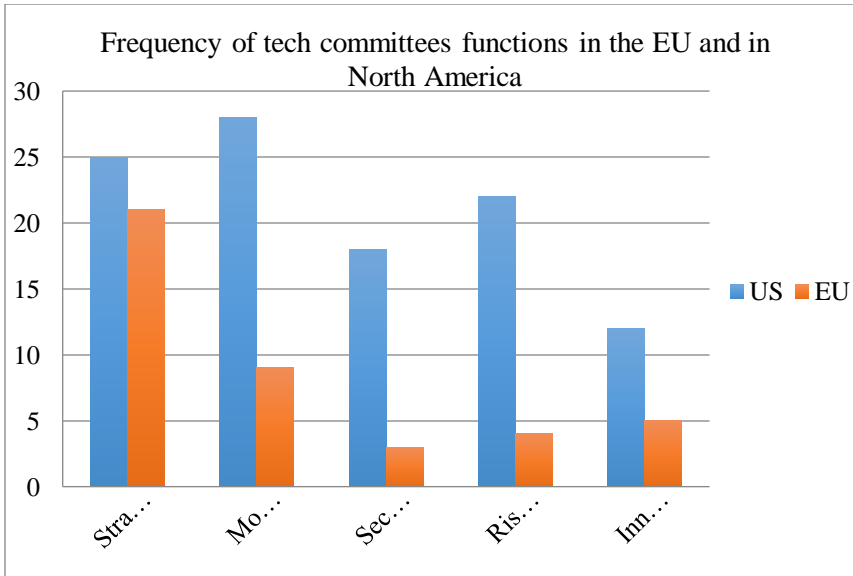


Figure 17

In the EU, with the exception of Deutsche Boerse AG’s tech committee, which performs all the identified functions,<sup>171</sup> all other documents mention them according to the following frequency: twenty strategy; eight monitoring; four innovation; three risk management; and two security.<sup>172</sup> Instead, in North America, out of forty-one documents analyzed, the frequency of the activities is as follows: twenty-nine mentions of monitoring; twenty-five mentions of strategy; twenty-three mentions of risk management; eighteen mentions of security; and twelve

<sup>170</sup> See *infra* Figure 17.

<sup>171</sup> See *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>172</sup> *Id.*



mentions of innovation.<sup>173</sup> This may suggest, at first glance, a large employment of tech committees for strategic or monitoring purposes in both jurisdictions; however, a more detailed analysis reveals some differences.

In the EU, most tech committees do have, indeed, both a strategic and monitoring role (twenty-one out of twenty-three),<sup>174</sup> whereas the two committees that carry out monitoring but not strategy (namely, Nokia OYJ and Schaeffle), do not undertake other activities as monitoring is likely to absorb all functions.<sup>175</sup> More precisely, Nokia's tech committee is established by the board primarily as an advisory forum and for the purpose of reviewing the high-level innovation and technology strategies of Nokia Corporation which are formulated and executed by the management of the company. The Committee will engage in a dialogue with management with respect to major innovation and technology trends, related significant risks and opportunities, as well as the company's technology competitiveness and bets made from time-to-time.<sup>176</sup> Schaeffle's supervisory board decided to establish an eight-member tech committee to facilitate the regular exchange of information regarding technological developments between the Supervisory Board and the Board of Managing Directors.<sup>177</sup>

In both cases, these committees are likely seen as an instrument to engage in dialogue with the management, as an advisory tool, and as an auditor of the firm's strategies from the innovation standpoint. Tech committees should be considered a sub-group of the board "accustomed to technology," because an implicit prerequisite of their function is they are capable of performing reporting functions and conveying information to management (which is also in the process of being educated and developed technologically).

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<sup>173</sup> *Id.*

<sup>174</sup> See *supra* Figure 17.

<sup>175</sup> Graeme Neill, *Nokia sets up tech committee for strategy review*, MOBILE EUROPE (June 1, 2018), <https://wpstaging.mobileeurope.co.uk/nokia-sets-up-tech-committee-for-strategy-review/>. See also Rules of Procedure for the Advisory Board of Schaeffle AG (Dec. 17, 2021) (on file with author), [https://www.schaeffler.com/remotemedien/media/\\_shared\\_media\\_rwd/01\\_company\\_1/supervisory\\_board\\_1/rules\\_of\\_procedure\\_supervisory\\_board\\_schaeffler\\_ag\\_en.pdf](https://www.schaeffler.com/remotemedien/media/_shared_media_rwd/01_company_1/supervisory_board_1/rules_of_procedure_supervisory_board_schaeffler_ag_en.pdf).

<sup>176</sup> See Neill, *supra* note 175.

<sup>177</sup> See Advisory Board of Schaeffle, AG, *supra* note 175.

The four documents<sup>178</sup>—Deutsche Boerse AG excluded—that mention innovation refer, besides strategy, to risk management in one instance (Medtronic PLC), and to security in another (Deutsche Bank AG), to show that in such cases security and risk management are central competencies of tech committees. Two of the three documents—Deutsche Boerse AG excluded—that mention risk management, also commonly mention strategy and monitoring, namely the charts of Banco Bilbao Vizcaya Argentaria SA (BBVA) and Medtronic, where the former also mentions security.<sup>179</sup> This may indicate that, in the case of BBVA, the tech committee is not an instrument to innovate but rather to take care of one of their main concerns: security.<sup>180</sup> To sum up, while strategy and monitoring are quite frequent, the other functions seem to play a less significant role within the tech committees.

Also, in North America, the number of charters that mention all of the functions previously detailed is extremely limited: in only two out of forty-one charters (namely, those of Global Payment and Magna International) were tech committees playing a significant role within the company.<sup>181</sup> In three other instances (Cubic Corp., Equifax Inc., and Maximus Inc.), tech committees still have a fairly broad competence and cover all functions except innovation, while two other tech committees have all functions except security (3D Systems Corp and Medtronic PLC).<sup>182</sup> In two instances, the charters only mention the more traditional board-related activities—strategy, monitoring and risk management—but not those that are specifically technological, like security and innovation (Bank of New York Mellon Corp and Methode Eelectronics Inc).<sup>183</sup>

Compared to the distribution that takes place in the EU, where most of the technical committees share a strategic function, in North America monitoring and strategy are combined in only seventeen cases, while in another twelve cases monitoring takes place without strategy, and in eight cases strategy does so but monitoring does not.<sup>184</sup> Finally, in four

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<sup>178</sup> Namely, Medtronic PLC, Deutsche Bank AG, Deutsche Boerse, Banco Bilbao Vizcaya Argentaria SA. Documents are on file with the author.

<sup>179</sup> See *infra* Appendix.

<sup>180</sup> See *infra* Appendix.

<sup>181</sup> See *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>182</sup> *Id.*

<sup>183</sup> *Id.*

<sup>184</sup> See *supra* Figure 18.

cases (i.e., ASML Holding NV, Camden National Corp, Citrix System Inc, First Interstate Bancsystem Inc), tech committees perform a strategy function and not a monitoring one, but perform a risk management task.<sup>185</sup> In conclusion, the North American tech committees apparently cover more functions (between two and four) than the EU ones, which mainly focus on strategy and monitoring.<sup>186</sup>

To have a deeper understanding of the correlations between the functions performed by tech committees, as a fourth step, we ran a qualitative comparative analysis (QCA) using the Stata software.<sup>187</sup> The goal of employing QCA in our empirical strategy is to merge quantitative methods with qualitative analysis of textual sources (i.e., the documents of tech committees). The five functions resulting from the content analysis are abbreviated as in the following: Strategy (abbreviated to S); Innovation (abbreviated to I); Monitoring (abbreviated to M); Risk Management (abbreviated to R); and Security (abbreviated to E). When one of these functions is performed by the committee, it takes the value of one. When the function is not performed, it takes the value of zero. Each company is assessed in terms of whether the committee performs one or more functions. All functions are then added up. When the sum of S+I+M+R+E is greater than one, then the committee is performing multiple functions (abbreviated to F). The function F can take the value one or zero.

When presenting combinations of the results, S, I, M, R, E (in capital letters) indicate the value of one; i.e. that function is reported. Whereas, when a small letter is used, it indicates absence of that function. For example, the acronym 'SiMre' indicates that the only reported functions by the committee are Strategy and Monitoring. The QCA tool counts the occurrences of specific combinations (like 'SiMre'). For instance, it may count that there are two banks in the sample that use the combination SiMre.

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<sup>185</sup> See *supra* note 32 and accompanying text; *supra* Section I.A (describing the sample and method of data collection). All original data is on file with the authors.

<sup>186</sup> See *supra* Figure 18.

<sup>187</sup> Kyle C. Longest & Stephan Vaisey, *Fuzzy: A Program for Performing Qualitative Comparative Analyses (QCA) in Stata*, 8 STATA J. 79 (2008).

We first analyzed the frequency with which the twenty-four possible combinations of functions are employed in the charters of the examined tech committees.<sup>188</sup>

Combination	Frequency	Percentage frequency (%)
SIMRE	3	4.76
SIMRe	3	4.76
SIMrE	1	1.59
SIImRE	1	1.59
SIImrE	1	1.59
SIImre	4	6.35
SiMRE	4	6.35
SiMRe	2	3.17
SiMrE	1	1.59
SiMre	10	15.87
SimRE	1	1.59
SimRe	2	3.17
SimrE	1	1.59
Simre	12	19.05
sIMRE	2	3.17
sIMRe	1	1.59
sIMrE	1	1.59
siMRE	2	3.17
siMRe	2	3.17
siMrE	2	3.17
siMre	4	6.35
simRE	1	1.59
simRe	1	1.59
simrE	1	1.59
Total	63	100.00

Table 1a. Distribution of combinations of functions – general view

<sup>188</sup> See *infra* Table 1a.

Without considering sectorial and geographical divisions, the general view of combination distribution suggests that the most popular combination is the one where Strategy alone is performed (Simre),<sup>189</sup> which occurs in the 19.05% of cases, with twelve tech committees (out of sixty-three) registering it.<sup>190</sup> This is closely followed by the combination of Strategy and Monitoring (SiMre), with ten companies registering it and a percentage frequency of 15.87%.<sup>191</sup> The frequencies of three other combinations, namely strategy and innovation (SIImre), strategy, monitoring, risk management and security (SiMRE), and monitoring alone (siMre), each recording a percentage frequency of 6.35 (*i.e.* four cards recorded for each combination), are decidedly less significant.<sup>192</sup> The percentage frequency of the remaining eighteen combinations is even more trivial, spanning from 1.59 (1 registration) to 4.76 (3 registration).<sup>193</sup>

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<sup>189</sup> *See supra* Table 1a.

<sup>190</sup> *See supra* Table 1a.

<sup>191</sup> *See supra* Table 1a.

<sup>192</sup> *See supra* Table 1a.

<sup>193</sup> *See supra* Table 1a.

Combination	EU	North America	Total
	SIMRE	1 (4.35%)	2 (5.00%)
SIMRe	1 (4.35%)	2 (5.00%)	3 (4.76%)
SIMrE	0	1 (2.50%)	1 (1.59%)
SImRE	0	1 (2.50%)	1 (1.59%)
SImrE	1 (4.35%)	0	1 (1.59%)
SImre	2 (8.70%)	2 (5.00%)	4 (6.35%)
SiMRE	1 (4.35%)	3 (7.50%)	4 (6.35%)
SiMRe	0	2 (5.00%)	2 (3.17%)
SiMrE	0	1 (2.50%)	1 (1.59%)
SiMre	4 (17.39%)	6 (15.00%)	10 (15.87%)
SimRE	0	1 (2.50%)	1 (1.59%)
SimRe	1 (4.35%)	1 (2.50%)	2 (3.17%)
SimrE	0	1 (2.50%)	1 (1.59%)
Simre	10 (43.48%)	2 (5.00%)	12 (19.05%)
sIMRE	0	2 (5.00%)	2 (3.17%)
sIMRe	0	1 (2.50%)	1 (1.59%)
sImRe	0	1 (2.50%)	1 (1.59%)
siMRE	0	2 (5.00%)	2 (3.17%)
siMRe	0	2 (5.00%)	2 (3.17%)
siMrE	0	2 (5.00%)	2 (3.17%)
siMre	2	2 (5.00%)	4 (6.35%)
simRE	0	1 (2.50%)	1 (1.59%)
simRe	0	1 (2.50%)	1 (1.59%)
simrE	0	1 (2.50%)	1 (1.59%)
Total	23 (100.0%)	40 (100.0%)	63 (100.0%)

Table 1b. Distribution of combinations of functions in the EU and in the U.S.

However, the comparison between the EU and North America reveals that the frequency of combinations varies by jurisdiction.<sup>194</sup> In particular, the combination ‘Simre’ (strategy only) is much more represented in the EU (ten committees out of twelve) than in North America (two out of twelve).<sup>195</sup> Instead, in North America, the most popular combination is definitely ‘SiMre’ (Strategy and Monitoring): six out of all forty American companies employ such combination.<sup>196</sup> This combination is also quite relevant in the EU too (four out of twenty-three committees).<sup>197</sup> As to the other combinations, they maintain a frequency between zero and three in both the EU and North America, with a difference between the two jurisdictions that is never more than two.<sup>198</sup>

As a matter of fact, the analysis performed with and without the QCA model is definitely consistent.<sup>199</sup> This also happens in relation to the minor nuances that have been detected. For example, according to the first analysis, the Strategy and Monitoring combination was quite frequent both in Europe and North America, and the latter technique (the QCA) shows just how the combination under scrutiny is more popular in North America, but not insignificant in Europe.<sup>200</sup> Furthermore, the concluding finding that there is a more uniform distribution of functions in North America is confirmed not only in Figure 17 above, but also in the Table 2 values and in the preceding passage’s remarks.<sup>201</sup>

As to the frequency with which the twenty-four combinations are employed by tech committees according to the industrial sector in which they operate, the highest number of registration is detected in the sector of Banks (eleven), followed by Software and Computer Service (seven).<sup>202</sup> However, there is scarce—if any—correlation between the most popular combinations identified above (Simre and SiMre) and the sectors at stake.<sup>203</sup> Indeed, in the banking field, the eleven registrations detected are

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<sup>194</sup> See *supra* Table 1b.

<sup>195</sup> See *supra* Table 1b.

<sup>196</sup> See *supra* Table 1b.

<sup>197</sup> See *supra* Table 1b.

<sup>198</sup> See *supra* Table 1b.

<sup>199</sup> Compare analysis *supra* pp. 32–37 (analysis resulting from the counting of the frequencies of the functions performed by the tech committees) to *supra* pp. 37–43 (analysis of the Stata data).

<sup>200</sup> *Id.*

<sup>201</sup> Compare *supra* Figure 17, with *infra* Table 2.

<sup>202</sup> See *infra* Table 2.

<sup>203</sup> See *infra* Table 2.

homogenously spread among various combinations (with the only exception of SiMre that counts two tech committees, while the other combinations count zero or one).<sup>204</sup> In the software and computer service sector, instead, the combination SiMre counts three registrations while the other counts from one to one.<sup>205</sup>

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<sup>204</sup> *See infra* Table 2.

<sup>205</sup> *See infra* Table 2.







Steel & Other Metals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Telecommunication Services	t	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trade Association	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	3	3	1	1	1	4	4	2	1	1	0	1	2	1	1	2	1	1	2	2	2	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	6	3

Table 2. Distribution of combinations of functions across sectors in the EU and North America

Our final investigation consisted of dividing up the functions into two groups according to their frequency of board-related functions versus tech-related functions. Technology-related functions are recorded whenever innovation (I) and security (E) are present, while board-related functions are whenever strategy (S), monitoring (M), and risk management (R) are present. Technology-related functions, when available, are indicated with the value of one (in numerical notation) and abbreviated with capitalized letter ‘T’ (when absent, they are indicated with a zero, and letter ‘t’). The same logic applies to board-related functions that either take the notation one (in numerical notation) and ‘B’ when present, or zero (in numerical notation) and ‘b’ when absent.

The following table presents the breakdown of combinations of technology- and board-related functions across the sample of all corporations.<sup>206</sup>

Combination	Freq.	Percentage frequency (%)
TB	40	63.49
Tb	13	20.63
tB	10	15.87

<sup>206</sup> See *infra* Table 3.

Total	63	100.00
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Table 3. Distribution of Technology vs. Board-related functions

The majority of tech committees (63.49%), regardless of their sectorial and geographical divisions, perform both technology- and board-related functions simultaneously.<sup>207</sup> While a number—albeit not a considerable number—of tech committees only perform tech-related functions, significantly fewer committees only perform board-related functions.<sup>208</sup>

Combination	Region		Total
	EU	U.S.	
TB	11 (47.83%)	29 (72.50%)	40
Tb	9 (39.13%)	4 (10.00%)	13
tB	3 (13.04%)	7 (17.50%)	10
Total	23	40	63

Table 4. Cross-geographical distribution of combinations of Technology-related vs. Board-related functions

Once the aggregated data is analyzed within the EU and North America, some divergences emerge as to the distribution of tech- and board-related functions within each jurisdiction.<sup>209</sup> In the EU, in fact, the percentage of tech committees that perform both functions outweigh the number of committees performing only tech-related function by a few percentage points, while the case where the functions being performed are only board-related is residual.<sup>210</sup> In North America, instead, the percentage of committees performing both functions is definitely higher than in the EU.<sup>211</sup> In addition, it is surprising that in the two remaining categories, the percentage of tech committees performing tech-related functions is lower

<sup>207</sup> See *supra* Table 3.

<sup>208</sup> See *supra* Table 3.

<sup>209</sup> See *supra* Tables 4; *infra* Table 5.

<sup>210</sup> See *supra* Table 4.

<sup>211</sup> See *supra* Table 4; *infra* Table 5.

than that of tech committees performing board-related functions.<sup>212</sup> In a sense, tech committees are used in a more innovative way in the EU than in North America.<sup>213</sup>

Finally, as to the sectorial distribution in the banking sector—which is the sector registering the highest number of combinations—tech committees appear to have a comprehensive role, exercising both board and tech-related functions in the vast majority of cases.<sup>214</sup> In the software and computer services sector, instead, a number of cases registered committees that perform only tech-related functions.<sup>215</sup> The other results are not particularly interesting, except that in the insurance field, similar to the banking field, the scope of tech committees' activity is wide and encompasses functions of diverse nature.<sup>216</sup>

Sector	TB	Tb	tB	Total
Automobiles & Parts	3	0	1	4
Banks	9	1	1	11
Business Services	3	0	0	3
Chemicals	1	1	0	2
Construction & Building Materials	1	1	0	2
Diversified Industrials	0	0	1	1
Electricity	0	0	1	1
Electronic & Electrical Equipment	2	2	1	5
Engineering & Machinery	1	0	2	3
General Retailers	1	0	0	1
Health	0	1	0	1
Information Technology Hardware	2	2	1	5
Insurance	5	0	0	5
Leisure & Hotels	1	0	0	1

<sup>212</sup> See *supra* Table 4; *infra* Table 5.

<sup>213</sup> See *supra* Table 4; *infra* Table 5.

<sup>214</sup> See *infra* Table 5.

<sup>215</sup> See *infra* Table 5.

<sup>216</sup> See *infra* Table 5.

Life Assurance	0	1	0	1
Pharmaceuticals and Biotechnology	1	0	1	2
Publishing	1	0	0	1
Real Estate	0	1	0	1
Renewable Energy	2	0	0	2
Software & Computer Services	4	3	0	7
Specialty & Other Finance	1	0	0	1
Steel & Other Metals	0	0	1	1
Telecommunication Services	1	0	0	1
Trade Association	1	0	0	1
Total	40	13	10	63

Table 5. Cross-sectoral distribution of combinations of generalized functions – Technology vs. Board Operations functions

### III. ... AND SHOULD BE DOING INSTEAD

The results from the empirical analysis show that despite the label used, tech committees do not currently address technological developments.<sup>217</sup> Tech committees operating in 2019 appeared more concerned with what the board delegated to them (board-related activities), rather than focusing on the specific issues that the implementation of advanced data processing and other newer technologies raise, which we would instead expect to be the core of their activities.<sup>218</sup> Even when they deal with the more technology-related activities, namely security/cyber security (which is the hallmark of a strongly technology-oriented risk management) and innovation (which, at first sight, should take on a considerable weight in a tech committee), these do not appear to be their main task, especially in North America.<sup>219</sup>

Indeed, tech committees are mainly focused on strategic/monitoring related tasks, which can also be related to the average age of these committees’ members, which, as opposed to members of other

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<sup>217</sup> See *supra* Section II.

<sup>218</sup> See *supra* Section II.

<sup>219</sup> See *supra* Table IV.

committees, is much higher for both North American and EU directors.<sup>220</sup> Similarly, within the companies in the sample, we checked whether any technology-related duty was mentioned among the tasks attributed to audit committees (normally taking care of the companies' risks) in the relevant charters and/or descriptions published on the corporate websites; however, the result was negative, as none consider technology related duties.<sup>221</sup> Overall, the results achieved show that tech committees do not govern AI (in the sense of the latest developments occurred), although they should concretely deal with the implications arising from its employment by directors and within the company board.<sup>222</sup>

Hence, to make more sense of the "technology" in the tech committee's label, we propose a two-level structure that, combining a more operational level with a thorough consideration of the principles that the use of AI should entail, turns technical committees into key players in governing disruptive technology developments.

On a more practical level, to perform this role, tech committees should be reshaped in both an objective and a subjective perspective. As to the former, tech committees should broaden their expertise to include a thorough understanding of the potential of AI and related risks. As to the latter, such committees should be diversified in terms of gender, age, expertise, and skills. The two profiles, namely the objective and the subjective ones, are indeed intertwined and would be both satisfied by opening up those committees to directors with non-traditional backgrounds, by encompassing within the committee—and the board—those skills that nowadays risk being outsourced.<sup>223</sup>

As noted in the corporate law field, the board is increasingly resorting to external experts in their capacity of consultants to reach its own decisions, which are then part of the pre-board reading package/information.<sup>224</sup> This may also be the case with tech-related issues, where specific expertise, for example in choosing the AI system, could

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<sup>220</sup> See *supra* Section I.C; see also *supra* Figure 4.

<sup>221</sup> See *supra* Section II.

<sup>222</sup> See *supra* Part II.

<sup>223</sup> See Section I.C for results achieved on the current composition of Tech Committees. See also Enriques & Zetzsche, *supra* note 7, as to the need of diversifying board of directors to avoid outsourcing its activities; STEPHEN M. BAINBRIDGE & M. TODD HENDERSON, *OUTSOURCING THE BOARD* (2018), 228-29 (describing outsourcing).

<sup>224</sup> See BAINBRIDGE & HENDERSON, *supra* note 223.

reinforce the board's idea of employing outside experts. Despite this, it seems to us that internalization is valuable for two reasons: first, setting up an ad hoc tech committee might seem expensive, but such costs do not seem determinant for a decision when compared with the costs of multiple external consultancies.<sup>225</sup> Second, the specific expertise gained by the directors on the needs of a given company allows them to make informed decisions for which they can be held responsible, thus raising the overall level of accountability.<sup>226</sup> On the other hand, internalizing this expertise (starting with the choice of the most suitable AI system from the outset) would not necessarily be costlier where the function of governing AI is awarded to an existing committee, such as the audit or risk committee, which, as specified below, does not seem to address this profile.<sup>227</sup>

On a more systemic level, in dealing with AI implications, tech committees should be guided by the ethical principles developed at a general level for a trustworthy AI.<sup>228</sup> Besides the compliance with the law,<sup>229</sup> the employment of AI should follow the principles identified by

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<sup>225</sup> *Id.*

<sup>226</sup> See Paul L. Davies, *The Board of Directors: Composition, Structure, Duties and Powers*, ORG. FOR ECON. CO-OPERATION AND DEV. 1, 1 (2000).

<sup>227</sup> This is because the committees that would oversee governing the use of the AI are already part of the company corporate governance.

<sup>228</sup> Luciano Floridi, *Establishing the Rules for Building Trustworthy AI*, 1 NATURE MACH. INTEL. 261, 261 (2019).

<sup>229</sup> See the EU Treaties (Consolidated Versions of the Treaty on European Union and the Treaty on the Functioning of the European Union, 2010 O.J. (C83), 2012 O.J. (C326)), the Charter of Fundamental Rights (Charter of Fundamental Rights of the European Union: 2010 O.J. (C83) 389. Proclaimed by the Commission, 7 December 2000. Proclamation and text at 2000 O.J. (C364) 1.), the General Data Protection Regulation (Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 (speaking 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, 2016 O.J. (L 679)), the Anti-Discrimination Directives (Council Directive 2000/43/EC of 29 June 2000) (implementing the principle of equal treatment between persons irrespective of racial or ethnic origin, OJ L 180, 19.7.2000, 22–26), and Council Directive 2000/78/EC of 27 November 2000 (establishing a general framework for equal treatment in employment and occupation, OJ L 303, 2.12.2000, 16–22), the Product Liability Directive (Council Directive 85/374/EEC of 25 July 1985) (regarding the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products, OJ L 210, 7.8.1985, 29–33), and the European Convention on Human Rights (Convention for the Protection of Human Rights and Fundamental Freedoms,



the European Group of Independent Experts on Artificial Intelligence.<sup>230</sup> These days, it is an (almost) universally acknowledged truth that AI can only show its power if it is “reliable,” otherwise the risks of generating, particularly when used on a large scale, serious consequences for companies that decide to use it indiscriminately would be too significant, ranging from reputational damage to loss of shareholder value.<sup>231</sup> The primary factors to be taken into account for the implementation of a “reliable” AI is, thus, an adequate level of: (i) human intervention and surveillance; (ii) technical and security robustness; (iii) confidentiality and governance of data; (iv) transparency; (v) diversity, non-discrimination and equity; (vi) social and environmental well-being; and, finally, (vi) accountability.<sup>232</sup>

In practice, therefore, members of tech committees must do the following: (1) Ensure they understand the data; (2) verify the adequacy, accuracy, and compliance of their own data with data regulations; (3) put into place sound data governance; (4) implement an informed design and/or choice of artificial intelligence (AI) system; (5) justify the chosen AI system; (6) ensure that the selected system meets the transparency requirements; (7) make the actions of the system explicable; and, finally, (8) ensure that all of the above occurs in a safe and robust environment from a technological point of view.<sup>233</sup> These factors would make the governance of AI (and, consequently, that of the enterprise) more

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Nov. 4, 1950, Europ.T.S. No. 5; 213 U.N.T.S. 221). In addition to horizontally applicable rules, there are also a number of sector-specific provisions, applicable to specific AI systems, such as the Regulation on medical devices in the healthcare sector (Regulation (EU) 2017/745 of the European Parliament and of the Council of 5 April 2017 on medical devices, amending Directive 2001/83/EC, Regulation (EC) No 178/2002 and Regulation (EC) No 1223/2009 and repealing Council Directives 90/385/EEC and 93/42/EEC).

<sup>230</sup> High-Level Expert Group on AI, *Ethics Guidelines for Trustworthy AI*, EUR. COMM’N (Apr. 8, 2019), <https://digital-strategy.ec.europa.eu/en/library/ethics-guidelines-trustworthy-ai>; see also Jessica Fjeld et al., *Principled Artificial Intelligence: Mapping Consensus in Ethical and Rights-based Approaches to Principles for AI*, BERKMAN KLEIN CTR. FOR INTERNET & SOC’Y (2020).

<sup>231</sup> See VIRGINIA DIGNUM, RESPONSIBLE ARTIFICIAL INTELLIGENCE: HOW TO DEVELOP AND USE AI IN A RESPONSIBLE WAY (2019).

<sup>232</sup> High-Level Expert Group on AI, *supra* note 230.

<sup>233</sup> Eleanore Hickman & Martin Petrin, *Trustworthy AI and Corporate Governance: The EU’s Ethics Guidelines for Trustworthy Artificial Intelligence from a Company Law Perspective*, 22 EUR. BUS. ORG. L. REV. 593 (2021).

accountable.<sup>234</sup> In their absence, however, various liability scenarios may arise when directors do not set up an adequate and safe system.<sup>235</sup>

While the practices listed are all equally important, they may differ in significance depending on the sectors in which AI is applied. For example, for large stock company boards, the use of AI as a tool for growth and renewal requires close attention to transparency, and, hence, to accountability.<sup>236</sup> Indeed, only a clear system in illustrating the phases of the processes—from the choice of the data to the identification of the elements on which the analysis process is based—can lead to an increase in accountability, firstly, of the system itself and, secondly, of the body that consciously relies on it.<sup>237</sup> Hence, in such a context, a tech committee, specifically the directors of it, ought to have the capability of identifying which features the chosen AI system should meet.

We believe that the tech committee’s structure and the practices proposed will become real only when they will be recognized as best practices, and thus encompassed in a Code of Corporate Governance. Due to its dynamic (almost experimental) role and inherent flexibility, corporate governance is the most suitable venue to empower tech committees and provide them with a truly tech role, which goes far beyond the activities that they currently perform. In a word, corporate governance could be the one that clarifies what tech committees should do and that ultimately can effectively plan, implement, and govern a “virtuous” use of AI.

#### IV. CONCLUSION

In this paper, we started out by analyzing tech committees to understand what the “technology” in their label stands for. The results of our empirical analysis on the tech committees adopted by EU and North American listed companies showed that mentioning “technology” does not actually enclose consideration of the latest and probably most disruptive technological development that is represented by AI.

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<sup>234</sup> *Id.*

<sup>235</sup> This would be the case of directors that have not evaluated the AI system in terms of accuracy, robustness, and transparency, before using it.

<sup>236</sup> Stefan Larsson & Fredrik Heintz, *Transparency in Artificial Intelligence* 9 INTERNET POL’Y REV. 1, 1 (2020).

<sup>237</sup> Hickman & Petrin, *supra* note 233.

Against this backdrop, we propose how corporate governance should shape tech committees' structure and activity in a way that goes far beyond the strategic or monitoring tasks that they currently perform. More precisely, we believe that Corporate Governance Codes could greatly improve companies' sensitivity to technology-related topics and give tech committees the key role that they should execute. This is becoming increasingly urgent as AI has concretely entered the boardroom and, if properly used, could become a relevant tool not only to maximize board functioning but also maximize shareholder value.<sup>238</sup> Indeed, this goal requires companies to consider the level of AI governance thoroughly and, even more importantly, to embrace inclusive practices that align with sustainable development goals, reconciling growing instances of stakeholder primacy and making purpose meaningful.

## V. APPENDIX

### A. *EU Companies*

#### i. BANG AND OLUFSEN – Technology

Committee: <https://investor.bang-olufsen.com/static-files/226b7194-cc0e-4a09-8c58-31ae1e0656b8>.

The overall assignments of the Technology Committee are to: i. On an ongoing basis, update the Board on technology trends that could significantly affect the Company and the industries in which it operates; ii. Review the Company's technology and innovation strategy and approach, including its impact on the Company's performance, growth and competitive position; iii. Assist the Board in its oversight of the Company's material investments in technology and software, including through acquisitions and other business development activities; iv.

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<sup>238</sup> See, Ricardo Vinuesa et al., *The Role of Artificial Intelligence in Achieving the Sustainable Development Goals*, 11 NATURE COMMUN'S 233, 233 (2020), <https://doi.org/10.1038/s41467-019-14108-y> e; see also Margaret A. Goralskia & Tay Keong Tanb, *Artificial Intelligence and Sustainable Development*, 18 INT' J. MGMT. EDUC. 10330 (2020).

Oversee the execution of technology strategies formulated by the Executive Management Board.

- ii. BBVA – BANCO BILBAO – Technology and Cybersecurity Committee:  
[https://shareholdersandinvestors.bbva.com/wp-content/uploads/2017/05/Reglamento-de-la-Comisi%C3%B3n-de-Tecnolog%C3%ADa-y-Ciberseguridad\\_Eng.pdf](https://shareholdersandinvestors.bbva.com/wp-content/uploads/2017/05/Reglamento-de-la-Comisi%C3%B3n-de-Tecnolog%C3%ADa-y-Ciberseguridad_Eng.pdf).

Notwithstanding any others assigned to it by the law, the Bylaws, the Regulations of the Board of Directors or these Regulations, or by decision of the Board of Directors, the Technology and Cybersecurity Committee will have the following functions: Oversight of technological risk and cybersecurity management: 1. Review the Group’s exposures to the main technological risks, including the risks related to information security and cybersecurity, as well as the procedures adopted by the executive area to monitor and control such exposures. 2. Review the policies and systems for the assessment, control and management of the Group’s technological infrastructures and risks, including the response and recovery plans in the event of cyberattacks. 3. Be informed of business continuity plans in matters of technology and technological infrastructure. 4. Be informed, as appropriate, of: a) compliance risks associated with information technologies; b) procedures established to identify, assess, oversee, manage and mitigate these risks. 5. Be informed of any relevant events that may have occurred with regard to cybersecurity, i.e. events that, either in isolation or as a whole, may cause significant impact or harm to the Group’s equity, results or reputation. In any case, such events will be communicated, as soon as they are identified, to the Chair of the Committee. 6. Be informed, with the frequency required by the head of the Technological Security area, of the activities carried out thereby, as well as of any incidents that may arise. Monitoring the Technology Strategy 7. Be informed, as appropriate, of the technology strategy and trends that may affect the Group’s strategic plans, including the monitoring of general industry trends. 8. Be informed, as appropriate, of the metrics established by the Group for the management and control in the technological field, including the Group’s developments and investments in this field 9. Be

informed, as appropriate, of matters related to new technologies, applications, information systems and best practices that may affect the Group's technology strategy or plans. 10. Be informed, as appropriate, of the main policies, strategic projects and plans defined by the Engineering area. 11. Report to the Board of Directors and, where appropriate, to the Executive Committee, on information technology-related matters falling within its remit.

- iii.* DEUTSCHE BANK – Technology, Data and Innovation Committee:  
[https://www.db.com/ir/en/download/ToR\\_Technology\\_Data\\_and\\_Innovation\\_Committee\\_25\\_10\\_2018.pdf](https://www.db.com/ir/en/download/ToR_Technology_Data_and_Innovation_Committee_25_10_2018.pdf)

It supports the Supervisory Board in fulfilling its oversight responsibilities relating to the bank's innovation, data and technology environment. It continually advises and monitors the Management Board with regard to the adequate technical and organizational resources and the definition of an adequate plan for IT systems, including their application with generally established standards to the arrangement of the IT systems and the related IT processes. This includes in particular the oversight over the Management Board's work on the IT strategy and its sustainability outlining the objectives and measures to be taken to achieve these objectives, the IT governance, the information security management, the user access management, the implementation of major IT projects and application development, IT operation, including data backup, outsourcing and other external procurement of IT services, data governance and data strategy, including their implementation, and any other material issues which may arise in connection with the IT systems and services or data quality. (Source: Annual Report 2019.)

- iv.* DEUTSCHE BOERSE – Technology Committee: <https://www.deutsche-boerse.com/dbg-en/investor->

The Technology Committee supports the Supervisory Board in its monitoring and control responsibility in the field of information technology in order to implement the business strategy of the Group and in relation to Information Security. The Technology Committee advises on IT strategy and architecture and oversees the monitoring of technology innovation, IT service delivery including technical performance and stability of IT systems, IT risks and information security services and information risks.

- v. MEDTRONIC - The Quality and Technology  
Committee: <https://europe.medtronic.com/xd-en/about/corporate-governance/board-directors-quality-technology-committee.html>.

The Quality and Technology Committee provides assistance to the Board of Directors of Medtronic plc (the ‘Company’) in its oversight of (1) product quality and safety; (2) scientific and technical direction; and (3) human and animal studies.

On behalf of the Board, the Committee shall, among its duties and responsibilities: Oversee risk management in the area of product quality and safety, including: Review of the Company’s overall quality strategy and processes in place to monitor and control product quality and safety; periodic review of results of product quality and quality system assessments by Medtronic and external regulators (including FDA and various notified bodies); and, review of important product quality issues and field actions.

Oversee the innovation strategy of the Company, including: Assessment for portfolio competitive superiority and disruptive technology impacts, approach to new market creation, monitor overall effectiveness of research and development; periodic targeted review of the IP strategy and portfolio, and technology evaluation of potential acquisitions for alignment with corporate strategy. Assess and evaluate the economic value proposition of new and existing products. Oversee risk

management in the area of human and animal studies, including the periodic review of policies and procedures related to the conduct of human and animal studies. Review this Charter annually and recommend any changes to the Board for approval. Review the Quality and Technology Committee's own performance annually."

- vi. VESTAS – Technology committee :
- [https://www.vestas.com/~//media/vestas/investor/investor%20pdf/announcements/2012/120208\\_ca\\_uk\\_08\\_annualreport2011.pdf](https://www.vestas.com/~//media/vestas/investor/investor%20pdf/announcements/2012/120208_ca_uk_08_annualreport2011.pdf) and
- [https://www.vestas.com/~//media/vestas/investor/investor%20pdf/financial%20reports/2012/2012\\_annualreport.pdf](https://www.vestas.com/~//media/vestas/investor/investor%20pdf/financial%20reports/2012/2012_annualreport.pdf).

The Technology Committee supports the Board in the evaluation of technological matters, IPR strategy and product development plans (2011). Technology & Manufacturing Committee In 2012, the Technology Committee and the Production & Excellence Committee merged into one committee – the Technology & Manufacturing Committee. Lars Josefsson was elected as chairman of the committee while Carsten Bjerg, Håkan Eriksson and Kim Hvid Thomsen were elected as members of the committee. The committee held a total of four meetings. Among other things, the committee assists the Board of Directors in assessing technological matters, IPR strategy and product development plans. The committee also supports the Board in matters concerning production, monitors and evaluates the short and long-term manufacturing footprint, evaluates sustainability performance and gives support to forums such as Vestas' Innovation Portfolio Council, Product Portfolio Council and Product Operation Council (2012).

#### B. *North American Companies*

- i. EQUIFAX – Technology Committee:
- <https://www.equifax.com/about->

The purpose of the Technology Committee (the “Committee”) is to assist the Board of Directors (the “Board”) of Equifax Inc. (the “Company”) with respect to its oversight of (i) the Company’s technology strategy and significant technology investments in support of its evolving global business needs and (ii) cybersecurity and technology-related risks and management efforts to monitor and mitigate those risks. Areas of review include: information technology strategy; significant new product lines or technology investments; and the Company’s response to technology-based threats and opportunities. In addition, the Committee will oversee the Company’s mitigation of any identified enterprise-wide risks in the above areas.

The specific duties and responsibilities of the Committee are set forth below. Unless otherwise specified, the intervals for review of any given policy or program may be annual, biannual, or at longer or shorter intervals, depending upon the nature of the subject matter and developments affecting the Company with respect to that subject matter.

**Technology Strategy and Investments:** Review the information technology strategy of the Company in light of the Company’s evolving global business needs; review and report to the Board with respect to the budget and resources allocated to technology; monitor significant new technology product development programs (including software initiatives) and new technology investments, including technical and market risks associated with product development and investment; monitor and oversee Company review of future trends in technology that may affect the Company’s strategic plans, including overall industry trends and new opportunities and threats occasioned by new technologies, especially disruptive technologies; and, assess the scope and quality of the Company’s intellectual property portfolio and strategy.

**Cybersecurity and Technology-Related Risk Management:** In coordination with the Audit Committee, oversee risk management with respect to cybersecurity. The Committee may, as it deems appropriate, hold joint meetings of the Audit Committee and the Committee regarding risk management with respect to cybersecurity or other appropriate matters. Review with management the Company’s technology investments and infrastructure associated with risk management, including



policies relating to information security, disaster recovery and business continuity. Review with management the effectiveness of the Company's cybersecurity program and all major changes and improvements pertaining to the Company's cybersecurity controls and plans. Receive reports on the Company's technical security architecture. Review and report to the Board with respect to the budget and resources allocated to cybersecurity. Review with management and report to the Board with respect to the root cause and remediation efforts with respect to all material cybersecurity incidents. Review with management and report to the Board with respect to technology aspects of business continuity planning. Review with management the effectiveness of the Company's escalation protocols with respect to prompt reporting of cybersecurity incidents to management, the Committee and the Board. In coordination with the Audit Committee, review periodic internal reports to management with respect to information technology and cybersecurity issues prepared by the internal audit department and management's response along with the status of prior outstanding recommendations.

**Outside Cybersecurity Advisors:** Oversee the selection, appointment and retention (by the Committee or otherwise) of outside advisors to review the Company's cybersecurity program and to otherwise support the work of the Committee. Review the plans and methodology for the periodic review and assessment of the Company's cybersecurity program by outside advisors. Review with management and outside advisors the findings of reviews of the Company's cybersecurity program by outside advisors and remediation plans to address any material control deficiencies identified.

**Other:** Meet at least quarterly with the Company's Chief Information Security Officer and Chief Technology Officer in executive session to discuss information technology and cybersecurity risks, programs, activities, opportunities and developments. Undertake from time to time such additional activities within the scope of the Committee's primary purposes as it may deem appropriate and/or as assigned by the Board of Directors.

*ii.* ESSENT GROUP - TECHNOLOGY,  
INNOVATION AND OPERATIONS  
COMMITTEE:

[http://s1.q4cdn.com/417295621/files/doc\\_downloads/governance/EssentGroup\\_Charter\\_TechnologyCommittee.pdf](http://s1.q4cdn.com/417295621/files/doc_downloads/governance/EssentGroup_Charter_TechnologyCommittee.pdf).

The primary purpose of the Technology, Innovation and Operations Committee (the “Committee”) of the Board of Directors (the “Board”) of Essent Group Ltd. (the “Company”) shall be to assist the Board in fulfilling its oversight responsibilities with respect to the overall role of technology in executing the business strategy of the Corporation including, but not limited to, (i) ensuring that the Company’s technology programs support the Company’s business objectives and strategies, and provide for appropriate data security and data privacy, (ii) identifying technology-related risks that could have a significant impact on Company’s operations and pursuit of its long-term strategic goals, (iii) advising the Company’s senior technology and operations management teams; and (iv) advising the Board on technology, innovation, data security and data privacy, and operations-related matters.

The Committee shall have the responsibility to:

1. Receive reports from the Company’s management on information technology, data security and data privacy, operations and technology strategies and trends that may affect the Company’s strategies, including monitoring of overall industry trends, and significant, technology, data security and data privacy, and operations strategies and investments.
2. Receive reports from management, as and when appropriate, on operations and technology metrics.
3. Review the Company’s technology, innovation, data security and data privacy, and operations planning strategies and associated budgets for the Company.
4. Review and make recommendations to the Board regarding significant investments in support of the Company’s technology, innovation and operations strategies.
5. Review the measurements and tracking systems in place to achieve successful innovation.
6. Review and discuss the Company’s technology, innovation, data security and data privacy, and operations policies.
7. Monitor and evaluate existing and future trends in technology, innovation, data security and data privacy, and operations that may affect the Company’s strategic plans, including monitoring overall industry trends.
8. Review the major technology and data security and data privacy risk exposures of the Company and the disclosure thereof in the Company’s annual report on Form 10-K, including risks relating to information security, data security and data privacy, software change management and deployment and

system capacity, and the steps management has taken to monitor and control such exposures. 9. Review the Company's business continuity planning and disaster recovery capabilities and contingency plans. 10. Review with the Company's management the Company's risk management and risk assessment guidelines and policies regarding technology (including data security and data privacy) and operations risks. 11. Coordinate with the Audit Committee and Risk Committee to help ensure that those committees have received the information necessary to permit them to fulfill their duties and responsibilities with respect to oversight of risk management and risk assessment. 12. Perform any other duties or responsibilities expressly delegated to the Committee by the Board from time to time.

*iii.* GLOBAL PAYMENTS – Technology

Committee :

[https://s21.q4cdn.com/254933054/files/doc\\_d](https://s21.q4cdn.com/254933054/files/doc_d)

[downloads/gov\\_docs/Technology-Committee-](https://s21.q4cdn.com/254933054/files/doc_d)

[Charter-\(effective-10-24-19\).pdf.](https://s21.q4cdn.com/254933054/files/doc_d)

The primary purposes of the Committee are to (1) assist the Board and management in their oversight of the Company's management of risks with regard to matters related to information technology, information security, cybersecurity, disaster recovery, data and data privacy, and business continuity, including, but not limited to, risks in these six areas related to hardware, software, personnel, architecture, organizational structure, management, resource allocation, innovation, and research and development (collectively, "Technology") and (2) review the practices and key initiatives of the Company related to Technology. The Committee shall have the responsibilities set forth below, in addition to any responsibilities assigned to it by the Board. In discharging its role, the Committee is empowered to make decisions and determinations, to grant approvals, and to inquire into any matter that it considers appropriate to carry out its responsibilities and other actions reasonably related to the Committee's purposes or assigned by the Board from time to time, with access to all books, records, facilities and personnel of the Company. The Company shall provide adequate resources, as determined by the Committee, to support the Committee. The Committee shall have the

authority, to the extent it deems necessary or appropriate, to ask the Company to provide the Committee with the support of one or more Company employees to assist it in carrying out its duties. The Committee shall also have the sole power and authority to retain, compensate, direct, oversee and dismiss any consultants, search firm, counsel and other advisers to assist the Committee in carrying out its activities, who shall be accountable ultimately to the Committee. A. The Committee's responsibilities relating to Technology are set forth below: 1. The Committee shall review and discuss with management the Company's assessment and management of risks associated with Technology. 2. The Committee shall review and discuss with management the Company's risk appetite and strategy and objectives relating to Technology risks, as well as the guidelines, policies and processes for monitoring and mitigating such risks and strategy and objectives. 3. The Committee shall discuss with the Board on not less than an annual basis the Committee's review and consideration of management's assessment and management of risks associated with Technology, including the Company's risk appetite and tolerance for Technology risks, and make recommendations to the Board with respect thereto.] 4. The Committee shall, in conjunction with the Board, ensure that the Company has a comprehensive written information security program that has appropriate administrative, technical and physical safeguards based on the size, complexity, nature and scope of the Company's operations and that such program meets applicable regulatory requirements. 5. The Committee shall, in conjunction with the Board, review and evaluate the Company's significant Technology plans, policies and strategies, including its significant research and development initiatives, as well as significant technical and market risks associated with product development and investment. 6. The Committee shall, in conjunction with the Board, review and evaluate all major technology expenditures. 7. The Committee shall review future trends in the areas of Technology that may affect the Company's strategic plans, including monitoring of overall industry trends. 8. The Committee shall make recommendations to the Board regarding the appointment, replacement, reassignment or dismissal of the Company's Chief Information Security Officer and shall take steps that are reasonable or necessary to ensure that the compensation and benefits allocated to the Chief Information Security Officer are not subject to modification or termination without the consent of the Committee. 9. The Committee shall periodically receive reports from the Company's Chief Information Security Officer concerning the status of the Company's information security program and other related matters. 10. The Committee shall periodically review the activities, organizational structure and qualifications of the Chief Information

Security Officer and make recommendations to the Board. The Committee shall make recommendations to the Board regarding the approval of the Chief Information Security Officer's plan, budget and resource plan. 11. The Committee shall periodically review with the Chief Information Security Officer the budget, staffing and responsibilities of his or her department. 12. The Committee shall periodically make appropriate inquiries of management and the Chief Information Security Officer regarding any significant difficulties, disagreements with management or scope restrictions encountered in the course of his or her work. 13. The Committee shall periodically receive reports from the Company's designated Data Protection Officer(s) ("DPO") concerning the status of the Company's compliance with applicable data protection requirements as assessed by the DPO(s). 14. The Committee shall perform any other activities consistent with this charter, the Company's Bylaws and governing law as the Committee or the Board deems necessary or appropriate.

B. The Committee's responsibilities relating to governance are set forth below: 1. The Committee shall review and reassess periodically the adequacy of this charter and recommend any changes to the Board. 2. The Committee shall conduct an annual performance assessment relative to the Committee's purpose, duties and responsibilities outlined herein. 3. The Committee shall report regularly to the Board on the Committee's activities."

*iv.* HUNTINGTON BANCSHARES –  
 Technology Committee:  
[https://www.huntington.com/-/media/pdf/HBI\\_Technology\\_Committee\\_Charter.pdf](https://www.huntington.com/-/media/pdf/HBI_Technology_Committee_Charter.pdf).

The Joint Technology Committee (the "Committee") of Huntington Bancshares Incorporated ("HBI") and its national bank subsidiary, The Huntington National Bank (the "Bank," and collectively with HBI, the "Company") is responsible for assisting their respective boards of directors as applicable (individually or collectively, as

applicable, the “Board”) in overseeing the Company’s: A. Technology and Innovation Strategies, Plans and Operations; B. Information and Cyber Security Risk Management Program; and C. Third Party Risk Management Program.

The Committee shall have the following duties and responsibilities: A. Technology and Innovation Management. In such a manner as the Committee deems appropriate to fulfill its purposes, the Committee shall: 1. Receive reports on and provide oversight of the Company’s technology: strategies, plans, functions, operations, risk management, significant investments and segment and support area needs; 2. Oversee management’s plans and activities relevant to technology innovation, including technology acquisitions and trends that may affect the Company’s strategic plans; 3. Review the Company’s Technology Resiliency recovery planning and preparedness; 4. Provide oversight to major initiatives for or supported by technology; and 5. Receive reports on the Company’s intellectual property program. B. Information and Cyber Security Risk Management. In such a manner as the Committee deems appropriate to fulfill its purposes, the Committee shall: 1. Provide oversight of the Company’s Information and Cyber Security plan, and the development, implementation, maintenance and risk management of the Information and Cyber Security program; and 2. Review and approve, no less than annually, the Information and Cyber Security program and plan. C. Third-Party Risk Management. In such a manner as the Committee deems appropriate to fulfill its purposes, the Committee shall: 1. Provide oversight of the Company’s third-party risk management program; and 2. Approve the Company’s risk-based policies that govern the third-party risk management process and identify critical activities. D. Other Responsibilities. In such a manner as the Committee deems appropriate to fulfill its purposes, the Committee shall: 1. Conduct an annual review of its own performance based on criteria or in accordance with the procedures agreed upon with the Nominating and Corporate Governance Committee.

v. LOWE’S – Technology Committee :

<https://corporate.lowes.com/sites/lowes->

corp/files/Committee-charters/Technology-  
Committee-Charter.pdf.

The Technology Committee (the “Committee”) is established by the Board of Directors (the “Board”) of Lowe’s Companies, Inc. (the “Company”) as an independent and objective committee of the Board. The primary purpose of the Committee is to assist the Board to provide oversight of, and counsel on, matters of technology, eCommerce and innovation.

The Committee shall have the following authority and responsibilities: 1. Review, discuss and make recommendations to the Board relating to the Company’s technology, eCommerce and innovation strategy in support of the Company’s objectives, including but not limited to: a. review and evaluate the Company’s technology-related systems and architecture to provide sufficient support to the Company’s strategy and business objectives; b. review and discuss the Company’s technology, eCommerce and innovation strategy, plan and budget, including IT talent acquisition and development, and the alignment thereof; c. review and discuss the Company’s major technology developments, acquisition and investments, provide oversight on major IT-related project progress, and evaluate the competitiveness and effectiveness thereof; d. review and evaluate the Company’s technology investment, planning and decisionmaking policies and processes; and e. integrate and align the Company’s technology, innovation and eCommerce efforts with the Company’s overall strategy. 2. Monitor, oversee and provide guidance on issues relating to significant emerging technology, eCommerce and innovation trends and issues that may affect the Company strategy. 3. Perform other activities consistent with this Charter as may be requested by the Board.

vi. MAGNA INTERNATIONAL – Technology  
Committee: [https://magna-  
p.magna.com/docs/default-source/corporate-](https://magna-p.magna.com/docs/default-source/corporate-)

This Charter has been adopted by the Board of Directors of the Corporation (the “Board”) to assist the Technology Committee (the “Committee”) and the Board in the exercise of their responsibilities, particularly by defining the scope of the Committee’s authority in respect of matters delegated to it by the Board relating to technology and innovation. Where used in this Charter, the term “Executive Management” has the meaning ascribed to it in the Corporation’s Board Charter. Role and Responsibilities of the Committee 1. The Board has delegated to the Committee the responsibility for the following matters: Technology Trends, Opportunities and Risks (a) Technology Trends: reviewing, monitoring, evaluating and making recommendations to the Board regarding general technological trends which may impact the automotive industry and/or the Corporation’s: product, service and solution software offerings; advanced manufacturing strategy; and/or overall strategic plan. (b) Opportunities and Risks: assessing the impact of technological trends and disruptive technological changes on the Corporation’s business or strategy, and making recommendations to the Board with respect to the Corporation’s approach to addressing the opportunities and risks arising from such trends and changes. Research & Development (“R&D”) (c) R&D/Innovation: reviewing the Corporation’s R&D/innovation initiatives, assessing the effectiveness of such initiatives in relation to the Corporation’s strategy, and making recommendations to the Board with respect to same. Technology Partnerships, Investments and Acquisitions (d) Partnerships and Investments: advising Executive Management on, monitoring, assessing the effectiveness of and making recommendations to the Board regarding, the Corporation’s overall approach to: □ technology partnerships, joint projects and other collaborative activities with universities, colleges, technical institutes, advanced research organizations or other similar bodies; □ initiatives involving technology incubators; and □ joint ventures with, or investments in, software and



technology companies. (e) Technology M&A: advising Executive Management and making recommendations to the Board as needed with respect to material M&A transactions aimed at addressing a technological trend, opportunity or gap in the Corporation's product or service portfolio.

Embedded Cybersecurity Risks (f) Product-Embedded and Solution Software Cybersecurity: assessing with Executive Management the Corporation's product-embedded and solution software cybersecurity risk exposures, together with the Corporation's actions to identify, monitor and mitigate such exposures. Technology & Corporate Strategy (g) Alignment Between Technology & Strategy: satisfying itself that the Corporation's overall approach to technology and intellectual property development and acquisition are aligned with the Board's strategic priorities. Reporting and Disclosure (h) Annual Reporting to Board: reporting to the Board at least annually with respect to the Committee's activities in respect of each fiscal year. (i) Technology Committee Report: overseeing the preparation of the Technology Committee report for inclusion in the Corporation's management information circular/proxy statement.