GREENWISE CONSULTING

2024 INTEGRATING IOT FOR SUSTAINABILITY

White Paper Volume 7

Greenwise Consulting

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FOREWORD

In today's world, where being environmentally and socially responsible is more important than ever, businesses are increasingly focusing on integrating these considerations into their operations. At Greenwise Consulting, we understand the crucial role of Environmental and Social Management Systems (ESMS) in driving this shift towards sustainability. Our latest whitepaper, titled "ESMS Empowered: Integrating IoT for Sustainability," explores how combining ESMS with Internet of Things (IoT) technologies can lead us towards a greener, more socially conscious future.

This whitepaper is a comprehensive guide that explains ESMS and how IoT fits into the picture. It shows how these systems work together to help businesses become more sustainable. We highlight the benefits of using IoT in ESMS, such as better monitoring of the environment and improved efficiency. We also acknowledge the challenges, like keeping data safe and making different systems work together smoothly.

Through real-life examples in areas like waste management, water conservation, and community involvement, we demonstrate how IoT can make a real difference in ESMS projects. We also look at current trends, like edge computing and 5G, and how they affect sustainable practices.

In conclusion, this whitepaper shows how IoT can transform ESMS for the better. By adopting sustainable IoT practices and facing challenges head-on, businesses can create a more sustainable future. We encourage everyone to take this opportunity and work together towards a better world.

Sincerely,

Viriya Paramita
Partner, Greenwise Consulting

INTRODUCTION

The Internet of Things (IoT) alludes to a arrange of interconnected gadgets implanted with sensors, computer program, and other advances that empower them to trade information over the web. These gadgets span a wide run, from ordinary objects like family apparatuses and wearable gadgets to mechanical apparatus and framework components. The center concept of IoT is to engage these gadgets to gather, share, and act upon information independently, cultivating effectiveness advancements, fetched investment funds, and advancement over different segments.

On the other hand, ESMS utilizes an Environmental and Social Management System (ESMS) as an organized approach to address and reduce the environmental and social impacts resulting from their operations, initiatives, or activities. Environmental and social factors are easily incorporated into an organization's broad management frameworks and procedures through the use of ESMS. Important elements usually include developing a strategy, evaluating its impact, involving stakeholders, tracking, reporting, and making ongoing improvements efforts.

Ensuring that organizations follow suitable legislation and standards and conduct themselves in a socially and ecologically responsible manner is the main goal of ESMS. This strategy is especially important for sectors like mining, construction, energy, and manufacturing that have significant social and environmental impacts.

Effect plays an essential part where IoT and ESMS converge. In the IoT space, efficiency revolves around the seamless acquisition, analysis, and application of data across interconnected devices. This efficiency can significantly support ESMS, empowering organizations to refine their environmental and social management systems through different roads. Initially, IoT sensors capture real-time information on natural factors such as discuss quality, vitality utilization, and water utilization, streamlining the location of operational wasteful aspects.

For example, energy monitoring systems integrated with IoT can pinpoint areas of energy wastage, inciting focused on interventions for reduction. Moreover, IoT devices encourage proactive equipment maintenance and monitoring, checking downtime and optimizing resource utilization. Through continuous gear performance monitoring, organizations can proactively address issues, yielding taken a toll investment funds and reduced natural affect. Besides, IoT-driven supply chain administration frameworks streamline coordination and transportation forms, eventually cutting fuel utilization, emanations, and the in general natural impression.

Leveraging information from IoT sensors in vehicles and coordination systems empowers optimized course arranging, vehicle sending, and stock administration, hence raising maintainability execution. Eventually, IoT-driven effectiveness propels ESMS by empowering data-informed activities to support asset effectiveness, relieve natural affect, and invigorate generally supportability endeavors.

UNDERSTANDING ESMS AND IOT INTEGRATION

Core Components of Environmental and Social Management Systems

The effective implementation of an Environmental and Social Management System (ESMS) under the Inter-American Development Bank's (IDB) Environmental and Social Policy Framework (ESPF) involves seven key elements.

Reference:
Turner A (2000), 'Central Preservation', People Management, March

01

Project-Specific Framework

Defines project-specific environmental and social objectives, principles, and ESMS structure.

02

Risk and Impact Identification

Systematically assesses environmental and social risks and impacts using tools like the mitigation hierarchy.

03

Management Programs

Develops programs with documented mitigation measures addressing identified risks and impacts.

04

Organizational Capacity

Establishes an organizational structure, ensuring resources and commitment for ESMS application.

05

Emergency Preparedness

Develops plans for effective response to project-related emergencies, involving local government agencies.

06

Stakeholder Engagement

Analyzes and engages with project-affected individuals and stakeholders iteratively.

07

Monitoring and Review

Establishes a system for ongoing monitoring, reviewing project progress, and adapting the ESMS.

Reference:
Adam, A. & Gaviano, A. (2022). The seven key elements of an Environmental and Social Management System. IDB. Retrieved from. https://blogs.iadb.org/sostenibilidad/en/espf-environmental-and-social-management-system/

Key Concepts of IoT in the Context of ESMS

Key IoT in ESMS	Conceps	Aplication
Sensor Networks	Real-time data collection with sensor networks.	Continuous monitoring of environmental and social parameters.
Data Connectivity	Seamless data connectivity for real-time transmission.	Timely access to information for decision-making.
Remote Monitoring	Monitoring inaccessible areas using IoT.	Insights into challenging locations with potential impact.
Big Data Analytics	Advanced analytics on large IoT datasets.	Deriving meaningful insights and identifying patterns.
Predictive Analytics	Predicting future trends with machine learning.	Proactive decision-making and risk planning.
Smart Devices and Wearables	Real-time data collection from individuals.	Monitoring worker health and safety compliance.
Geospatial Integration	Integrating IoT data with GIS.	Visualization of spatial environmental and social impacts.

Reference:
Gillis, S. A., (n.d.). Internet of Things (IoT). Tech Target. Retrieved from https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT

Interconnected Systems: IBM's Pioneering Role in Sustainable Practices

In the rapidly advancing landscape of sustainable business practices, IBM emerges as a trailblazer, offering a suite of interconnected systems designed to empower organizations in their pursuit of environmental and social excellence.

An Integrated Sustainability Framework

At the heart of IBM's commitment is a comprehensive sustainability framework. This visionary approach seamlessly integrates environmental, social, and governance considerations, providing organizations with a roadmap for sustainable success.

Watson IoT Driving Environmental Insights

Leveraging the Watson IoT platform, IBM facilitates real-time monitoring of critical environmental metrics. From energy consumption to emissions, the platform enables organizations to make informed decisions based on data-driven insights.

Blockchain Boosting Supply Chain Transparency

IBM's blockchain initiatives revolutionize supply chain management, offering unprecedented transparency. Businesses can now trace the journey of products, ensuring adherence to rigorous sustainability standards.

Green Horizons Initiative

IBM's Green Horizons initiative stands as a beacon of innovation. Harnessing AI and IoT, this program collaborates with academic institutions and environmental organizations, aiming to address pressing environmental challenges.

Reference:
Gillis, S. A., (n.d.). Internet of Things (IoT). Tech Target. Retrieved from https://www.techtarget.com/iotagenda/definition/Internet-of-Things-IoT

Renewable Energy Solutions

IBM's commitment to achieving net-zero greenhouse gas emissions by 2030 is realized through solutions that assist organizations in transitioning to renewable energy sources. This paves the way for a sustainable and low-carbon future.

Smarter Cities and Buildings

IBM's smart city solutions optimize energy usage, enhance transportation systems, and contribute to overall urban sustainability. These interconnected systems foster intelligent and eco-friendly urban development.

AI-Enabled Environmental Intelligence

IBM's AI capabilities play a crucial role in analyzing vast datasets related to environmental factors. This data-driven approach provides invaluable insights for informed decision-making and sustainable practices.

Weather Data and Forecasting for Sustainability

Through The Weather Company, a subsidiary of IBM, businesses gain access to weather data and forecasting services. This information is pivotal for planning and optimizing operations with a focus on sustainability.

Employee Empowerment Through Sustainability Training

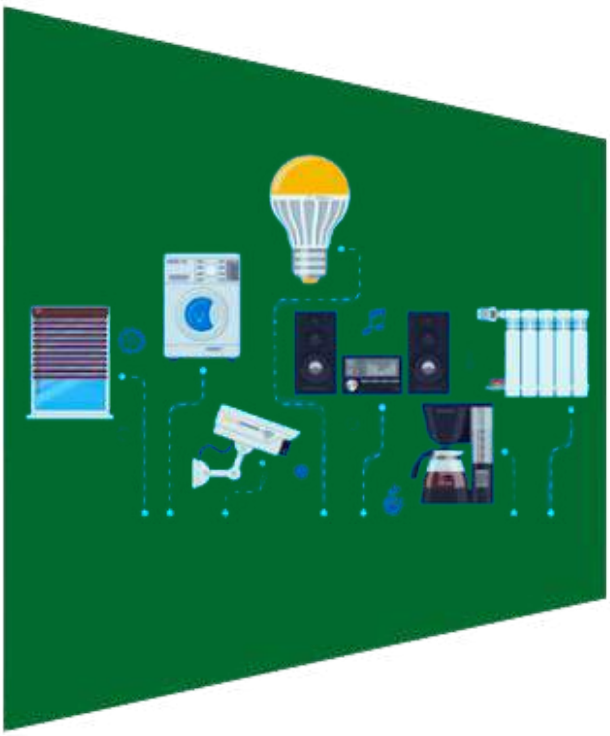
IBM invests in educating its workforce on sustainability issues, fostering a culture of awareness and responsibility. These training programs empower employees to actively contribute to IBM's commitment to sustainability.

Reference:
IBM. (n.d.). Sustainability Solution From IBM. Retrieved from https://www.ibm.com/sustainability?utm_content=SRCWW&p1=Search&p4=43700077015021269&p5=p&gad_source=1&gclid=CjwKCAiAopuvBhBCEiwAm8jaMTMGmGXReCmjT57y4h0xzNRdnzoNIHryN93MDFcVwSO3rQZ8XiuZBhoCix4QAvD_BwE&gclsrc=aw.ds

IOT TECHNOLOGIES FOR ESMS

The internet has emerged as a critical infrastructure across society and various economic sectors. It plays a pivotal role in addressing challenges such as Climate Action, Environment, Resource Efficiency, and Ecosystem Services as part of the Horizon 2020 initiative. This involves integrating future internet research and innovation into diverse domains, aiming to bridge fundamental research with experimentally-driven initiatives involving stakeholders.

Reference:
chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.atiner.gr/papers/ECL2016-2135.pdf
https://www.sciencedirect.com/science/article/abs/pii/S0167739X17314127
Connectivity Technologies for IoT
Edge-Computing Architectures for Internet of Things Applications: A Survey https://www.mdpi.com/1424-8220/20/22/6441



IoT encompasses a network of interconnected devices and systems, linking real-world sensors and actuators to the internet. Cisco predicts that there will be more than 50 billion internet-connected devices by 2020. This proliferation facilitates the implementation of the Quintuple Helix model, fostering a mutually beneficial relationship between ecological sustainability and technological innovation. It fosters synergies among science, economy, and society, creating opportunities for collective advancement.

Sensors and Data Collection Devices

Wireless Sensor Networks, typically comprise compact sensing devices, each with limited resources, interconnected wirelessly. These devices, also known as Wireless Network Nodes, can communicate both with each other and with the Internet. Equipped with specific sensors, they gather data from their surroundings, process it, and transmit it to the Internet. Notably, WSN nodes have the capability to move, continuously collecting measurements from various points. Moreover, they possess the intelligence to handle network faults.

Alongside these benefits, they offer ease of installation and usage.
However, a significant drawback lies in the power consumption limitation of battery-operated nodes. Addressing this challenge has become a priority for community development efforts, with strides already made in leveraging alternative energy sources such as solar, water, and wind (Smart Grid).

Connectivity Solutions (IoT Protocols)

Today, there are multiple variants of Industrial Ethernet protocols available on the market. In most cases, the choice of protocol varies between industrial devices, either from vendor to vendor or from one Industry Alliance to another. Consequently, devices are often only compatible with equipment from the same vendor or an Industry Alliance using the identical protocol. This phenomenon is commonly referred to as manufacturer lock-in.

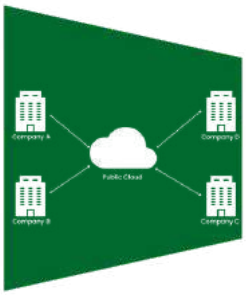
As a result, customers are compelled to procure all industrial equipment from a single vendor or a restricted group of vendors belonging to the same Alliance. However, this approach might not offer the most cost-effective and performance-optimized solution. Opting out of this scenario presents a significant challenge: integrating equipment from multiple vendors into a unified network system. Alternatively, implementing a series of protocol conversion gateways between different Industrial Ethernet protocols becomes necessary.

The landscape is rapidly evolving with the emergence of the IoT and Industry 4.0, retrieved in a new era of full automation and deeper insights into manufacturing processes. These advancements necessitate a shift towards more adaptable and interconnected industrial automation architectures. In such converging environments, real-time connectivity is paramount for effectively controlling critical processes and promptly gathering and analyzing machine data.

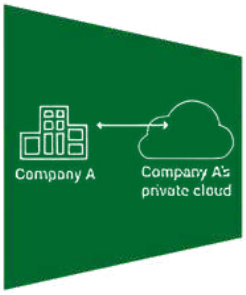
Time-Sensitive Networking (TSN) emerges as a solution offering real-time connectivity capabilities that often surpass those of existing Industrial Ethernet protocols. Moreover, TSN boasts the added benefit of being based on IEEE standards, providing a flexible framework for seamless integration within evolving industrial ecosystems.

Cloud Computing and Edge Computing

Cloud computing is the technology of delivering on-demand computing services over the Internet for servers, databases, and storage through applications and web-based tools [29]. Cloud computing deployment models are classified into four types.



Public cloud:
This cloud infrastructure provides services for public users over the Internet. This infrastructure is operated, owned, and managed by one or more cloud service providers.



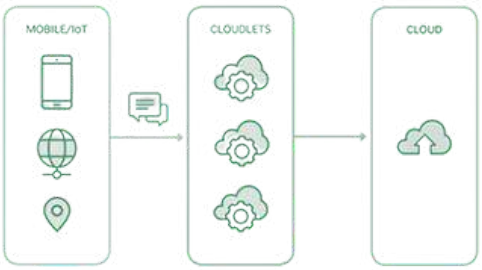
Private cloud:
This cloud infrastructure provides services for a specific usage through a single organization including various consumers. This infrastructure is operated, owned, and managed by the organization.

Community cloud:
This infrastructure is used to provide services to specific usage by a specific consumer from different organizations that have shared concerns, for example, different schools use the same platform that is offered by some organization

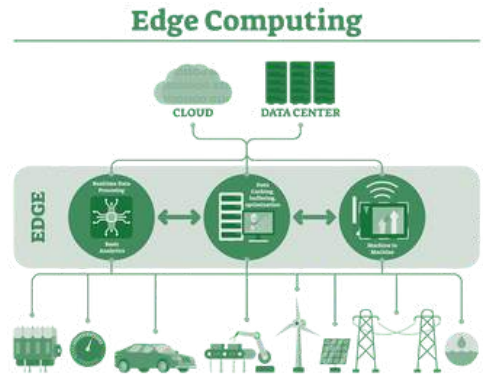
Hybrid cloud:
A combination of one or more cloud service models.

Cloud computing addresses the problem of internet-of-things (IoT) storage and network through training machine-learning models using diverse IoT devices' data. Besides, edge-computing is a type of decentralized IT architecture that brings services near to end-users to reduce problems linked to bandwidths, storages, and computations faced when dealing with huge IoT data volumes.

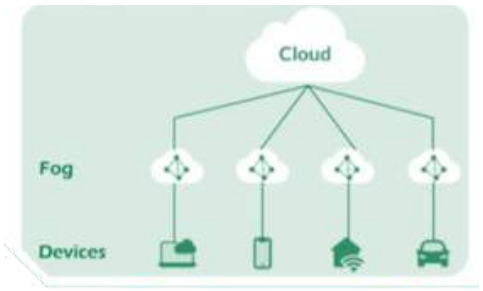
Edge computing supports cloud computing by improving real-time applications' latency time and response period as it moves storage functions closer to the users while carrying out control over them in addition, as well as communication tools. Edge computing has three primary types all adapted for specific use-case requirements and implementation needs.



Cloudlet:
Is a group of computers that represent a small data center referring to cloudlet nodes dedicated to providing services to IoT devices located within the same geographical area.



Mobile edge computing:
(MEC) or multi access edge computing is a network that provides cloud-computing services to mobile devices at the edge of a mobile network to reduce latency. On the other hand, MEC enhances cellular network services with low latency and high bandwidth analyzes huge amounts of data before sending them to the cloud, and provides context-aware services. Unlike fog-computing nodes, MEC servers could be deployed at a 3G radio controller or an LTE macro base station.



Fog computing:
Was first introduced by Bonomi et al. In 2012. Fog terminology comes from the fact that fog is closer to the end-user than to the cloud. Fog computing is a decentralized infrastructure of computing nodes in which the services provided to end-users are located between end-users and the cloud. Fog-computing nodes are heterogeneous; thus, various types of devices could be fog-computing devices: switches, industrial controllers, and access points. This leads to the flexibility of fog computing because fog-computing nodes could be located anywhere between end-users and the cloud. Fog-computing nodes also transfer small payloads faster than cloudlets do. However, it is four times slower than cloudlet is when transferring larger payloads.

BENEFITS OF IOT INTEGRATION IN ESMS

Integrating IoT into Environmental and Sustainability Management Systems (ESMS) offers significant benefits by upgrading real-time natural observing capabilities. Through deliberately sent sensors over different parameters such as discuss and water quality, soil conditions, and temperature, IoT collects and transmits real-time information to central databases or cloud stages. This information is at that point analyzed in real-time, empowering organizations to expeditiously distinguish irregularities, distinguish patterns, and pick up significant experiences.

Reference:
Turner A (2000), 'Central Preservation', People Management, March

IoT encourages further checking, especially in farther or unsafe areas, streamlining information collection and guaranteeing convenient mediation through cautions and notices activated by predefined edges or anomalous conditions. Consistent integration with ESMS stages gives a comprehensive see of natural execution, adjusting observing endeavors with broader supportability objectives and administrative necessities. By leveraging prescient analytics models, organizations can estimate future natural patterns and dangers, empowering proactive measures to relieve unfavorable impacts. Moreover, IoT upgrades compliance observing, decision-making, partner engagement, and persistent change endeavors, driving maintainable hones and long-term natural stewardship.

With the vast amount of data generated by IoT devices, IoT will help you understand data management, analysis, and security practices, which are increasingly crucial in today's data-driven world.

The Internet of Things (IoT) is enabling the creation of innovative solutions to real-world challenges. Learning about IoT will empower you to develop and implement creative solutions that can enhance efficiency, safety, and convenience across various domains. IoT has the potential to make our world more sustainable and energy-efficient.

Reference:
https://www.researchgate.net/publication/358234853_Environmental_Monitoring_Using_Internet_of_Things https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3919355
Petra repository https://repository.petra.ac.id/18008/1/Publikasi1_03023_4069.pdf

Using IoT also has a good impact on the measurement of the Environmental & Social Management System (ESMS). Why IoT should be used to monitor the environment is to:

Gain Real-Time Insights

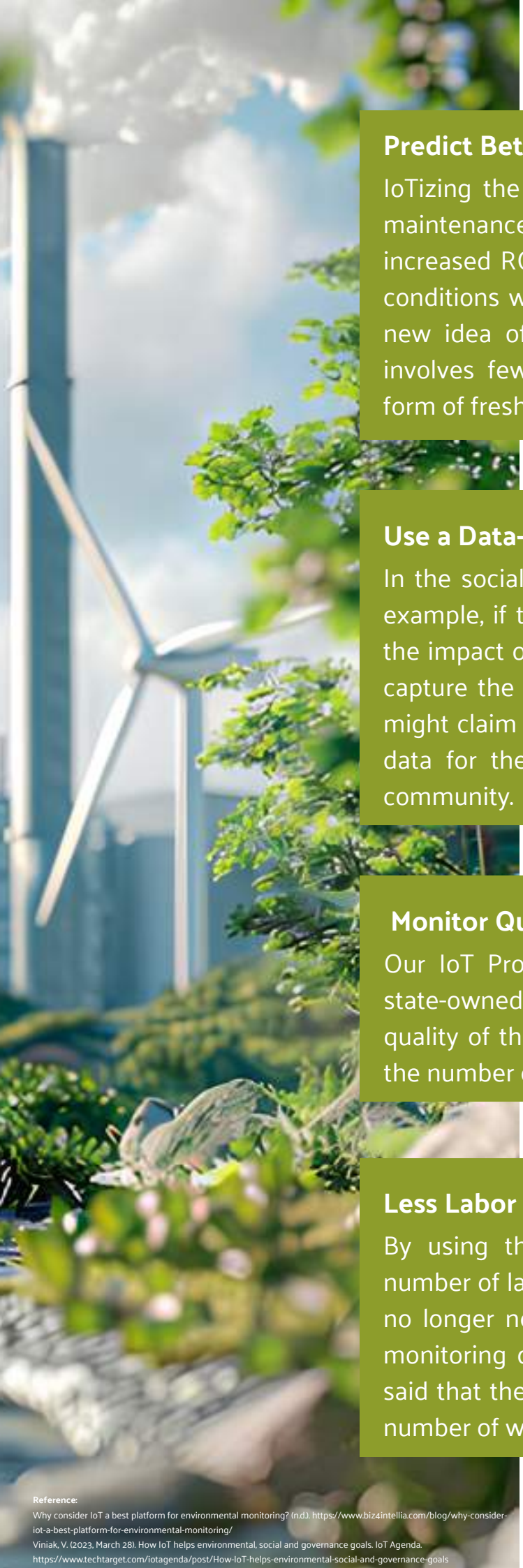
All the stakeholders can access the data measurement for real-time. It could be helping the company to use the measurement for environmental, social, and governance (ESG) related reporting.

Reduce Carbon Emission

Some IoT systems are specially designed to understand the interference of pollutants in the environment. Pollutants like ozone, NO_2, or NOx can interfere in the air and create a dangerous environment for us to breathe. Therefore, a smart solution captures the presence of such particles or toxic gasses in any space and alerts the authorities to take severe actions. It also provides insights and forecasts related to any harmful scenario in the future, which further alarms the managers to instantly act on the same.

On the other hand, Automated processes can help control building operations, such as climate control, lighting and security. This enables companies to reduce energy consumption, optimize space and minimize the environmental impact of their buildings.

Reference:
Khanday, G. J. (2023, August 6). Reasons why we should study the internet of things (IoT)? https://www.linkedin.com/pulse/5-reasons-why we-should-study-internet-things-iot-khanday/
Why consider IoT a best platform for environmental monitoring? (n.d.). https://www.biz4intellia.com/blog/why-consider-iot-a-best-platform-for-environmental-monitoring/



Predict Better Results

IoTizing the industries have also significantly reduced the maintenance and other extra expenses, turning them into increased ROIs. Similarly, revolutionizing the environmental conditions with the help of IoT technology creates a whole new idea of technically dealing with the environment. It involves fewer risks and more investment returns in the form of fresh surroundings.

Use a Data-Driven Approach

In the social impacts, using IoT will give accurate data. For example, if the company builds the IoT system to measure the impact of solar panel usage in one sub-district, they can capture the household that gets the benefit. The company might claim the data for the social impact report, or use the data for the case study to improve more impact to the community.

Monitor Quality

Our IoT Products, INTERVA has been implemented in the state-owned company, PTPN 6. INTERVA can capture the quality of the tea leaf production in PTPN 6 and can predict the number or the risks in the production step.

Less Labor Required

By using the technology, the company will reduce the number of labors. IoT monitoring is accessible online. So it is no longer necessary for labor to be deployed to carry out monitoring directly in the operational area. Thus, it can be said that the use of IoT will have an efficient impact on the number of workers.

Reference:
Why consider IoT a best platform for environmental monitoring? (n.d.). https://www.biz4intellia.com/blog/why-consider-iot-a-best-platform-for-environmental-monitoring/
Viniak, V. (2023, March 28). How IoT helps environmental, social and governance goals. IoT Agenda. https://www.techtarget.com/iotagenda/post/How-IoT-helps-environmental-social-and-governance-goals

CHALLENGES AND CONSIDERATIONS

There are many obstacles to navigate in integrating IoT technologies into sustainability initiatives. This part examines the main considerations and barriers that companies face while trying to use IoT to enhance their environmental and social management systems. From concerns about data security and privacy, interoperability issues through to importance of capacity building and training; these challenges must be met in order to achieve successful integration of IoT, as well as sustainable operations.

Reference:
Turner A (2000), 'Central Preservation', People Management, March

Data Security and Privacy

While the Internet of Things is being a new approach for sustainability and thus rapidly growing. It is important to have adequate data security protection in place. As more and more devices get connected, there is a rising risk of getting unauthorized access to important data and a data breach also. There should be adequate protocols for securing confidential data and guarding it from cyber-threats exploiting vulnerabilities within IoT networks.

Capacity Building and Training

Integrating IoT for sustainability requires not just technology, but also empowered individuals. A significant challenge lies in capacity building and training, ensuring people have the knowledge and skill to operate, maintain, and leverage the systems effectively. By investing in capacity building and training, we can empower individuals to become active participants in the sustainable IoT.

Implementing IoT solutions is complex, requiring data analysis, system integration, and cyber security expertise. With rapidly advancing technology, continuous learning and adaptation is crucial to stay current. Diverse stakeholders - from engineers to regulators - need to grasp IoT's potential and limitations, enabling informed decisions and collaboration.

Without proper understanding, systems may face misuse or underuse, barring full potential for sustainability. Unfamiliarity with cyber security best practices can leave systems vulnerable, endangering data and privacy. Limited access to knowledge and training can worsen inequalities, hindering inclusive participation in development.

Reference:

N. Mishra and S. Pandya (2021). Internet of Things Applications, Security Challenges, Attacks, Intrusion Detection, and Future Visions: A Systematic Review, in IEEE Access, vol. 9. https://ieeexplore.ieee.org/document/9405669

Dave, D.M., & Mittapally, B. (2024). Data Integration and Interoperability in IOT: Challenges, Strategies and Future Direction. INTERNATIONAL JOURNAL OF COMPUTER ENGINEERING & TECHNOLOGY. 15. 45-60. https://www.researchgate.net/figure/Challenges-in-Data-Integration-and-Interoperability-in-IoT_fig1_377805078

Interoperability and Integration

Achieving sustainability through the IoT holds immense promise, but interoperability and integration hurdles pose challenges. Interoperability is defined by IEEE as "the ability of two or more systems or components to exchange information and to use the information that has been exchanged", imagine intelligent waste management systems struggling to share data with recycling facilities. Lack of seamless integration between diverse devices and systems prevents the efficient use of resources, hindering the very goals of sustainable development.

The problem lies in the heterogeneous nature of the IoT landscape. Devices come from various manufacturers, each with unique protocols, data formats, and communication standards. This creates silos of information, making it difficult for systems to share and understand each other's data, hindering effective collaboration and optimization.

Several factors contribute to this complexity such as the absence of unified standards for data formats, communication protocols, and security mechanisms creates a fragmented ecosystem with limited interoperability. Manufacturers have a tendency to use proprietary technologies, therefore they lock their device into tailored environments and often prevent communication with the devices of other vendors.

It is important to tackle these issues through a multidimensional approach and after that the benefits that IoT offers to environmental sustainability become evident. Interconnectivity between devices and systems is the key factor that can maximize resource usage, promote balance of renewable energy and generate data which make functioning possible for future eco-friendly solutions.

Reference:
Mary K. Prat. (2021). IoT interoperability standards complicate IoT adoption. https://www.techtarget.com/iotagenda/tip/IoT-interoperability-standards-complicate-IoT-adoption. Noura, M., Atiquzzaman, M. & Gaedke, M. (2019) Interoperability in Internet of Things: Taxonomies and Open Challenges. Mobile Netw Appl 24, 796–809. https://rdcu.be/dzzK3. World Economic Forum (2020). The Global Risks Report 2020. https://www.weforum.org/reports/the-global-risks-report-2020 CyberTalk. (2023, December 6). The Green Revolution: How IoT is Driving Sustainability. https://www.cybertalk.org/2023/12/06/the-green-revolution-how-iot-is-driving-sustainability

CASE STUDIES:
IOT UTILIZATION FOR ESMS

The Internet of Things (IoT) has the potential to become a transformative force in environmental and social management systems. This section explores case studies where IoT technology has been applied to address key issues in waste management as well as water conservation.

Reference:
Array of Things | Argonne National Laboratory. (n.d.). https://www.anl.gov/mcs/array-of-things#:~:text=The%20Array%20of%20things%20(AoT,the%20Art%20Institute%20of%20Chicago.
BizIntellia. (n.d.). IoT in water: Water conservation for future generation. https://www.biz4intellia.com/blog/iot-in-water-water-conservation-for-future-generation/#:~:text=The%20digital%20system%20identifies%20unusual,standard%20for%20water%20technology%20worldwide

Waste Management & Recycling

Implementing IoT devices in public dustbins enables real-time monitoring of garbage levels, optimizing garbage collection routes and reducing fuel costs. Load sensors enhance data accuracy, while moisture sensors aid in waste segregation. The continuous data analysis supports authorities in improving smart waste management plans through system-generated reports. In Malta, 800 smart recycling bins have curbed overflowing waste issues by transmitting capacity data instantly to the IoT network.

Community Engagement

Apart from benefitting the authorities and companies, IoT implementation could also increase the local community engagement. In the City of Chicago, USA, a project called Array of Things deploys sensor nodes to collect real-time data on environmental parameters, infrastructure conditions, and urban activity. The collected data is made available to the public, and the project team actively involves the community throughout the projects through various programs such as workshops, outreach events, and educational programmers. By empowering citizens with the tools and information to monitor and understand their environment, the project fosters a sense of ownership towards the environment and its development.

Reference:
Jagtap, S., Skouteris, G., Choudhari, V., Rahimifard, S., & Duong, L. (2021). An internet of things approach for water efficiency: A case study of the beverage factory. Sustainability, 13(6), 3343. https://doi.org/10.3390/su13063343
Mahajan, S., Kokane, A., Shewale, A., Shinde, M., & Ingale, S. (2017). Smart Waste Management System using IoT. International Journal of Advanced Engineering Research and Science, 4(4), 93-95. https://doi.org/10.22161/ijaers.4.4.12

Water Conservation

IoT solutions revolutionize water management by leveraging data from smart sensors in the distribution network, enabling proactive leak detection and pressure management. Predictive analytics identify potential pipe failures, minimizing water loss and damage.

For instance, a beverage factory commissioned an IoT-based water monitoring system by installing smart meters to gain insights into the major water-intensive processes within the factory. The detailed water usage data, which was monitored with an IoT system, helped the factory to map the value stream of the water consumption. The factory reduced its usual water usage from 2.49 to 1.9 L by the end of June 2018. The IoT water monitoring system application resulted in a reduction in the cooling tower and boiler water requirements. It resulted in an approximately 11% reduction in the daily water usage of the beverage factory.

GREENWISE

Greenwise IoT Based Environmental & Social Management System

Greenwise is currently developing a customizable, integrated, IoT based Environmental & Social Management System (ESMS) that is based on international standards such as the IFC's 8 Performance Standards. The collected data will be easily accessed by stakeholders such as investors, government bodies, and the company's management level to ensure transparency. With the system's real-time data, it also allows for quick decision making.

Reference:
Mutabazi, P. (2021, March 4). How can using IoT for "Waste Management" be an efficient tool for waste collection? https://www.linkedin.com/pulse/how-can-using-iot-waste-management-efficient-tool-patrick-mutabazi
Saha, S., & Chaki, R. (2023). IoT based smart waste management system in aspect of COVID-19. Journal of Open Innovation: Technology, Market, and Complexity, 9(2), 100048. https://doi.org/10.1016/j.joitmc.2023.100048

CURRENT TRENDS IN IOT

In the fast-changing world of technology, the Internet of Things (IoT) is leading the way, showing important trends that are shaping its future path. Here are several current trends that drive innovation in the vast world of IoT.

Reference:
(2022, 29 July). What is IoT Edge Computing? https://www.redhat.com/en/topics/edge-computing/iot-edge-computing-need-to-work-together
Procept. The Future of IoT Development: Key Trends and Innovations to Watch in 2023. https://www.procept.com.au/blog/future-of-iot-development/
Telenor IoT. What is 5G Technology and What Does 5G Mean for IoT? https://iot.telenor.com/technologies/connectivity/5g/

Edge Computing

IoT developers are likely to experience a surge in requests for edge computing solutions. Edge computing processes data on devices instead of a separate application, making things faster. It happens on the outer edge of the network, easing pressure on servers, using less bandwidth, and helping organizations manage cloud resources better. This is crucial for IoT projects like industrial automation, healthcare systems, and self-driving cars that need quick responses and reliability.

Edge computing is about putting computing services close to where the user or data is. This speeds up services, giving users a better experience. Companies benefit by supporting quick applications, finding trends, and offering better products and services. Edge computing helps use and share resources in many locations, allowing companies to grow and support more devices and data.

5G and IoT Connectivity

5G is the first mobile network made specifically for IoT uses. 5G is created with the purpose of helping cars drive safely, guiding automated vehicles, flying connected drones, and making public safety systems better. The 5G standard includes features to support different situations, such as:

- Massive mobile IoT: this is for lots of simple IoT devices, like sensors. These devices send small amounts of data, and it's important that they are cheap, use energy well, and have good coverage even in remote areas.
- Enhanced Mobile Broadband: 5G Enhanced brings more data, which is useful for streaming information and faster speeds.
- Critical Communication: 5G improves how predictable data is, providing a fast response.

Reference:
Rishabh Software. (2023, 5 January). IoT in Supply Chain and Logistics: Role, Benefits & Use Cases. https://www.rishabhsoft.com/blog/iot-in-scm-and-logistics

IoT in Supply Chain Management

The era of smarter supply chain management, where the IoT acts as a guiding force at every step. In this interconnected world, IoT applications revolutionize how companies track goods, monitor storage conditions, estimate arrival times, and strategically plan for potential delays. The advantages it brings includes:

- Enhancing visibility
- Team collaboration - IoT helps break down these information barriers by using cloud and data analytics
- Optimizing resources - analyzing data from IoT devices to predict things
- Ensuring customer satisfaction - IoT lets managers monitor shipments and products in real-time
- Automation process - IoT powered smart logistics solutions help businesses automate complicated tasks.

Sustainable IoT Practices

Sustainability is emerging as a key focus of IoT development, exploring sustainable approaches with the help of IoT devices, especially for smart resource management. Today, thanks to advancements in IoT sensor technologies and wireless connections, digital innovation and sustainability go hand in hand. To embrace sustainability, companies must join the trend of digital transformation, using critical insights to steer towards energy-efficient practices, responsible resource use, and streamlined processes that minimize waste. Here are five impactful ways companies can leverage IoT for sustainability:

- Smart energy management
- Air pollution monitoring
- Smart waste management
- Fleet management
- Smart water management

Reference:
Courtney, S. (2021, 7 April). IoT and Sustainability: 7 Applications for a Greener Planet. https://behrtech.com/blog/iot-and-sustainability-7-applications-for-a-greener-planet/

CONCLUSION

In conclusion, the integration of IoT within Environmental and Social Management Systems (ESMS) marks a significant step forward in our journey towards sustainability, offering exciting opportunities for organizations to improve their environmental and social performance. Through the case studies highlighted in this whitepaper, we have seen firsthand how IoT technologies can strengthen ESMS initiatives, benefiting waste management, water conservation, and community engagement efforts.

In waste management, IoT devices provide real-time insights into garbage levels, helping optimize collection routes and save costs. The use of smart recycling bins in Malta is a great example of how IoT can help manage waste more effectively, which aligns well with the goals of ESMS.

Similarly, in water conservation, IoT solutions enable proactive leak detection and efficient resource management. The case study of a beverage factory shows how IoT-based water monitoring systems can significantly reduce water consumption and improve operational efficiency, which is in line with the objectives of ESMS.

Moreover, IoT implementation encourages community participation, an essential aspect of effective ESMS. Projects like the Array of Things initiative in Chicago demonstrate how IoT-generated data can empower citizens, fostering a sense of ownership and collaboration in environmental protection.

At Greenwise Consulting, our commitment to advancing sustainability through innovation remains strong. As we continue to develop a customizable, integrated IoT-based ESMS, we recognize the crucial role of technology in promoting transparency, accountability, and informed decision-making. By providing stakeholders with real-time access to environmental and social data, our ESMS empowers organizations to address sustainability challenges proactively, promoting resilience and driving positive societal change.

Looking ahead, let us continue working together to embrace the potential of IoT in empowering ESMS initiatives worldwide. Together, we can create a more resilient, equitable, and sustainable future for all.

GREENWISE

Greenwise Consulting is your partner in driving sustainable change within your organization. Our team specializes in ESG consulting, investor matchmaking, and ESMS advisory, providing tailored solutions to meet your specific needs. We are committed to guiding businesses through the process of adopting robust Environmental and Social Management Systems. With our proven expertise and industry knowledge, we can help your organization navigate the path toward sustainable business practices. Contact us today to start your journey toward a greener and more socially responsible future.

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