Corporate Responsibility & the Internet of Everything

Submission to the 2015 Robert Davies Commemorative Essay Award

“Describe how ‘the internet of everything’ can enhance large-scale transformational change around corporate responsibility and economic opportunity”

Picture this

Picture this: a farmer sends a tractor into the fields, but she is not riding it. Instead, the map of the fields has been programmed into the machine and an optimal course tracked. Sensors direct its path. The soil has been assessed to provide guidance on what crops will grow best and chemicals in the air and water tracked to identify and stop the source of pollutants. Electric traps target and ward off pests. As the crop comes in to the new warehouse, temperature and moisture automatically adjust. Above, drones arrive to carry other crops directly to processors. The farmer manages the system based on real-time data through a centralized platform which connects her with suppliers, buyers, and external networks. Productivity, quality, and profits have improved drastically.

Anyone familiar with agriculture, particularly at the subsistence level, will be aware that this is not how the sector currently functions. Yet, it could be. The internet of everything (IOE) presents prospects that seem both tantalizingly possible and impossibly futuristic. The question for today's business leaders is how to reach that future, and how to do so in a way which enhances large-scale, transformational change around corporate responsibility (CR) and economic impact.

This paper briefly describes IOE and the related concept of big data. It then outlines how IOE could be used to address four major challenges of corporate responsibility - traceability, supply chain optimization, environmental sustainability, and impact measurement - envisioning what IOE-enabled CR would look like if applied to agriculture in the developing world.

The Internet of Everything

Applications of IOE range from the gimmicky to the game-changing, from smartphone-enabled crockpots to trackers which alert authorities when protected forests fall to illegal logging (Rothman, 2014; Castro, 2013). However, the significance of IOE, also known as the internet of things or the industrial internet, is more than individual products. Rather it is "the intelligent connection of people, processes, data, and things" (Chambers & Elfrink, 2014). IOE comprises three elements: the physical product itself, smart components such as sensors and software, and connectivity with a wider system, either between individual products, between products and a central network, or between many products and external data sources (Porter & Heppelmann, 2014). The combination is more than the sum of its parts; smart energy grids, for example, combine inputs from power users in homes and offices with inputs from power providers in plants and windfarms to determine when and where energy is used, changing cost to reflect demand and ultimately decreasing overall energy use.

IOE can be thought of as the infrastructure powering big data. Big data analysis "refers to things one can do at a large scale that cannot be done at a smaller one." It is characterized by the ability to access a complete data set rather than a supposedly representative sample; a preference for more "messy" data over limited clean data; and a shift away from knowing exactly *why* something happens to knowing exactly *what* has happened (Cukier & Mayer-Schonberger, 2013). The methodology can offer stunning insights; for instance, Uber uses big data to predict where customers will direct their rides even before they enter a destination (Titlow, 2014). IOE is "big" in that each device produces a constant outpouring of data and even bigger in that the network of devices creates multiple sources to draw on and cross-reference.

Attempts to quantify the economic and strategic impact of IOE produce breath-taking estimates. In economic terms, Cisco estimates that IOE will produce US$14.2 trillion in saved costs and increased revenues between 2013 and 2022 (Bradley, et al 2013). Another report claims IOE and big data "will generate US$300 billion of value per year in the US healthcare industry [and] EU250 billion of value per year in European public sector" (Rubenstein, 2013). In strategic terms, companies will be forced to think beyond the traditional parameters of their industries, pivoting from producing isolated products or services towards "end-to-end solutions that are integrated across disparate or siloed systems" (Chambers & Elfrink, 2014). Even strategy guru Micheal Porter was forced to revisit his classic "Five Forces" model of competition in light of IOE (Porter & Heppelmann, 2014). While IOE presents a considerable strategic challenge, it also presents a timely opportunity to address some of the most deep-rooted difficulties of CR.

IOE and Corporate Responsibility

CR has passed the days when a donation to a school or a hospital was a sufficient demonstration of corporate citizenship. Today, CR is closely aligned with the concept of inclusive business, the idea that companies can maximize their social and environmental impact not through philanthropy but rather through the design and sourcing of their products. Inclusive business recognizes minimum environmental and human rights standards but seeks to surpass them through the creation of "win-win" opportunities which balance increased impact and increased business opportunity. To take just one example, in Bangladesh improvements in livestock care and milk transport among smallholder dairy farmers led to deliveries to processors increasing by 43 percent and quality increasing by 30 percent (KcKague, 2013).

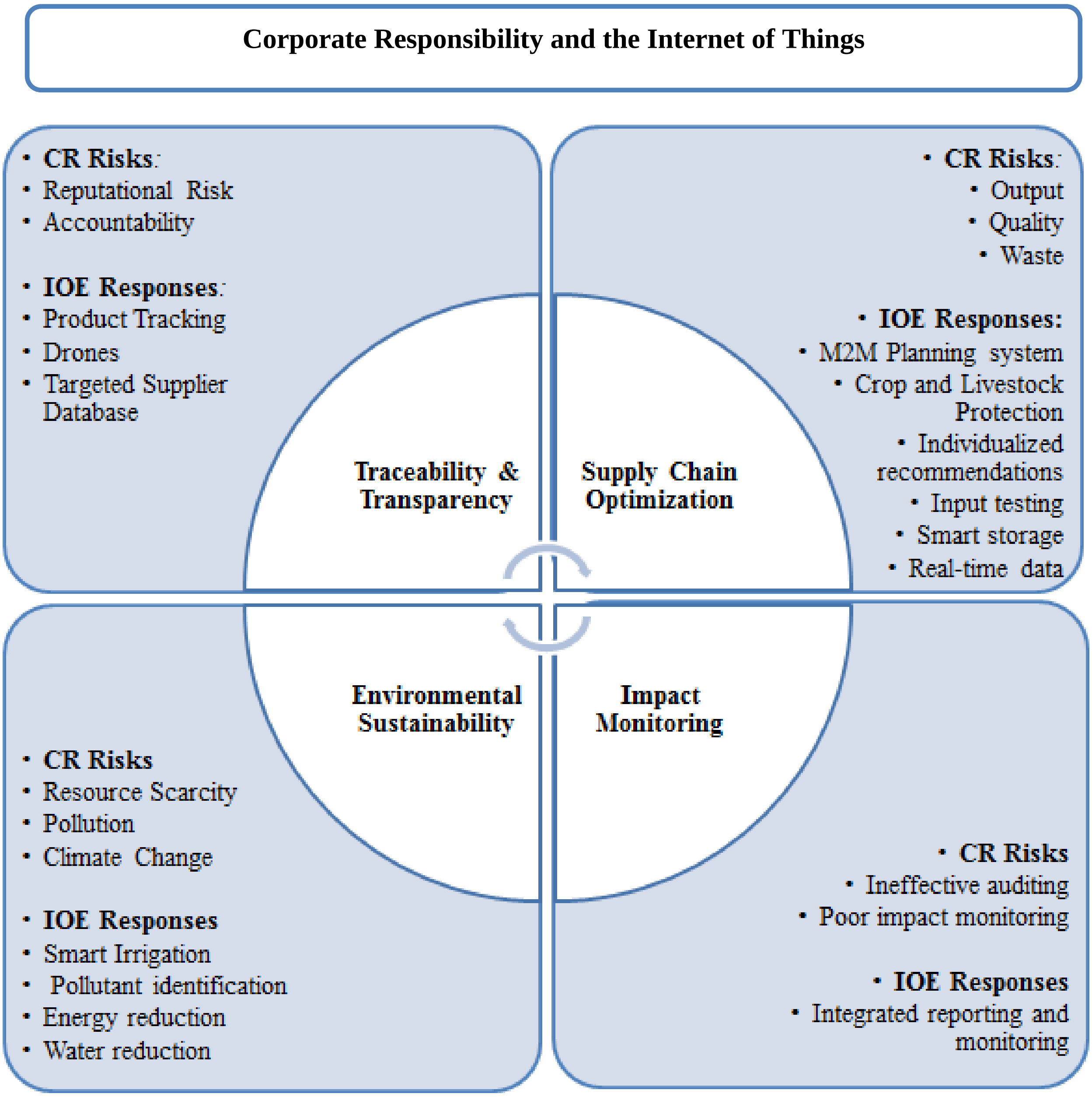
In theory a simple idea, inclusive business is, in practice, quite difficult to implement. Four of the most deep-rooted challenges, described in more detail in the following section, are lack of traceability, supply chain inefficiencies, environmental sustainability, and impact measurement. As a rule, the closer to commodity level of production, the more problematic it is for end-product manufacturers and retailers to apply an adequate CR framework. This is due to the low proportion of value captured by commodity producers, which encourages unsustainable practices and the degree of separation between producers and retailors across opaque value chains. IOE offers the potential to fundamentally shift value chain dynamics by increasing the income and opportunities of food producers and creating transparent connections between producers, buyers and consumers.

Moreover, a CR vision for an IOE world is vital because it is corporations which will have the most influence on its evolution. A recent McKinsey study mapped organizations with high access to big data against those with high value potential. Public sector institutions had high potential value but relatively low-potential access. All those with high potential access, notably companies in manufacturing, natural resources, and finance, sat in the private sector (Assay, 2014). Companies operating at the global and regional levels will have particular influence as "transitional corporation-coordinated global value chains account for some 80 per cent of global trade" (UNCTAD, 2013).

IOE and Agriculture

The social and environmental impacts of IOE are likely to prove proportional to its economic impact; in other words, immense. In the words of one commentator, "connecting products to the web will be the 21st century version of electrification" (Maly, 2013). This paper focuses on CR in agriculture for three reasons: first, rural agriculture employs 75 percent of the global poor and is responsible for widespread environmental damage (USAID, 2015); second, there is strong latent potential for companies to increase profits through inclusive business; and, third, the sheer scope of the challenge. Applying the IOE in places currently lacking regular electrical or internet access is a daunting task. Success requires a clear vision of what such a future could look like and the benefits it would entail for all stakeholders.

The table below outlines key CR challenges in the context of under-developed rural agriculture and proposes responses drawing on the emerging technologies of IOE and big data. Whilst specific responses would be dependent on the needs of individual sectors, these examples demonstrate the high degree to which IOE could lead to enhanced CR and economic opportunity regardless of context.



Challenge	Corporate Responsibility Risks	Internet of Everything Future
Traceability	*Reputational Risk:* Companies have a limited view of their products beyond the first tier of their supply chains. This leads to high reputational risks. Reports of forced and child labour in cocoa production, for instance, have damaged the reputation of companies like Hershey's and Mars for over a decade despite tens of millions of dollars of CR investments (McKinsey, 2012). "The reality is we only reduce risk when we directly engage with our supply base," notes Tim Smith, Quality Control Director at Tesco (Van Vark, 2014). *Direct connections:* Indirect purchasing links also leads to an inability to reach smallholder and women farmers, who tend to be left out of outreach schemes despite making up a large portion of the agricultural workforce. *Accountability:* For companies which do not actively pursue CR, poor traceability provides plausible deniability and limits accountability. Improved transparency would create an even playing field and ensure that no company gains an unfair advantage through illicit practices.	*Tracking:* Products are outfitted with unique codes allowing consumers to see exactly where each good was produced and processed. Reports are automatically cross-compared with data on social and environmental performance, ranking producers on both. Consumers can easily scan these codes and make informed choices about their purchasing practices. Companies which do not practice good CR are penalized with consumer action or by regulators. *Drones:* Drones monitor high-risk areas for abuses such as forced or child labour, submitting reports to companies and alerting local authorities to take action. Rather than analysing risk broadly by sector or region, companies use findings to make informed choices of where to source from to maximize CR and avoid exposing themselves to risk. *Supplier Databases:* Direct supplier connections mean that buyers can identify women-owned farms, helping companies make proactive steps on CR and gender. Reaching women farmers directly leads to increased production in low-value high-volume markets and increased quality in high-value and premium markets (Chan & Barrientos, 2010).
Supply Chain Inefficiency	*Output:* To meet projected needs, world food production must increase by 60 percent by 2050 (FAO, 2013). Currently low-quality, adulterated inputs hamper productivity improvements. In the US alone, crop damage from insects costs farmers over US$20 billion per year (Castro, 2014). *Quality control:* Improper harvesting,	*Production:* Integrated machine-to-machine planning systems such as John Deere's isystem, which use GPS guidance and integrated soil treatment, have led to 35 percent production increases where applied (Cullen, 2013). *Crop and livestock protection:* Electronic traps track and capture insect populations, protecting crops. Animal health is tracked through implanted

	handling, storage and packaging reduce product quality (FAO, 2013). *Waste:* Poor connections between producers and consumers lead to lost production, consumption, and profit. This includes lack of adequate transport or storage. Every year approximately one third of global food production is wasted (FAO, 2011).	sensors, preventing the spread of disease. *Input testing:* Farmers test the quality of inputs such as fertilizer to confirm the quality before purchasing, reducing fraud. *Individualized recommendations:* Farm sensors and geo-trackers feed into big data analysis, producing individualized recommendations on how to best improve farm output and informing policy decisions. *Smart storage*: Smart crop storage tracks contents of storage bins and monitors and adjusts temperature and moisture, protecting harvests. *Waste:* Smart tractors direct seeding and harvesting to avoid overlap, reducing input use and maximizing energy use. *Real-time data:* Farmers receive real-time data on demand so that they can carry harvested goods to the right place at the right time, raising incomes and reducing waste. Aggregators, processors and retailors receive real-time production information, making them better able to better manage purchases, reducing the effects of volatility. (Maranon, 2013).
Environ-mental Sustainability	*Resource Scarcity:* Agriculture accounts for 70 percent of global freshwater use, 60 percent of which is wasted due to inefficient or faulty irrigation (WWF, n.d.). Further resources are wasted by poor choice of crops for the local climate. *Pollution:* Phosphorous from fertilizers and ammonia from manure enters water run off, causing algae blooms and	*Resource scarcity:* Smart irrigation systems read current soil status and release or restrict water according to specific crop needs and current weather. Soil readings could also recommend appropriate crops. Water use in the US would drop by 20 percent with IOE technology (Cullen, 2013). *Pollution:* Sensors along water drainage areas identify pollutants and track their

reducing water potability.

Climate Change: Agriculture causes an estimated third of climate change (Gilbert, 2012) and drives approximately 70 percent of deforestation (Kissinger et al, 2012).

Agricultural outputs are also highly subject to shifting weather patterns, with "complex, localized impacts" that are hard for individual farmers to predict (FAO, 2013).

source.

The application of IOE-driven precision agriculture such as tractor guidance systems reduces America's fuel use by 16 million gallons when applied to 10 percent of farmland, applied globally the figures are even more substantial (Cullen, 2013).

Climate Change: IOE cuts climate change across all sectors by 19 percent, with agriculture accounting for a cut of 1.6gT, for example by monitoring cattle digestion to reduce methane (Cullen, 2013). Improved geo-tracking better links specific farms to deforestation, and trackers on individual trees alerts authorities to illegal activity (Castro, 2013).

Impact measurement

Ineffective Auditing: Most companies rely heavily on audits to verify supplier compliance with social and environmental standards. Social audits are highly subjective and often overlook key abuses (Toffel, 2014). They are also ineffective in catalysing meaningful change: a macro-study covering ten years of audits from leading companies found they led to limited improvement over time (Locke, 2013).

Monitoring: There is limited understanding of the long-term social or business benefits of CR initiatives, shrinking investment in responsible practices.

Integrated Reporting and Monitoring: IOE enables a system of reporting and monitoring not driven by one-time sampling under controlled circumstances but rather by real time data.

Impact monitoring would also be improved, for instance, a productivity improvement program could take live data before, during and after the progress, compare it with external data, and show what improvements are attributable to the programme.

Such systems would benefit both producers and their downstream buyers, empowering farmers to maximize production and enabling downstream buyers to invest in CR with confidence.

From here to there

Critics could be forgiven for reading what seems like an idealized future, comparing it with the decidedly imperfect status quo, and dismissing it as utopian. This would be short-sighted. The world of IOE is imminent, and the developing world will be part of it. However, there are risks which need to be addressed, and both the public and private sector have leading roles in creating an enabling environment for the productive use of IOE and big data in CR.

The technology to enable large-scale, transformational change is closer than many appreciate. All of the products cited in this paper already exist and operate in a real-world context. What is lacking is a critical mass which allows IOE-enabled products to function as parts of dynamic, interconnected systems, where their true value lies. This is not far off; Samsung predicts that within five years every single one of its products will be IOE-enabled (Humble, 2015). Google, IBM, and Xiaomi are all competing to host the platform where future IOE applications are developed, opening opportunities to a greater body of IOE innovators. Already, the majority of machine-to-machine connections exist *outside* of the developed world (Reuters, 2014). Initial development may be costly, but the marginal cost of operating the network is close to zero, encouraging application at scale over the long-term (Iansity & Lakhani, 2014). It seems increasingly likely that much of the developing world will leapfrog the incremental evolution of the internet experienced by early adopters and jump directly to IOE, "much like cell phones have allowed developing nations to leapfrog landlines" (Schwartz, 2012).

That being said, IOE brings risks that need to be considered. The risks of IOE and big data have been described by many; these include energy use, privacy, data ownership, and data utilization, none of which would be less tangible when applied to CR. To take just one example, drones could prove highly effective in obtaining information on child labour and other illicit activities, but these same drones could also present an invasion of privacy. The rise of IOE also raises new concerns from a CR perspective. For instance, much of the projected value of IOE comes from increased transparency, but it is likely that attempts to falsify data will be just as common as attempts to falsify documents today. In addition, the technologically advanced agriculture described here is efficient and sustainable, but not necessarily job-heavy. A recent survey found respondents who anticipated that IOE would lead to increased employment outnumbered those who thought it would lead to job losses by just a narrow margin (Bradley et al, 2013). For IOE to lead to real economic opportunities, it should not replace existing employment; ensuring this is the case will require substantial skill development.

How to overcome these risks and create the preconditions which will fast-forward the adoption of IOE among those who could most benefit from it? There are three starting points:

- *Invest in IOE catalysts:* Reliable internet and energy provision are prerequisites for the adoption of IOE devices. Even if these are not core business for key actors in farming or IOE, investments in their application would facilitate future opportunities in both sectors. Coordinated drives to bring solar energy and satellite-enabled network access could be viewed not only as international development but also as future business development.

- *Make IOE access pre-competitive:* There is strong competition to become the dominant player in IOE systems and technologies. However, beyond the platform developers themselves, companies would be best served by lowering barriers to entry so that the widest possible range of IOE-enabled agricultural products are developed and applied. As these are not investments that even the largest agricultural companies could make alone, they must be joint, multistakeholder efforts.

- *Build proof of concept:* The best way to build momentum around CR and IOE would be for multiple stakeholders to establish a functioning IOE system. Applied with focus to a high-potential region or commodity, this would demonstrate returns on investment for applying IOE and uncover new methods of applying IOE technology. A commodity like cocoa, concentrated in a limited growing area in West Africa, with demand expected to exceed supply by 2020, and with strong government and corporate interest, is ripe for an IOE intervention.

Conclusion

The rise of IOE will lead to a further concentration of information in the hands of the private sector, particularly multinationals. For IOE to lead to large-scale transformation in economic development and environmental sustainability, a clear vision of how these tools can enhance CR is required. This is particularly apposite in underdeveloped agriculture, which is marked equally by poverty and environmental degradation and by potential to enhance inclusive business outcomes by addressing challenges in traceability, supply chain inefficiencies, environmental sustainability, and impact monitoring.

IOE will be a catalyst of such widespread change that it can be hard to fully comprehend or imagine. Yet, consider that in our current networked world only 1 percent of devices are connected to the internet and how much and how quickly the world has changed as a result (Tredger, 2014). Each additional percent growth will lead to new transformations, each with far-reaching consequences. The impact of IOE has been compared with that of the industrial revolution (Johnson, 2014); however, the industrial revolution left a great portion of the world behind. IOE-enabled CR can be the driver that brings the IOE revolution to everyone.

Works Cited

Asay, M., (2014), “Big data's biggest impact is not on Silicon Valley”, TechRepublic.com, 12 August 2014: http://www.techrepublic.com/article/big-datas-biggest-impact-is-not-on-silicon-valley/ (Accessed 20 January 2015)

Bradley, J., Loucks, J., Macaulay, J.m Noranha, A., (2013), “Internet of Everuthing (IoE) Value Index”, *Cisco:* http://internetofeverything.cisco.com/sites/default/files/docs/en/ioe-value-index_Whitepaper.pdf (Accessed 20 January 2015)

Castro, D., (2013), “Thirty (plus) ways the internet of things is changing the world”, *The Futurist:* http://www.wfs.org/blogs/daniel-castro/thirty-plus-ways-internet-things-changing-world (Accessed 24 January 2015).

Cate, F.H. and Mayer-Schonberger, V., (2013) *"Tomorrow's privacy: Notice and consent in a world of Big Data"*, International Data Privacy Law, vol. 3, no.2, pp67-73

Chambers, J. & Elfrink, W., (2014), “The future of cities” *Foreign Affairs,* 31 October 2014: http://www.foreignaffairs.com/articles/142324/john-chambers-and-wim-elfrink/the-future-of-cities> (Accessed 24 January 2015).

Chan, M. and S. Barrientos (2010) ‘Improving Opportunities for Women in Smallholder-based Supply Chains: Business case and practical guidance for international food companies’ (Seattle: Gates Foundation; https://docs.gatesfoundation.org/Documents/gender-value-chain-guide.pdf, accessed 12 March 2014).

Cullen, M. (2013), “Machine to Machine Technologies: Unlocking the potential of a $1 trillion industry”, *Carbon War Room and ATT: http://www.grahampeacedesignmail.com/cwr/cwr_m2m_down_singles.pdf* (Accessed 26 January 2015).

Cukier, K., Mayer-Schonberger, V., (2013) *Big Data: A revolution that will change the way we live, work and think*, Eamon Dolan/Houghton Mifflin Harcourt

Food and Agriculture Organization, (2011), “Global food losses and food waste”, 2011. http://www.fao.org/ag/ags/ags-division/publications/publication/en/c/74045/ (Accessed 24 January 2015).

Food and Agriculture Organization (2013) “Climate-Smart Agriculture Sourcebook” http://www.fao.org/docrep/018/i3325e/i3325e.pdf (Accessed 24 January 2015).

Johnson, S. (2014), “Internet of things could be the next industrial revolution,” Mercury News, 1 February 2014: http://www.mercurynews.com/business/ci_24835528/internet-things-could-be-next-industrial-revolution

Gilbert, N., (2012) “One-third of our greenhouse gas emissions come from agriculture”, *Nature,* 31 October 2013: http://www.nature.com/news/one-third-of-our-greenhouse-gas-emissions-come-from-agriculture-1.11708 (Accessed 24 January 2015).

Humble, A., (2015) “Google's Schmidt believes the internet will soon disappear”, *VoiceChronicle.com:* 24 January 2014: http://www.voicechronicle.com/201501-googles-schmidt-believes-internet-will-soon-disappear (Accessed 24 January 2015).

Iansity, M. & Lakhani, K., (2014), “How Conections, Sensors, and Data are revolutionizing business”, *Harvard Business Review,* November 2014: https://hbr.org/2014/11/digital-ubiquity-how-connections-sensors-and-data-are-revolutionizing-business (Accessed 24 January 2015).

ITU News, (2014), “Smart irrigation for sustainable agriculture in Abu Dabi”: https://itunews.itu.int/En/4853-Smart-irrigation-for-sustainable-agriculture-in-Abu-Dhabi.note.aspx

Locke, R., (2013), *The promise and limits of private power,* Cambridge University Press.

Kissinger, G., M. Herold, V. De Sy (2012), *Drivers of Deforestation and Forest Degradation*. Lexeme Consulting, Vancouver Canada, August 2012: http://www.decc.gov.uk/assets/decc/11/tackling-climate-change/international-climate-change/6316-drivers-deforestation-report.pdf

Maranon, R. (2013), “Winning the beer game with the internet of things”, *Cisco:* blogs.cisco.com/ioe/winning-the-beer-game-with-the-internet-of-things-iot (Accessed 28 January 2015).

Maly, T., (2013), “The digital haircut that could change the world”, *Wired,* 2 February 2013: http://www.wired.com/2013/02/little-printer-gets-a-haircut/all/ (Accessed 24 January 2015).

McKague, (2012) “The business case for engaging with poor farmers in Bangladesh’s Dairy Sector,”: CARE International, July 2012: http://insights.careinternational.org.uk/publications/in-profit-and-out-of-poverty-the-business-case-for-engaging-with-poor-farmers-in-bangladesh-s-dairy-sector-1?highlight=YToxOntpOjA7czo1OiJkYWlyeSI7fQ== (Accessed 28 January 2015)

McKinsey, D. (2012), “Child slavery and chocolate all too easy to find”, *CNN,* 19 January 2012: http://thecnnfreedomproject.blogs.cnn.com/2012/01/19/child-slavery-and-chocolate-all-too-easy-to-find/(Accessed 28 January 2015)

Neagle, C., (2013) “25 weirdest things in the ‘Internet of Things’”, *NetworkWorld.com,* 22 April 2013: http://www.networkworld.com/article/2357907/data-center/96832-25-weirdest-things-in-the-Internet-of-Things.html (Accessed 24 January 2015).

Porter, M. & Heppelmann, J. (2014), “How smart connected products are transforming competition” *Harvard Business Review,* November 2014: https://hbr.org/2014/11/how-smart-connected-products-are-transforming-competition (Accessed 24 January 2015).

Reuters, (2014) “Africa fast off blocks in adopting the internet of things”: *Reuters,* 6 November 2014:http://www.reuters.com/article/2014/11/06/africa-tech-idUSL6N0SW5O920141106 (Accessed 20 January 2014)

Rothman, W., (2014) “A test of whether a smartphone-controlled cooker is worth it”, *Wall Street Journal,* 24 June 2014: http://www.wsj.com/articles/how-smart-is-your-crock-pot-1403628459 (Accessed 20 January 2014)

Rubinstein, I., (2013) "*Big Data: The End of Privacy or a New Beginning?”*, International Data Privacy Law, vol.3, no.2, pp74-87

Schwartz, A. (2012) "A real internet of things for the developing world" *Fast Company,* 1 August 2012: http://www.fastcoexist.com/1680223/a-real-internet-of-things-for-the-developing-world-and-burning-man (Accessed 20 January 2014)

Titlow, J. (2014) "Uber can now predict where you're going before you get in the car", *Fastcompany,* 18 September 2014: http://www.fastcolabs.com/3035350/elasticity/uber-can-now-predict-where-youre-going-before-you-get-in-the-car?partner=rss (Accessed 20 January 2014)

Toffel, M.,(2014) "Could more women auditors prevent another Rana Plaza?", *The Guardian,* 24 April 2014: http://www.theguardian.com/sustainable-business/women-supply-chain-auditors-study-bangladesh (Accessed 20 January 2014)

Tredger, C. (2014) "Does Africa get the internet of things?" WebAfrica.com, 28 November 2014. http://www.itwebafrica.com/network/333-africa/233847-does-africa-get-the-internet-of-things?#sthash.immXdnpF.dpuf (Accessed 20 January 2014)

United Nations Conference on Trade and Development, (2013), *World Investment Report 2013: Global Value Chains, Investment and Trade for Development:* http://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCsQFjAA&url=httppercent3Apercent2Fpercent2Functad.orgpercent2Fenpercent2Fpublicationslibrarypercent2Fwir2013_en.pdf&ei=LazEVP6rGcLpaOSQgMAI&usg=AFQjCNFEBGFIe7VRM3tBHXC9b7m11tYZxQ&sig2=ag7Yy8qg3NcxRtGgLDnMyQ&bvm=bv.84349003,d.d2s&cad=rja (Accessed 25 January 2015)

USAID (2015) "Agriculture and food security," January 2015: http://www.usaid.gov/what-we-do/agriculture-and-food-security (Accessed 20 January 2014)

Van Vark, X, (2014) "How to tackle food waste", *The Guardian,* 17 October 2014: http://www.theguardian.com/sustainable-business/2014/oct/17/tackle-food-waste-global-consumption-conundrum (Accessed 20 January 2014)

World Wildlife Foundation, n.d., "Farming: wasteful water use" http://wwf.panda.org/what_we_do/footprint/agriculture/impacts/water_use/: (Accessed 20 January 2014)