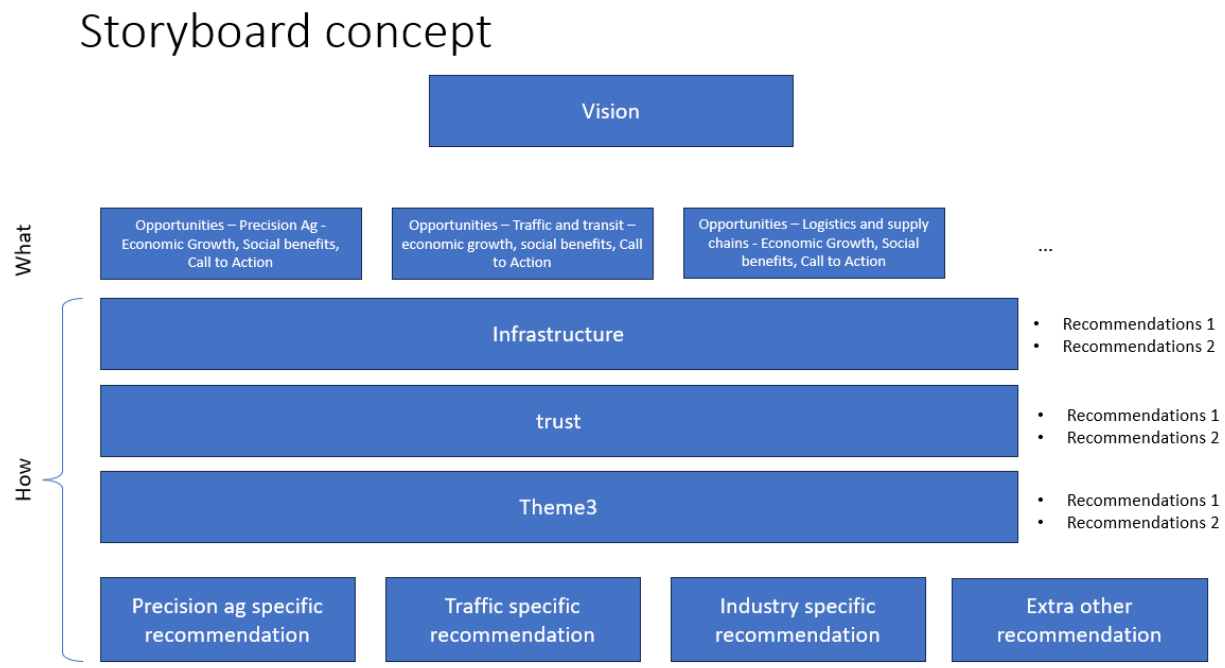
Goals of report

- Address the needs and requirements in the legislation
- Create understanding of the key impacts, opportunities, challenges of IoT from an industry perspective
- Create a sense of “urgency” to act faster and in a bigger way



Vision

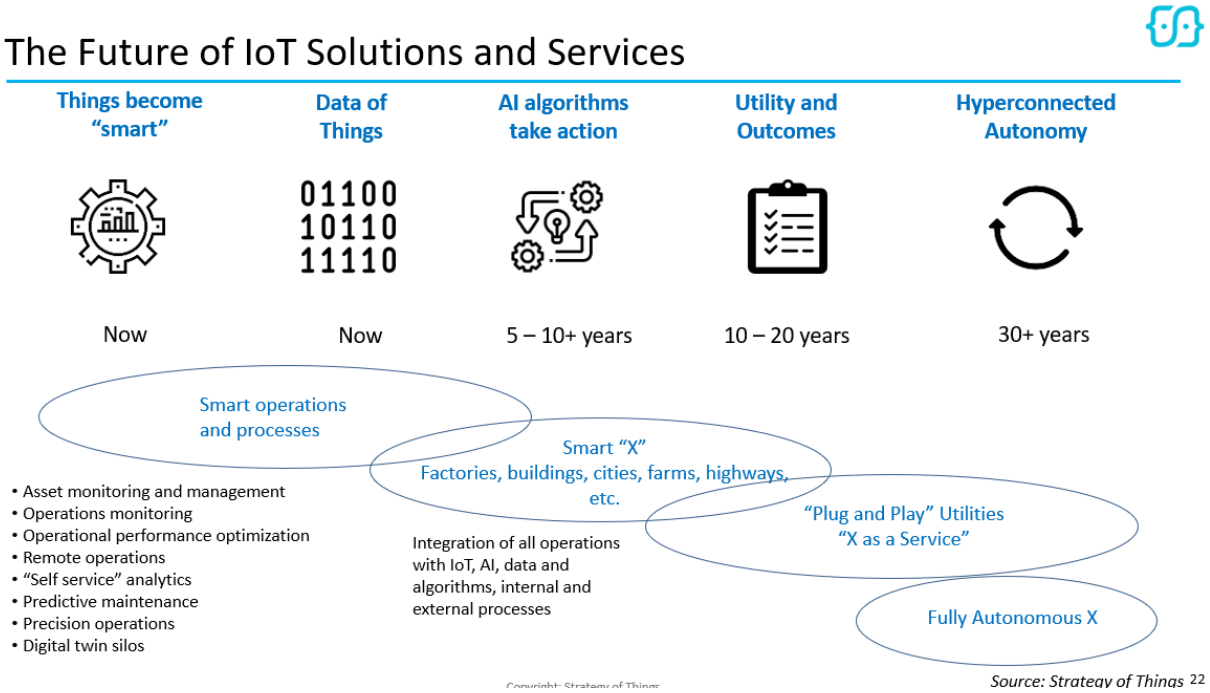
- High level vision of what is possible with IoT
- Broader, big-picture

What: What are the Opportunities?

1. What are 3 things IoT can bring (economic, societal, etc.)
    a. Opportunity 1 [outcome]
        i. Description
        ii. Statistics or some quantification
        iii. What problem is it solving?
        iv. Challenges
    b. Opportunity 2
    c. Opportunity 3
    d. Or challenges (more broadly to the vertical)
2. Opportunities aligned to legislation areas
    a. Intelligent traffic and transit
    b. Precision agriculture
    c. Environmental monitoring
    d. Healthcare
    e. Sustainability
    f. Supply chain
    g. Public safety
    h. Healthcare
3. What makes a good opportunity to document?
    a. Highlights the significant potential/possibilities/outcomes that is made possible with IoT
    b. Creates an “significant” outcome that gets people excited or affects a lot of people
    c. Could be something that is multiple smaller, near term use cases

Example Vision Writeup (for illustrative purposes only)

Industry analysts estimate that the number of connected IoT devices will grow from 11.3 billion in 2020 to 27 billion by 2025.[1] As the physical environment is equipped with more and more sensors, the way those sensors and devices are used will evolve. Many of the IoT devices deployed today largely operate in isolation or "islands". However, as IoT matures and standards and technology platforms emerge, the "islands" of devices integrate to form systems of connected devices. Driven by cross industry standards, use cases and middleware, these systems of connected devices integrate with other systems to form broader and bigger "systems of IoT systems". For example, individual IoT applications in a factory integrate to create a smart factory. These smart factories connect with others to share data and create a network of smart factories. The data from these smart factory networks integrate with IoT applications across industries, such as freight and logistics providers, to coordinate the delivery of raw materials to factories and finished products to distributors and retailers.



[1] "State of IoT 2022: Number of Connected IoT Devices Growing 18% to 14.4 Billion Globally", M. Hasan, May 18, 2022. Link

Example Opportunity Writeup for Precision Agriculture (for illustrative purposes only)

Opportunity: IoT can help small family farms be productive and profitable.

There were 2.05 million farms in operation in 2017. Family farms accounted for 98% of all U.S. farms in 2018. Small family farms, defined as having a gross cash farm income (GCFI) of less than $350,000, represented 89.6% of all farms, 48.8% of all farmland and 21.1% of all production in 2019.

Most small family farms, between 62% to 81% (depending on the specific farm type), are operating at less than 10% operating profit margins. As farming is capital intensive, these farms are operating with high financial risk with little margin for error. Chapter 12 bankruptcy filings rose from 361 Chapter 12 filings in 2014 to 599 in 2019 before dipping slightly to 560 filings in 2020. While Chapter 12 filings dropped by half to 276 in 2021, helped in part by rising commodity prices costs, production expenses have gone up by 18% in and 2022 farm income is expected to decline 0.6% from the previous year.

Small family farms had a higher income from non-farming activities than from farming. For example, low sales family farms (with GCFI less than $150K) had a negative income of $1,427 from farming while generating an off-farm income of $65,482. Similarly, family farms with GCFI between $150K and $350K, reported an average non-farm income of $56,135 and an average farm income of $42,170. Mid-size family farms, having a GCFI between $350K and $1 million, generated 35% of their total income from non-farming activities.

Finally, federal government payments contribute to a portion of the farmers net income, ranging from an average of 11% in 2014 to 48% in 2020. The government payments include pandemic assistance, market facilitation programs, crop insurance and disaster assistance programs.

IoT technologies can help these smaller farms to increase agricultural production and yields, while being more productive and efficient with the labor and resources they have, optimizing the application inputs through informed decisions based on timely and accurate data and minimizing waste and spoilage.

Challenges

While IoT can help small farms be productive and profitable, a number of challenges must be overcome. For example, these agricultural producers are running off low financial profits, and have little upfront cash to invest in these technologies. Taking these scarce funds to invest in IoT means taking money away from other needed resources, such as fertilizers, seeds and other inputs.

I could spend $50,000 on this, or I could spend the same $50,000 on more inputs where I know exactly what results I will get.
Ron Hiller, Founder/CEO, blx.io

There is also a lack of awareness and the value of these technologies, and a reluctance to adopt something new. The adoption cycle for IoT is around the order of 7 to 15 years. Many agricultural producers have been farming for a long time, with “tried and true” knowledge, expertise and practices handed down from generation to generation. Much of this had been informed by historical understanding of weather patterns, hands-on experiences and knowledge exchanges with other farmers, input providers and suppliers. Even when crops benefit from agriculture innovation, the farmer may be skeptical to attribute the benefits to the technology, instead crediting what they know, such as good weather patterns or a change in the fertilizer mix.

A third challenge are concerns around the ownership of the data collected from these solutions, and whether and how they may be used and shared by the solution suppliers. These concerns were reflected in a 2016 American Farm Bureau Federation survey of 400 farmers and ranchers that reported they want to control the information collected from their equipment. Specifically, 77% are concerned with who accesses their data and whether it could be used for regulatory purposes. Two-thirds, or 67%, stated they will consider how outside parties use and treat their data when deciding which technology or service provider to use. Similarly, 61% were concerned that companies can use the farm data to influence market decisions.[2]

Opportunity: IoT can help agricultural producers navigate around the impacts of the changing climate.

Shifting climate patterns pose a challenge to U.S. agricultural producers. Increasing temperatures and changing precipitation patterns affect plant life cycles and decrease crop productivity. Exposure to higher and lower temperatures increases stress in livestock and affects their health, reproduction and the production of milk and eggs.

These changes also affect pests and beneficial insects, including plant pollinators, weed growth, plant and livestock health and productivity yields. Extreme weather events, from heatwaves, droughts to excessive rainfalls and flooding, are likely to become more frequent and last longer and will impact growing conditions and result in increased damages and lower yields.[3] For example, previous studies of temperature changes that had already occurred found that “corn yields declined 3.8% and wheat declined 5.5% compared to the yields without climate trends”.[4]

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[2] “Farm Bureau Survey: Farmers Want to Control Their Own Data”, Precision Farming Dealer, May 12, 2016. Link

[3] “Climate Change and Agriculture In The United States: Effects and Adaptation”, USDA Technical Bulletin 1935, February 2013. Link

[4] “Agriculture In the Midwest”, White Paper Prepared For The U.S. Global Change Research Program National Climate Assessment Midwest Technical Input Report, J. Winkler, J. Andresen, J. Hatfield, D. Bidwell and D. Brown, coordinators, Hatfield, J., 2012. Link

To maintain productivity, agricultural producers will be required to adapt to changing climate patterns by adjusting inputs and the types of inputs, use of new disease and drought tolerant crop species, crop rotations and a variety of new harvesting strategies.

IoT technologies help agricultural producers adapt practices and operations to partially mitigate the effects of a changing climate. For example, field sensors detect soil moisture levels and enable growers to adjust the amount of watering needed. Other sensors detect plant health and inform growers for early intervention.

Challenges - TBD

Opportunity: IoT can help increase agricultural production yields to support the upcoming food shortage.

Top experts in global health have warned that food shortages could cause the next global health crisis. The world grows enough food to feed 12 billion people, yet more than one billion people are underfed.[5] According to the World Food Programme ("WFP"), 345 million people are in immediate danger from acute food insecurity and 828 million people go to bed hungry every night.[6] The UN estimates that by 2050 we will reach a tipping point and there will be a global food crisis if we continue on our current path of food consumption and waste.[7]

"The last time there was a big increase in yield was the green revolution of the 60s. And when I say big increase… I'm not talking about doubling. If the annual increase would stay one and a half percent a year globally, and you changed it to 2% a year, that was enough to end starvation and famine in India, when the Green Revolution was introduced. So now, what's happened is the yield increase has fallen, it is not increasing at an annual rate to meet that 2050 demand."

Robert Tse, USDA

This demand for food is not driven by population growth, but by the rise of the global middle class. So consumption rises when people become more prosperous, consuming more food, and different types of food. For example, food consumption patterns change from basic grains to more meats.

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[5] "Is the Internet of Things the Answer to the Global Food Crisis?", GlobalData,Thematic Intelligence, September 14, 2021. Link
[6] ibid.
[7] "Global Food Crisis Demands Support for People, Open Trade, Bigger Local Harvests", IMF Blog, September 2022. Link

Challenges
TBD