# DIGITALIZATION IMPACTS ON CORPORATE GOVERNANCE

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## Abstract

For improved corporate governance in this age of digitalization, the Board of Directors could investigate key operating performance indicators or KPIs for competitive advantages with Digitalization Dashboards. There are over 30 such digital metrics in the Digitalization Dashboard example in this paper. A starting point for developing such key metrics could be the digital values indicated by the "efficient stock market" with the market to book ratio calculation. The ten "new economy" companies had an average market to book ratio of 10.85 while the ten "old economy" companies had an average market to book ratio of 2.64. Why are sophisticated investors indicating that the equity market value or market capitalization of "new economy" companies is almost eleven times larger on average than their equity book value? Why is the average market to book ratio of "new economy" companies over four times larger than for "old economy" companies? What key digitalization metrics and competitive advantages are in play here? Digital dashboards are recommended here to answer such questions. While the awareness on boards regarding risks originating from disruptive innovation, cyber threats and privacy risks has been increasing, board members must equally be able to challenge executives and identify opportunities and threats for their companies. This shift for companies is not only about digital technology but also cultural. How can people be managed when digital, virtual ways of working are increasing? What do robotics and "big data" analysis mean for managing people? One way to accelerate the digital learning process has been advocated: the use of digital apprentices for boards. For example, Board Apprentice, a non-profit organization, has already placed digital apprentices on boards for a year-long period (which helps to educate both apprentices and boards) in five different countries.

**Keywords:** Digitalization, Artificial Intelligence, 3D Printing, Blockchain

## 1. INTRODUCTION

"If a board is not bothered about digital, I would sell your shares in that company!" Brian McBride, Chairman, Asos (Korn/Ferry Institute, 2013). The major research question of this paper is: what are the key digitalization impacts that executives and boards of directors should pay attention to for enhanced corporate governance?

At the 2016 World Economic Forum meeting in Davos, Switzerland, some influential leaders advocated the need to develop a digital mind which understands the potential, the disruptive nature, and the risks associated with the use of digital data. They stressed that a company's ability to harness digital data can drive profitability, offer critical insights, and open new business opportunities. For 2017, 735 board members and executives voted the speed of disruptive innovation as the fourth highest risk for their business (Amato, 2016). Peter Montagnon, Associate Director of the Institute of Business Ethics, observed that a major role of a board is to allocate capital, but how can directors fulfill this role if they do not fully understand the implications of the digital economy? Rather than treating digital knowledge as a specialist skill, he

argued that such skill must be developed by all directors (Heimer & Valeur, 2016).

In his new December 2016 book "Thank you for being late" Thomas Friedman stated that a lifelong job requires lifelong learning, especially now in the age of digitalization which Freidman said had an incredible boost in 2007. Apple released its first iPhone, starting the smartphone revolution that can provide an internet-connected computer to anyone. Facebook opened itself to anyone with an email address and Twitter started to scale globally. Hadoop software expanded the ability of any company to store enormous amounts of data which helped enable "big data" and cloud computing. Palantir Technologies, the leading company using "big data," launched its first platform. Amazon released Kindle which started the e-book revolution. Google bought YouTube and introduced Android, an open-standards platform for devices that would help smartphones scale globally. AT&T invested in "software-enabled networks" to expand its capacity to handle mobile cellular traffic which then increased more than 100,000% from January 2007 through December 2014. IBM started Watson, the world's first cognitive computer, which combined machine learning and artificial intelligence. The cost of sequencing a human genome began to fall significantly as the biotech industry shifted to new sequencing techniques and platforms. 2007 was the beginning of the clean power revolution with an exponential rise in solar energy, wind, biofuels, LED lighting, energy efficient buildings, and the electrification of vehicles. All steered through the smart grid, any electrical device today becomes a digital hub in the future: electric cars, refrigerators, washing machines, screw drivers, etc. A government energy official said it was a "hockey stick moment."

Also starting in 2007 were Airbnb, change.org, and GitHub, now the world's largest open source software sharing library. Intel introduced non-silicon materials into its microchip transistors, extending the duration of Moore's Law, the expectation that the power of microchips would double about every two years with the exponential growth in computer power still continuing to this day. Internet users worldwide exceeded one billion which seemed to have been a tipping point. Netscape founder, Marc Andreessen, observed: "Software is eating the world." Thus, 2007 may be viewed as one of the greatest technological inflection points in history with so many more things that could be digitalized, so much more storage for digital data, so many faster computers, so much more innovative software, and so many more organizations and people who could access and contribute to those benefits with their handheld computers---their smartphones. Even though 2007 generated all these amazing digitalization benefits, it was missed completely, due to the overwhelming impact of the 2008 financial crisis (Friedman, 2016).

To understand how digitalization can have an impact on corporate governance, it is first necessary to define digitalization and to know how it can enable new business models. Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities. Digitalization is the process of moving to a digital business which changes a business's operating model. Digital technology enables new data flows, insights, and capabilities. To convert the digital information into new value-producing opportunities, businesses must develop new business procedures and rethink how work gets done. This may result in a complete revamping of the business's entire operating model.

This tremendous surge in digitalization has huge impacts for both corporate executives and their Boards of Directors. Their duties in running and supervising their organizations have become significantly more challenging. In the spirit of lifelong learning, they need to develop digital skills without having to become, or just rely upon, digitalization experts.

Executives and boards of directors need to pay attention to key digitalization impacts. Accordingly, the remaining sections of this paper discuss the following topics: board of directors in the digital age, disruptive digitalization applications, digitalization with Artificial Intelligence, digitalization with Industry 4.0, digitalization with Blockchain, digitalization with 3D Printing, the end of traditional accounting, digital dashboards, emerging risk management challenges, and conclusions.

## 2. BOARDS OF DIRECTORS IN THE DIGITAL AGE

A 2016 McKinsey & Company report discussed a new class of problems caused by this digital age where directors' experiences in managing and monetizing traditional assets are now insufficient. The digital age has enabled the growth of new competitors, rapid-fire funding cycles, fluidity of technology, digital experiences demanded by customers, and the rise of nontraditional risks. Accordingly, McKinsey & Company has advocated four ways to help Boards of Directors deal with these digital age challenges and view themselves as catalysts for digital transformation efforts (Sarrazin & Willmott, 2016):

1. Close the insights gap.
2. Understand how digital can upend business models.
3. Engage more frequently and deeply on strategy and risk.
4. Fine-tune the onboarding and fit of digital directors.

### 2.1. Close the insights gap

Boards have to do more than just hire a digital director. Digital has such a huge impact on a company's business model, its value chain, and its competitive environment, i.e., e-commerce, mobile, security, the Internet of Things (IoT) and "big data," that more knowledge and experience are needed than just one or two tech-savvy directors. As a possibility, digital skills relevant to individual product lines could be communicated to help train boards. Special subcommittees and advisory councils can also help narrow this insights gap of boards. For example, one technology council suggested a radical solution of reorganizing the company around customer experiences, such as the home, the car, and the office, instead of traditional product lines.

### 2.2. Understand how digital can upend business models

Many boards do not fully understand the digital pressures and challenges to their existing business models. For example, the design of satisfying,

human-centered experiences is fundamental to digital competition but few boards focus on such challenges. Boards should push company executives to explore and describe the company's digital assets, such as data accumulating across businesses and the level of data analytics, i.e. pattern analysis, machine learning, and sophisticated "big data" analytics. Boards should question how managers are using such digital techniques to develop insights, strategy, and product lines.

Digitalization can change business models by removing cost and waste and by accelerating a company's pace of operations. Inexpensive, scalable automation and new Information technology architectures help provide the means to strip overhead and operate at a fraction of prior costs. Boards must challenge company executives concerning their companies' traditional high costs and low flexibility which may enable digital competitors to set up online marketplaces and sell directly to the company's own customers.

### 2.3. Engage more frequently and deeply on strategy and risk

Boards need to be more adaptive and involved with their companies than just meeting once or twice a year to review strategy. For example, a major cyberattack can erase one third of a company's market capitalization in one day and a digital competitor can take over a thriving product category in six months. Boards should also help senior management negotiate the tension between "making the numbers" each quarter for Wall Street and making long term and costly, digital investments for strategic purposes. The 2016 Corporate Governance Principles report by 13 top U.S. Chief Executive Officers recommended against focusing upon quarterly numbers in order to emphasize long term benefits for investors (Governance principles 2016).

McKinsey & Company has recommended that boards start asking management strategic questions in this age of digitalization, such as: "What are the handful of signals that tell you that an innovation is catching on with customers?" and "How will you ramp up customer adoption and decrease the cost of customer acquisition when that happens?" Risk analysis and discussion need more emphasis. In this era of continual cyber threats, only about 20% of board directors feel confident that the necessary controls, metrics, and reporting are established to address hacker incursions. One example at a global bank was provided where the board used a Digital Dashboard of ten key operational performance indicators (KPIs), such as the percentage of daily service transactions performed without human interaction. These KPIs provided benchmarks for directors to measure digitized delivery of banking services often provided by emerging competitors (Sarrazin & Willmott, 2016). Providing meaningful numbers is a challenge that needs to be met by both sides in reducing the insights gap. Digital cannot stay a nerd's exclusive playground where insights are artificially made exclusive to keep directors 'outside.' Reporting in dashboards must become meaningful to boards through meaningful input from the technology side.

### 2.4. Fine-tune the onboarding and fit of digital directors

Many digital directors are younger, maybe even "geeks", who have no other board experience. Thus, board searches must go beyond background and skills to include candidates' temperament and ability to commit time, especially with better board members now devoting two or three days a month of work plus extra hours for conference calls and other tasks. Thus, induction and onboarding processes need to bridge the digital—traditional gap or possibly just create an advisory role for digital experts. Also, existing board members need to increase their digital skills to help company executives think about, cope with, and adapt to these digitalization challenges. Such digital skills can be learned by board members, who are experienced, competent people, similar to Thomas Freidman's observation that lifelong jobs require lifelong learning.

## 3. DISRUPTIVE DIGITALIZATION APPLICATIONS BY AMAZON

For an example of the digital disruptions McKinsey & Company has warned about, Amazon may be reinventing the grocery store. In Seattle, it is currently testing a grocery store model that works without checkout lines. Shoppers can scan a new app called Amazon Go when they enter the store and sensors register items chosen by shoppers and automatically charge them to the Amazon app. If shoppers return items, they are not charged. The store offers ready-to-eat meals, staples like bread and milk, and meal-making kits. It is just one way Amazon has been exploring the $800 billion food and beverage market. Amazon also offers grocery delivery in some markets with its Prime Now app for last-minute items delivered in one or two hours. One financial analyst said: "We are encouraged by Amazon's growing footprint in this category, which we see as ripe for potential disruption, given younger demos increasing purchasing food and beverage grocery items via digital channels" (Associated Press, 2016).

Amazon made drone delivery history in December 2016 by performing its first drone delivery to an actual customer. This delivery was a Fire TV and a bag of popcorn to a rural house in England 13 minutes after receiving an online order on its Prime Now app. In April 2016, Amazon was awarded a patent for giant flying warehouses called airborne fulfillment centers (AFCs). These AFCs will serve as home bases for drones that will be coming and going from the AFCs hovering about eight and a half miles above metropolitan areas. Currently, Amazon's Prime Air drones can carry up to five pounds of merchandise. Per the patent, each AFC is a dirigible or lighter-than-air aircraft which can navigate under its own power and will carry merchandise, warehouse workers, and drone launch platforms. After delivering packages from an AFC to customers, the drones will navigate to a nearby ground based, materials handling facility. There, a replenishment shuttle, another smaller airship, will send drones, additional materials, and even workers

back to the AFC. AFCs are not limited to a fixed position but can navigate to different areas, depending upon various factors, such as weather and expected or actual demand, such as at a Super Bowl or World Series game (Castelluccio, 2017).

Amazon's proposed use of drones may drive down the cost to deliver small packages crosstown to as little as $1, a fraction of existing same-day delivery option costs by UPS, Federal Express, the U.S. Post Office, and couriers which represent an $82 billion market (Levin & Soper, 2016). Another Amazon threat is to the 6.2 million people who work at stores found in malls or shopping centers, i.e. General Merchandise, Apparel and Accessories, Furniture, and Other Sales (GAFO) stores. After years of no growth, GAFO stores' sales actually fell $1.8 billion in 2016 with 125,000 retail workers being laid off in the past two years. Meanwhile, online sales increased $14 billion in 2016 with Amazon accounting for most of that growth with its own sales growth rates of 19% in 2014, 20% in 2015 and 28% in 2016. One economist predicted that Amazon will kill more American jobs than the 2 million American jobs killed by China's manufacturing exports to the U.S. (Nutting, 2017).

## 4. DIGITALIZATION WITH ARTIFICIAL INTELLIGENCE APPLICATIONS BY GOOGLE

Digitalization with artificial machine learning intelligence (AI) is poised to reinvent computing itself. For an example in November 2016, Google Translate, the company's machine-translation app, had suddenly improved and become more transparent after it had been converted to an AI-based system as over one hundred languages were upgraded in just nine months for its U.S., Europe, and Asia traffic of over 500 million monthly users (Lewis & Kraus, 2016). An additional example was the fivefold increase in improved translations between Arabic and German from the recent European refugee situation. This machine learning AI system demonstrated overnight improvements roughly equal to the prior total gains of Google's Translate app over its entire lifetime. It is based on the goal of "artificial general intelligence" which does not follow adherence to explicit instructions but demonstrates a facility with implicit and interpretive information. Artificial neural networks acquaint themselves with the world via trial and error, as young children do, and try to develop something like human flexibility. Accordingly, computers are learning from the ground up (from data), rather than from the top down (from rules).

Google's decision to reorganize itself around AI with its Google Brain project led to an industrywide machine learning focus. Over the last four years, six leading companies, Google, Facebook, Apple, Amazon, Microsoft, and the Chinese firm Baidu, have been competing to recruit AI talent with some starting salaries reaching seven figures. The long term AI goal is control over an entirely new computational platform: pervasive, ambient artificial intelligence or "artificial general intelligence." Recent examples of machine learning included AI-enhanced assistants, like Apple's Siri, Facebook's M, and Amazon's Echo, and Samsung's medical-digital imaging subsidiary which has new ultrasound devices that can detect breast cancer. Management consultants are prepping executives (and possibly Board members) for the emerging AI business applications by computers that program themselves (Lewis & Kraus, 2016).

## 5. DIGITALIZATION WITH INDUSTRY 4.0

Industry 4.0 is a current trend of automation and data exchange in manufacturing technologies, which started from a project in the high-tech strategy of the German government. It includes cyber-physical systems, the Internet of Things or IoT, and cloud computing, using SCADA protocols (Supervisory Control And Data Acquisition). It creates a "smart factory" where cyber-physical systems monitor physical processes, create a virtual copy of the physical world, and make decentralized decisions. Over the IoT, cyber-systems communicate and cooperate with each other and with humans in real time, and via the Internet of Services, both internal and cross-organizational services are offered and used by participants of the value chain (Hermann 2016).

In a McKinsey & Company study, a German software consultant, Siegfried Dais, was quoted: "It is highly likely that the world of production will become more and more networked until everything is interlinked with everything else." While this assumption is a driving force behind the Internet of Things, it also means that the complexity of the value chain will grow significantly versus the current limitation of networks and processes to a single factory. In an Industry 4.0 scenario, individual factory boundaries will no longer exist as multiple factories or even geographical regions are interconnected (Liffler & Tschiesner, 2013). However, cybersecurity issues are magnified by this Industry 4.0 need to open up previously closed production shops. Reliability and stability are needed for critical machine-to-machine communication (M2M), especially to maintain the integrity of production processes. Cybersecurity also is needed to protect industrial knowhow and control files (BIBB, 2015). The speed of manufacturing enterprises adapting to use the digital potential for efficiency, such as a programmer from the US changing in real time production lines in China or accessing a water turbine in Alaska, will help decide their survival. Warren Bennis predicted: "The factory of the future will have only two employees, a man and a dog. The man will be there to feed the dog. The dog will be there to keep the man from touching the equipment" (Bennis, 2014).

## 6. DIGITIZATION WITH DISTRIBUTED LEDGER TECHNOLOGY, THE BLOCKCHAIN

A technology expert commented: "In Distributed Ledger Technology (DLT) we may be witnessing one of those potential explosions of creative potential that catalyze exceptional levels of innovation" (Walport, 2016). DLT first showed its disruptive nature in the development of the blockchain technology in the financial sector where it competes with national governed currencies on a worldwide scale. Changes to ledgers can be made in a un-permissioned setting like the blockchain by anyone and are fully transparent. DLT introduced the triple-entry accounting, enhancing the double-entry ledger system, in which all accounting entries involving outside parties are cryptographically sealed by a

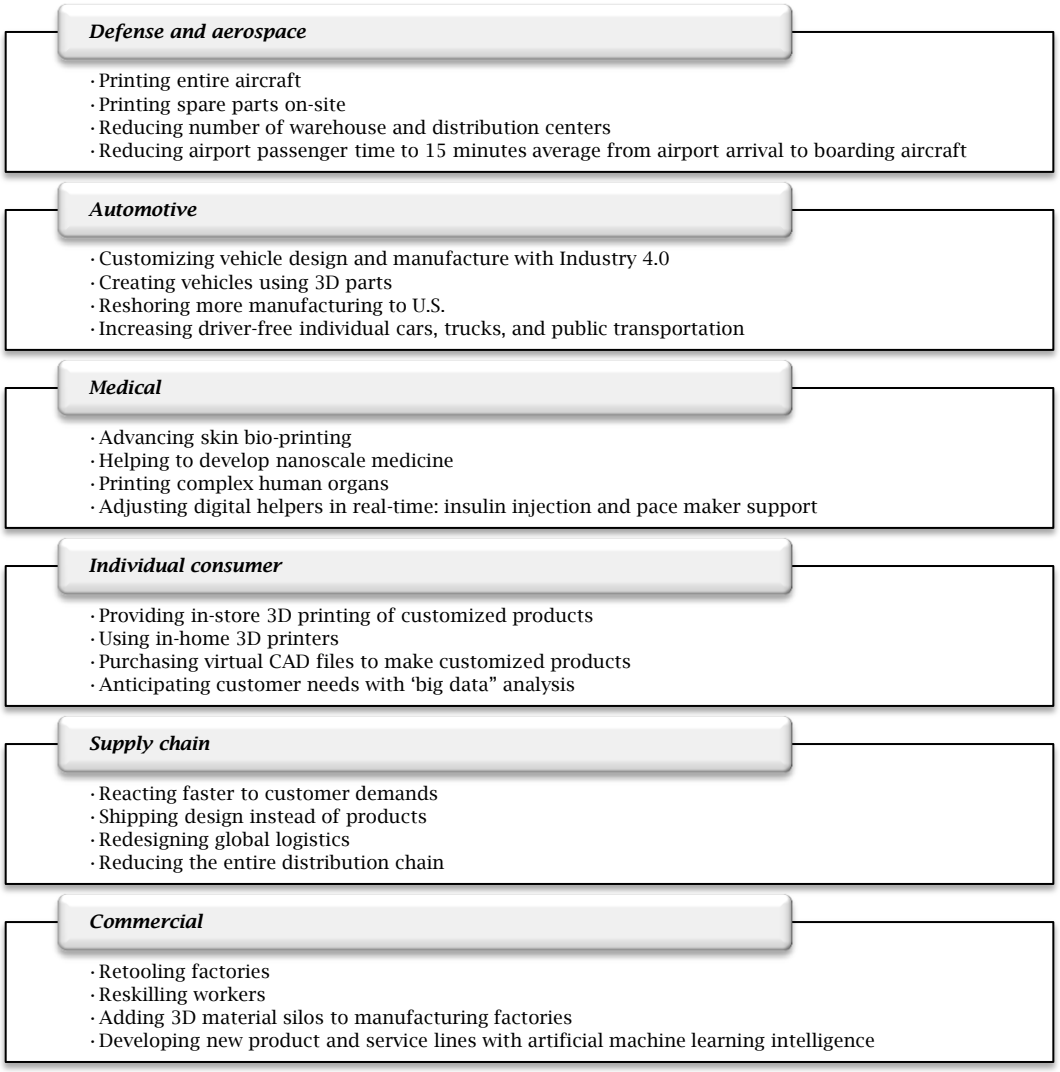
third entry (Watson and Mishler, 2017). This process increases the level of trust and at the same time reduces the complexity of managing security and compliance, making the usage of such systems much easier and cheaper. Initially, governments started adopting this technology, e.g., for tax payments processes in Zug, Switzerland. Wide possibilities for adaption may generate rethinking, not only power structures but also concepts, e.g., in security where transparency beats secrecy.

## 7. DIGITALIZATION WITH THREE-DIMENSIONAL PRINTING

Started in the 1980s, three-dimensional (3D) printing, also called additive manufacturing (AM), was created as a faster and more cost-effective method for creating product prototypes. The process began with product design creation using a computer aided design (CAD) or a similar 3D digital file. A 3D printer deposited successive layers of basic polymer material on top of each other until the final product was created. Recent technology improvements have expanded the type of printable materials to include plastics, metal, nylon, plaster, ceramics, food, and even human tissue cells. By changing the digital files' configuration, products can be customized to an individual consumer's tastes and preferences. Once created, a blueprint digital file can be sent anywhere in the world so that a product can be replicated by a 3D printer. For example, at the 2015 annual auto show in Detroit, Local Motors Company arrived without a car! Instead, company representatives created the latest version of their Strati car on-site, using a digital file and a 3D printer (Wiatt, 2016).

The value of the 3D/AM printing industry reached $5.1 billion in 2015 with a 26% annual growth rate (Wohlers Associates, 2016). Emerging 3D/AM benefits include improving lead times for product prototypes, cutting manufacturing and storage costs, and creating innovative products. Emerging 3D/AM and AI advancement and application benefits are listed below by major business sectors (Wiatt, 2016).

**Figure 1.** Emerging 3D and AI benefits



So what are companies and Board of Directors doing about these emerging digital advances and applications? Are they seizing opportunities to create competitive advantages? Are they analyzing the challenges and risks? Are they adapting their business models and strategies? Already internet-based collaborative service companies are helping companies to optimize and create new products using 3D/AM technology. Digital opportunities include manufacturing parts with complex designs, reducing prototype and tooling costs, improving product design, and increasing customization at low cost. Digital challenges include protecting intellectual property, reskilling workers, addressing factory environmental concerns, and improving supply chains. Where is the Board of Directors' corporate governance to determine if corporate executives are creating competitive advantages with these opportunities while also dealing with the related risks? Metrics for such opportunities and risks could be integrated into a Digital Dashboard.

Companies taking advantage of this 3D/AM digital opportunity to create competitive advantages include Boeing which now has more than 20,000 spare parts maintained in digital files that can be printed on demand, whenever and wherever they're needed. It may possibly be used in Iran where Iran Air recently signed a $60.6B deal with Boeing to purchase 50 737s and 30 777s airplanes (Hielmgaard, Bomey, & Dorell, 2016). General Electric used AM to consolidate 18 separate parts into a single jet engine fuel nozzle and Lockheed Martin reduced material waste by using a 3D printer to make a specialty bracket from titanium. The U.S. Air Force created 3D-printed molds as a means to cut holes for replacement air-duct brackets. A medical research team in Belgium successfully implanted a 3D-printed titanium jaw prosthesis. Customized hearing aids and muscle implants have also been created by 3D printers.

Staples, Home Depot, and UPS have added 3D printing services in select stores for both small business owners and other consumers. Amazon and eBay have added 3D product stores to their websites and Walmart's website offers a dozen 3D printers, some for less than $1,000. Such inexpensive 3D printers will enable consumers to purchase digital files, add customization features, and then print the products at home. Websites, such as Thingiverse, Shapeways, and Pinshape, enable users to make, share, and customize printable objects and promote creative collaboration. The Advanced Composite Structures firm repairs helicopter rotor blades and produces specialized composite parts for the aerospace industry. Using a 3D modeling machine, the company reduced tooling designs from $2,000 to $400 and lead times from 45 days to one day (Wiatt, 2016).

Each company and its Board of Directors need to do risk assessment before adding any digital capacity to its business. Intellectual property (IP) owners must assess the potential for widespread infringements that their existing monitoring systems may not detect or control. With the rise and anonymity of 3D printing services and home 3D printers, Gartner, an information technology (IT) consulting firm, predicted that annual IP losses could exceed $100 billion by 2018 (Gartner, 2016). Nebulous websites on Pirate Bay and the dark web function as platforms that enable users to easily upload and share scanned images of protected designs. These websites have already created 3D printable files ("physibles") for sharing and trading in the global digital black market.

The World Economic Forum has predicted that this 3D/AM "Fourth Industrial Revolution" will result in more than five million jobs being eliminated by the year 2020 among the 15 largest world economies (World Economic Forum, 2016). Employee reskilling will require greater skills in computing, mathematics, robotics, and engineering. New safety standards will go beyond the traditional manufacturing factory. The National Institute of Standards and Technology (NIST) has issued specific safety protocols covering the handling of metal powders, static electricity prevention, and flammability risks. Long-sleeved lab coats, goggles, rubber gloves, fire-resistant clothing, respiratory protection, and antistatic footwear will be needed in various 3D/AM manufacturing environments.

For a positive risk view, digital technologies offer companies enhanced value and competitive advantages. For example, a 3D/AM supply chain has fewer links and greater flexibility to decentralize and re-shore production by building products at the point of consumption. Such decentralization reduces supply chain risk factors, such as geopolitical events and natural disasters. By improving responsiveness to changes in manufacturing requirements, suppliers and collaborators may help reshape and strengthen supply chains. 3D/AM technology enables companies to increase responsiveness to changing customer demands and to build competitive advantages. It provides an opportunity to improve existing business models and to find new business opportunities with customization, faster product availability, and waste reduction (Wiatt, 2016). Corporate executives and Boards of Directors should take advantage of all these new business opportunities but also assess the risks involved in this emerging 3D/AM environment.

## 8. THE END OF TRADITIONAL FINANCIAL ACCOUNTING

In their new June 2016 book "The End of Accounting" Baruch Lev and Feng Gu argued that investors are poorly served by arcane accounting methods, and new ways to measure companies' performance are needed. One new way is a Digital Dashboard for company executives and Boards of Directors in this new era of digitalization. The authors stated that traditional reported earnings and financial statements no longer reflect the realities of businesses but instead follow an arcane set of accounting rules and regulations, established for "old economy" companies such as energy, steel, autos, and other traditional manufacturing. New metrics are needed for "new economy" companies, such as technology, software, biotech, and internet operators. Also, with the advent of 3D/AM digital technologies, new metrics are needed for both "old" and "new economy" companies in this digitalization age.

Traditional financial accounting has reflected an alternate reality which fails to highlight essential factors that make an enterprise rise or fall. For example, the most important, value-creating investments in patents, brands, information technology (IT), and other intangibles must be expensed, just like salaries and rent, instead of reflecting future value or benefits. Reported earnings

include both long-term sustainable growth and one-time, transitory gains and losses. Reported earnings are based on many subjective managerial estimates and projections, such as prospective bad debts, future pension liabilities, stock-option expenses, and asset impairments or write-offs. Thus, the authors argued that all such reporting results in backward-looking accounting statements that say little about an enterprise's future growth and ability to compete. Research has shown an increasing gap between reporting earnings and share prices, especially for "new economy" technology and science-based companies and that earnings have lost their ability to predict future corporate performance which is their main use by investors (Lev & Gu, 2016).

Such a gap between "old economy" and "new economy" companies is reflected in Table 1 by a comparison of the Equity Market Value to Equity Book Value ratio for ten companies in each category. This market to book ratio is a measure of the increase in shareholder wealth. In capital budgeting, the Net Present Value (NPV) is calculated as PVget – Pvgiveup. The book value of the equity is the historical amount invested in the business by the equity investors. It can be thought of as the PVgiveup. The market value of the equity is what the equity investors' investment is worth now; it is the PVget. If PVget is greater than PVgiveup, then NPV is positive, and the positive NPV is the increase in shareholder wealth. This increase will be larger if the market to book ratio is larger. When examining this ratio, the higher the rate of return a business is earning on its equity relative to the return required by the equity investors, the higher will be the market to book ratio. For the market to book ratio to be greater than 1.0, the firm has to earn a return on its equity greater than the equity investors' required rate of return.

**Table 1.** Digitalization competitive advantages per Market/Book

| *Old Economy Companies* | *Market/Book* | *New Economy Companies* | *Market/Book* |
|---|---|---|---|
| Alcoa AA | 0.40 | Apple AAPL | 4.52 |
| Caterpillar CAT | 2.53 | Alphabet GOOG | 4.38 |
| Chevron CVX | 1.00 | Alibaba BABA | 5.95 |
| Coca-Cola KO | 7.32 | Amazon AMZN | 23.70 |
| Exxon XOM | 1.92 | eBay EBAY | 4.91 |
| General Electric GE | 2.83 | Facebook FB | 6.33 |
| General Motors GM | 1.20 | IBM IB | 8.90 |
| Pfizer PFE | 2.84 | Microsoft MSFT | 5.27 |
| Proctor & Gamble PG | 3.86 | Netflix NFLX | 21.30 |
| Wal-Mart WMT | 2.51 | Tesla TSLA | 23.27 |
| Total | 26.41 | Total | 108.53 |
| Average | 2.64 | Average | 10.85 |
| Comparisons | 76% | Comparisons | 4.1 x |
| | Lower | | Higher |

*Note: Market/Book = Equity Market Value / Equity Book Value*

The twenty companies in the Table 1 comparisons were chosen because they are large, well-known publically traded companies with business models and operational technologies that enable them to be categorized as either "old economy" or "new economy". As shown in Table 1, there is a huge gap in the market to book ratios between "new economy" and "old economy" companies. The average of 10.85 for new companies is 4.1 times larger than the average of 2.64 for old companies or, alternatively, the old company average is 76% lower than the new company average. Since stock prices are set by an "efficient stock market," there must be reasonable justifications for such a huge gap. But what intangibles cause such a gap and digitalization competitive advantages for these "new economy" companies? Such a question demonstrates the need for KPIs and a Digital Dashboard.

This focus upon traditional financial accounting by both Wall Street and corporate executives to "make the numbers", i.e. short-term (quarterly), predetermined (analysts' consensus) numbers, has damaged firms' competitiveness. Such damages include postponing or cutting advertising, research and development, employee training, and maintenance expenses to "make the numbers." Research has also shown that such earnings management techniques are relatively futile efforts since a consensus earnings miss by a company generally produces an insignificant 1.5% to 2% share price drop on average. However, corporate executives may be focused on "making the numbers" to achieve their short-term, earnings bonus targets. Since traditional financial accounting deficiencies make it hard for executives to report the real performance of the company, they often resort to earnings based upon non-generally accepted accounting principles (non-GAAP). Such non-GAAP numbers have created suspicion and even derision. Lynn Turner, the former Chief Accountant of the Securities and Exchange Commission (SEC), has called such reporting: Earnings Before Bad Stuff (EBBS).

## 9. DIGITAL DASHBOARDS

As advocated by McKinsey & Company and Lev/Gu, a recommended solution is the systematic disclosure of information that focuses upon the fundamentals of the business in this age of digitalization. Instead of the backward-oriented financial accounting statements, there are many forward-looking indicators of performance and growth that emphasize a business's strategy and execution success, as well as its risks. Such information may be provided in quarterly conference calls with Wall Street, investor meetings, and Management Discussion and Analysis in annual reports but are often reported in a haphazard or inconsistent way. Other companies do not provide such information at all which makes competitive comparisons impossible. As Albert Einstein warned: "Not everything that can be counted counts, and not everything that counts can be counted."

Digital Dashboards would help remedy these disclosure problems and could be organized similar to the well-established Balanced Scorecard approach which has the traditional four categories of financial, customer, internal business, and innovation/ learning, as well as an emerging category of risk management (Frigo, 2012). Such information should be developed into industry-specific, comparable strategic information frameworks, focusing upon a company's strategy and success of its execution and value creation (Lev & Gu, 2016). Here is one Digital Dashboard example, based upon many of the McKinsey & Company and Lev/Gu recommendations for key digital queries and metrics, organized by the five Balanced Scorecard categories (Figure 2).

**Figure 2.** Digital dashboard example

***Financial***

- Book-to-Bill Ratio (time from customer order received until customer invoiced).
- Specific Types and Amounts of Company Investors: Convertible Debt, Convertible Preferred Stock, Angel Investors, Venture Capital, Private Equity, "Activist" Investors, Corporate Raiders, Hedge Funds, Value Investors, Growth Investors, Turn-Around Investors.
- Inventory of Digital Assets: AI machine learning applications, 3D/AM digital files, IP digital assets and applications, digital asset use by internal customers (managers), cross functional (not silo) data applications, pattern analysis, "big data" and other data analytics; cost and waste removal by digitalization with cheap, scalable automation, and new IT architectures.

***Customer***

- Customer Acquisition Costs.
- Customer Growth Rates.
- Digital Competition: design of satisfying, human-centered experiences.
- New Subscribers and Churn Rates for Internet, Telecom and Media companies.
- Same-store Sales for Retail companies.
- Policy Renewal and Cancellation Rates for Insurance companies.
- Weekly Prescription Sales for Parma companies.

***Internal business processes***

- Maintenance and New Tangible Capital Expenditures.
- Test Results of Products Under Development.
- Progress of the Product Pipeline for Parma and Biotech companies.
- Capacity Utilization for Transportation companies.
- Replacement of Resources by Oil and Gas companies.
- Satellite Scanning of Retailer's Parking Lots.

***Innovation/Learning***

- Digital Experiences that Customers Demand.
- Proactive Use of Digitalization Opportunities (e-commerce, mobile, security, Internet of things, and "big data").
- New Innovations: key signals that indicate acceptance by customers; how to ramp up for such new demand and decrease customer acquisition costs.
- Potential New Competitors.
- New Intangible Capital Expenditures (Patents, Brands, IT, HR, etc.).
- Fluidity of Technology and Technology Environment: Potential Impacts on Value Chain.
- Route Changes (Coverage) for Transportation companies.
- Automation: percentage of daily service transactions performed without human interaction for Banks and possibly for Transportation companies with self-driving cars and trucks.
- Acquisition and Development of Digital Talent (both for companies and their boards).

***Risk management***

- Actual Threats of New Competitors/Market Entrants: set up online marketplaces, disrupt established distributor networks, and sell directly to our existing customers.
- Cyber Security Threats: a major cyberattack can destroy a third of a company's market cap in one day! Are necessary controls, metrics and reporting in place to address such threats?
- Nontraditional Risks: Digitalization Undermining Existing Strategies and Stimulating Needs for New Strategies (Digital Disruptions and Digital Transformation Efforts).
- Quicker Proactive, not Reactive, Responses to Digitalization Threats: Use of Technology Committees and Advisors.
- Risk Diversification of the Product Pipeline for Parma and Biotech companies.
- Frequency and Severity of Claims for Insurance companies.

## 10. EMERGING RISK MANAGEMENT CHALLENGES

Cyber security risks change with every new digital invention introduced, adding potential threats. Cyber security risks are specific to a company's business model and values, possibly turning a threat into a vulnerability that must be addressed by the company. Both threats and vulnerability exposure must be regularly reassessed and organized in meaningful categories, such as security risks compromising the business processes, client facing activities, or support functions. Technologically, these areas can be separated in logical IT-architectural domains in order to help managers and boards understand the business impact of IT-security risks (Georg, 2015).

Another emerging risk is related to the Internet of Things (IoT) which is made up of billions of everyday devices connected for convenience to the internet. In Fall 2016, hackers attacked this network. Commandeering as many of 100,000 of these devices by using malicious software that guessed at their simple, factory-set passwords and, then, ordering them to send volleys of nuisance messages to the computers of Dyn, a company which functions as a switchboard for the internet. Large sectors of the internet, such as Amazon, Twitter, Netflix, Paypal, and online newspapers, slowed down to a crawl for a good part of the day. Another notorious 2016 hack occurred one day in March when $81 million of Bangladesh's money disappeared out of its account at the Federal Reserve Bank of New York. The hackers accessed the SWIFT international bank messaging system, "billed as a super secure system that banks use to authorize payments." In contrast, it took the famous U.S. bank robber, Willie Sutton, 40 years to steal $2 million (Castelluccio, 2017).

Traditional customer needs are being changed by completely new technology possibilities. An example is Samsung entering the market for refrigerators or washing machines, using large touch screens to manage the devices and personalize the design. Also, companies that innovated in the field of water and energy efficiency, noise, or performance can suddenly be faced with a competitor with an individualized design and remote control for customer convenience and satisfaction.

Digitalization depends on networks which are often shared and do not follow typical geographical or industrial silos, such as Industry 4.0 technology for a value or supply chain. Networks can be shared around the world and cover all types of clients. At the same time, if these networks are infected, such infections can spread widely and affect the business of the entire network. An infection in a cloud provider with an international customer base offering virtualization technology would affect all such customers equally. For example, an infected insurance company on the cloud could be facing an accumulation of claims that could threaten its survival and also might eliminate insurance coverage of individual customers. Discovering these hidden interrelationships between companies generates new assessment tasks, including new questions that cover such interconnectivity risks (Georg, 2015).

## 11. CONCLUSIONS

For improved corporate governance in this age of digitalization, the Board of Directors could investigate key operating performance indicators or KPIs for competitive advantages with Digitalization Dashboards. There are over 30 such digital metrics in the Digitalization Dashboard example in this paper. A starting point for developing such key metrics could be the digital values indicated by the "efficient stock market" with the market to book ratio calculation. In Table 1, the ten "new economy" companies had an average market to book ratio of 10.85 while the ten "old economy" companies had an average market to book ratio of 2.64. Why are sophisticated investors indicating that the equity market value or market capitalization of "new economy" companies is almost eleven times larger on average than their equity book value? Why is the average market to book ratio of "new economy" companies over four times larger than for "old economy" companies? What key digitalization metrics and competitive advantages are in play here?

The three highest market to book ratios for the "new economy" companies were Amazon, Tesla, and Netflix at 23.70, 23.27, and 21.30, respectively. Possible intangible or digital assets and competitive advantages for Amazon's very high market to book ratio could relate to being the largest internet-based retailer in the world (by total sales and market capitalization), its diverse product lines including online bookstore, DVDs, Blu-rays, CDs, downloads/streaming of video, MP3, and audiobooks, software, video games, electronics, apparel, furniture, food, toys, and jewelry, production of consumer electronics, such as Kindle e-readers, Fire tablets, and Fire TV, and being the world's largest provider of cloud infrastructure services (IaaS).

Tesla's very high market to book ratio could relate to being the second largest global plug-in car manufacturer and the market potential for its product lines of electric cars, powertrain components of Tesla Powerwall and Powerback batteries for home and industry, and battery charging equipment. Netflix's very high market to book ratio could relate to its large network of 86 million subscribers in 190 countries worldwide, including 47 million in the U.S., and its diverse service lines of streaming media and video on demand online, DVDs by mail, film and television production as well as online distribution. Through its "Netflix Original" online library, it is releasing an estimated 126 original series or films in 2016, more than any other network or cable channel.

Conversely, the only "old economy" companies with a market to book ratio higher than 3.0 were Coca-Cola (7.32) and Proctor & Gamble (3.86). These higher scores probably represent their intangibles of brand names and distribution networks. Alcoa had the only market to book ratio below 1.0 at 0.40, indicating that Alcoa is earning a return on its equity that is less than the return the equity investors require, probably due to the poor performance of steel and other basic materials companies in these times of global economic stagnation.

Digitalization competitive advantages for these

companies are reflected in their very high market to book ratios, as established by "efficient stock market" investors. Many such investors are financial analysts who regularly follow certain stocks and issue reports with buy, sell or hold recommendations on these stocks. According to a public company Chief Financial Officer, who did over 40 quarterly conference calls and numerous meetings with financial analysts, fund managers, and investors over ten years: "They are the some of the smartest people in the world because they have been attracted to Wall Street which is the largest money game in the world" (Coburn, 2016). Thus, board members should educate themselves by reviewing quarterly conference calls and by reading financial analyst reports to get an indication of the key digital metrics that help drive high market to book ratios. Often key intangible, digital assets and competitive advantages are valued in these financial analyst reports, using either free cash flow and/or market comparable valuation methods.

In this age of digitalization, especially with artificial machine learning intelligence and three-dimensional printing or additive manufacturing, new metrics are needed for both "old" and "new economy" companies. Such emerging digital metrics could then be inserted into a Digitalization Dashboard and used as benchmarks by Board of Directors to question corporate executives about strategies, competitive advantages and threats, and progress on such digital metrics. Board members have already become comfortable with metrics in traditional financial reports. Using new digital metrics should just be a reasonable learning extension for these competent and experienced people, as part of their lifelong learning process to stay relevant for the company executives whom they are overseeing and the investors whom they are representing. Such an approach would strengthen corporate governance in this age of digitalization impacts.

While the awareness on boards regarding risks originating from disruptive innovation, cyber threats and privacy risks has been increasing, board members must equally be able to challenge executives and identify opportunities and threats for their companies. This shift for companies is not only about digital technology but also cultural. How can people be managed when digital, virtual ways of working are increasing? What do robotics and "big data" analysis mean for managing people? One way to accelerate the digital learning process has been advocated: the use of digital apprentices for boards. For example, Board Apprentice, a non-profit organization, has already placed digital apprentices on boards for a year-long period (which helps to educate both apprentices and boards) in five different countries (Heimer & Valeur, 2016).

Additional plans and strategies are needed in this age of digitalization and lifelong learning. For example, cybersecurity risks are magnified by all these new IT trends, such as AI, Industry 4.0, M2M, and 3D/AM. Accordingly, new cybersecurity strategies, such as building system resiliency and system deterrence, and even using "hack-backs," have been advocated (Rosenzweig, 2013; Grove, Georg, & Clouse, 2017). Additional plans and strategies are also needed to cope with predicted digital technology advances, as shown in the following Appendix, organized by the same industry classifications used in this paper.

The main limitation of this study is how fast technology is changing, especially these key digitalization topics of artificial intelligence, Industry 4.0, blockchain, and 3D printing. Future perspectives for research in this field include key technology updates for organizational and corporate governance impacts. For one key future research perspective, an especially challenging issue for executives and boards of directors is "the deadly soul of a new machine."

That was the title of a New York Times article on December 7, 2018, by Timothy Egan. He wrote about the Indonesian Lion Air Flight 610 which crashed 13 minutes after takeoff on October 29, 2018, and killed all 189 people on board. (This new Boeing 737 MAX airplane had already been in service for two months and had flown 800 hours, including a safe flight on the prior day.) The pilots requested a return to the airport 2 minutes after takeoff as the advanced electronic brain in this airplane was forcing the jetliner down. The human pilots tried to return the plane to manual control and override the electronic brain in order to correct this downward plunge but the automatic pilot took control back from them and crashed the plane into the Java Sea. Egan's question is: "At what point is control lost and the creations take over? He answered: how about now?" He commented that all these artificial intelligence innovations are designed to make life easier and safer—or at least more profitable for their corporate owners. He cited another example where a driverless car killed a woman in a U.S. crosswalk and noted that other driverless cars have been slower to react than humans.

A report by the U.S. Federal Aviation Administration in 2013 found that 60 percent of flight accidents over the recent decade were linked to confusion between pilots and automated systems. What is the role of corporate executives and boards of directors in dealing with these technology advances? Satya Nadella, the Microsoft CEO, provided guidance at the company's 2018 annual shareholder meeting as he said: "Big Tech should be asking not what computers can do, but what they should do." Egan agreed and commented that Facebook has never asked such a question, only focusing upon its own company growth, and has become a "monster of misinformation." He summarized: "We are at the cusp of an age of technological totalitarianism and need to ask for more screening, more ethical considerations, more projections of what can go wrong, as we surrender judgment, reason, and oversight to our soulless creations." Concerning Flight 610, he summarized: "It's equally haunting to grasp the full meaning of what happened: the system overrode the humans and killed everyone. Our invention. Our folly." Shouldn't corporate executives and boards of directors be asking these more general questions and considering technology's impact on society in an evolving, intrinsic value focus, rather than just the narrow profitability impact on their own companies? (Grove & Lockhart, 2018).

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## APPENDIX

## Digital technology predictions

As Yogi Berra (1998) said: "The future ain't what it used to be." To enhance corporate governance and help protect investors, corporate executives and Boards of Directors need to develop plans and strategies for oncoming digital technology changes. For example, concerning business opportunities, corporate executives and Boards of Directors should first ask: "In the future, do I think we will have that? If the answer is yes, how can we make that happen sooner? If it doesn't work with your phone, forget the idea" (Aplanetruth, 2017).

Software technology will disrupt most traditional industries in the next 5 to 10 years. With artificial intelligence, computers are becoming exponentially better in understanding the world. For example, in the U.S., many young and talented lawyers don't get jobs because of IBM's Watson. It provides basic legal advice within seconds with 90% accuracy, compared with much slower 70% accuracy by humans. Facebook now has pattern recognition software that can recognize faces better than humans. By 2030, computers will become more intelligent than humans (Aplanetruth, 2017).

The following digital technology predictions (Aplanetruth, 2017) are organized by the six major business sectors previously discussed in this paper plus an agriculture sector. Many of these predictions are already starting to happen.

### Defense and aerospace

The U.S. military currently operates over 11,000 unmanned aerial systems (UAS). UAS have expanded from just intelligence, surveillance, and reconnaissance missions to include electronic attack, strike missions, suppression or destruction of enemy air defense, network node or communications relay, combat search and rescue and derivations of these functions. UAS range in cost from a few thousand dollars to multi-millions and range in weight from less than one pound to over 40,000 pounds. In 2012 for the first time, the U.S. Air Force trained more UAV pilots than ordinary jet fighters and UAV pilots now represent about 10% of total U.S. Air Force pilots. There are also thousands of civilian UAV operators (Hoagland, 2013). The space station now has a 3D printer that eliminated the need for the large amount of spare parts which were carried on board and some spare airplane parts are already 3D-printed in airports.

On January 8, 2017, there was a public demonstration of future combat by the U.S. military on the 60 Minutes News Hour. 100 light-weight (a few pounds), autonomous drones, named the Perdix, were launched from three F-18 jet fighters. These Perdix fly 40 to 50 miles per hour, are self-directed with Artificial Intelligence (AI), and communicate Machine to Machine (M2M). In this demonstration, they autonomously performed a complicated swarm maneuver. They have the capacity to launch their own weapons but are currently supervised by military personnel who approve any kill shots. A U.S. military technology expert in charge of this demonstration said that such drone capabilities are the most significant advance in military technology since the atomic bomb! The five most deadly drone powers in the world (in power order) are the United States, Israel, China, Iran, and Russia (Farley, 2015).

### Automotive

In a prediction for 2018, the first self-driving cars will be publicly available. People probably will not want to own a car but instead, call for a car with their phones. Thus, people will not need to park their cars but just pay for the driven distance while also being productive during their journeys. Although 1.2 million people die annually in car accidents worldwide, with autonomous driving, that number is estimated to drop by one million lives annually. Since many people will never own a car or need a driver's license, there will be 90% to 95% fewer cars. Cities will evolve as parking lots will be changed to housing and parks. While traditional car companies are trying to build a better car, tech companies, such as Tesla, Apple, and Google, are building a computer on wheels. The car insurance business line of insurance companies will all but disappear.

### Medical

IBM's Watson already helps diagnose cancer and it is four times more accurate than human nurses. Coming within a year, The Tricorder X medical device works with a phone. It will scan your retina, sample your blood, and when you breathe into it, it will analyze 54 bio-markers that can identify nearly any disease with amazing accuracy. In a few years, everyone could have access to world class medical analysis with Tricorder for next to nothing, compared to the current cost of healthcare. There is already a software app called "moodies" that can tell what kind of mood you are in and by 2020 there will be apps that can tell by your facial expressions whether you are being truthful or lying.

### Individual Customer

Uber and Airbnb are more than just digital tools. Even though Uber doesn't own any cars, it is now the largest taxi company in the world. Even though Airbnb doesn't own any hotel properties, it is now the biggest hotel company in the world. Some shoe companies already are making 3D-printed shoes, rather than manufacturing shoes the old-fashioned way. Smart phones will soon have 3D scanning capabilities. Consumers can then 3D scan their own feet and 3D print the perfect pair of shoes in the comfort of their own homes.

### Supply Chain

Electricity will become incredibly cheap and clean. In 2016, more solar energy was installed worldwide than fossil fuel systems. Home solar installations will also increase the availability of electricity. With cheap electricity comes cheap and abundant water. Desalination of salt water now only needs 2kWh per

cubic meter (at 0.25 cents per kWh). In most places, there is only scarce drinking water, not scarce water. Thus, there will be abundant clean water for a very cheap price. Israel already has five operational desalination plants.

## Commercial

China has already 3D-printed and built a complete 6-story office building. By 2027, at least 10% of everything that is being manufactured will be 3D-printed. In the next 20 years, 70% to 80% of jobs will disappear. Self-driving trucks will displace more than 3,000,000 drivers just in the U.S. Think tanks are looking at how a Universal Basic Income (UBI) system would work as there will be millions of fewer jobs than workers just in the U.S. On January 2, 2017, Finland began a UBI trial with 2,000 unemployed workers. They will continue to receive UBI even if they find work as the government does not want to disincentive anyone.

## Agriculture

There will be a $100 agricultural robot in the future. Farmers will then become managers of their fields, rather than laboring in them all day. Aeroponics will need much less water. The first Petri dish-produced veal is now available and will be cheaper that calf-produced veal by 2018. Since 30% of all agricultural acreage is now used for cattle, what will become of cows and land values? Several startup companies are planning to bring insect protein to the market. Pound for pound, insects contain more bioavailable protein than traditional meats but such products will initially be labeled as "alternative protein source" since most people currently reject the idea of eating bugs.

Digital technology is already facilitating both crop management and livestock management. Precision crop management techniques are using real-time data on weather, soil quality, and plant maturity to make decisions on planting, fertilizing, and harvesting crops. Precision livestock management techniques are using biometric ear tags, basically a Fitbit for cows (starter kit costs $500 and comes with 25 tags and a reader). The ear tags monitor each cow, recording its heart rate, body temperature, and location, and they store other information, such as the animal's date of birth and vaccination history. A rancher can access this data, using Bluetooth-enabled devices with a smartphone app, essentially creating smartcows. Obtaining data on how much a cow ate or drank allows correlations to be calculated with production or yield (Worthington, 2017).