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POTENTIAL USAGE AREAS OF IIOT IN FOREST PRODUCTS INDUSTRY

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Abstract

The increasing usage of wood materials in the industry necessitates correct, effective and sustainable use of existing raw material resources. In this context, the concept of Industry 4.0, which includes smart production systems, smart objects, and smart management models, stands out. Industry 4.0 is defined by the concept where human, machinery, robotic control equipment, products and all related objects can communicate with each other; thus, lines are arranged, and eventually they work as a networked system. IoT (Internet of Things) is defined as the communication of all elements/objects within the industry 4.0 system. In the light of current developments, the use of technology in the routine life activities of people is expanding. The most striking example of this is the progress in the telecommunication sector like smartphones. The aim here is not only to ensure verbal communication between people, but also the communication between objects, and objects with people. This creates the system referred as IoT. IIoT (Industrial Internet of Things), also called industrial internet, is the use of IoT in industry/manufacturing. This means that the whole supply chain works in interrelation. In this paper, the definition of IIoT concept and its potential in the forest products industry are examined.

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1. IIoT Concept

The Industrial Internet of Things or IIoT is defined as countless devices, machines, computers and people connected by programming tools and data analytics for reflexive business results. IIoT or Industry 4.0 as it is called in the market, utilizes the power of smart machines and constant analytics to make use of the data that vehicles have accumulated in industrial conditions for a long time. Two of the main reasons why IIoT has such an impact on the industry is that smart machines are better at capturing and analyzing data in real time than humans and better at delivering important information such as business decisions from that data accurately and quickly.

Especially with machine-to-machine (M2M) communication, big data, and machine learning, IIoT enables businesses to be more efficient and reliable in their processes. Achieving this effect with connected sensors and actuators, IIoT helps businesses save time and money by contributing to early detection of inefficiencies and problems in businesses and supporting the effort to turn complex data into meaningful-usable information. The most potential usage areas of IIoT are quality control, sustainable applications, supply chain traceability and general supply chain efficiency. In an industrial environment, IIoT is the key component to stages, such as preventive maintenance, advanced field service, energy management and asset tracking.

2. How Does IIoT Work?

The IIoT ecosystem, a network of smart devices connected to build systems that monitor, collect, exchange and analyze data, consists of:

- Smart objects: Objects that can detect, transmit and store information about themselves
- All kinds of data communication infrastructure
- Analytical systems and applications that produce meaningful business information by processing raw data
- People

Edge devices and basic functioning of smart objects; involves transmitting information directly to the data communication infrastructure and converting it into actionable information about how a particular machine part works in this infrastructure. This data would then be able to be utilized to enhance operational cycles, such as preventive maintenance and business processes.

Typical IIoT frameworks require information to be shared over various devices and over numerous networks, from edge gadgets (such as sensors, remote devices, and computers) to the cloud (central computing systems). Huge data volumes can easily overwhelm a network, particularly a network spanning remote operations. In addition, strict security requirements make the system more demanding. To manage increased data volume, performance requirements, security risk and security certificates, interconnected systems require new approaches (Canavan, 2020).

Managing the flow of data in IIoT systems is vital to ensuring that IIoT applications work as designed. Unlike a database which manages past data at rest, the data bus manages data in motion. Bus system makes operations and integration logic easier. Software components communicate through shared and filtered data, rather than trading messages. Applications straightforwardly read and write the value of these privately stored data objects.

2.1. IIoT and IoT Difference

The IoT (Internet of Things) and IIoT (Industrial Internet of Things) are almost the same thing but have very little difference in terms of the scope of their operation (Jeffrey Lee, 2017). IIoT focuses on improving network among devices, saving time, efficiency optimization and other potential advantages,

while IoT can be utilized for industrial, manufacturing and agricultural tasks. It plays a significant role in the daily effect of businesses and their security.

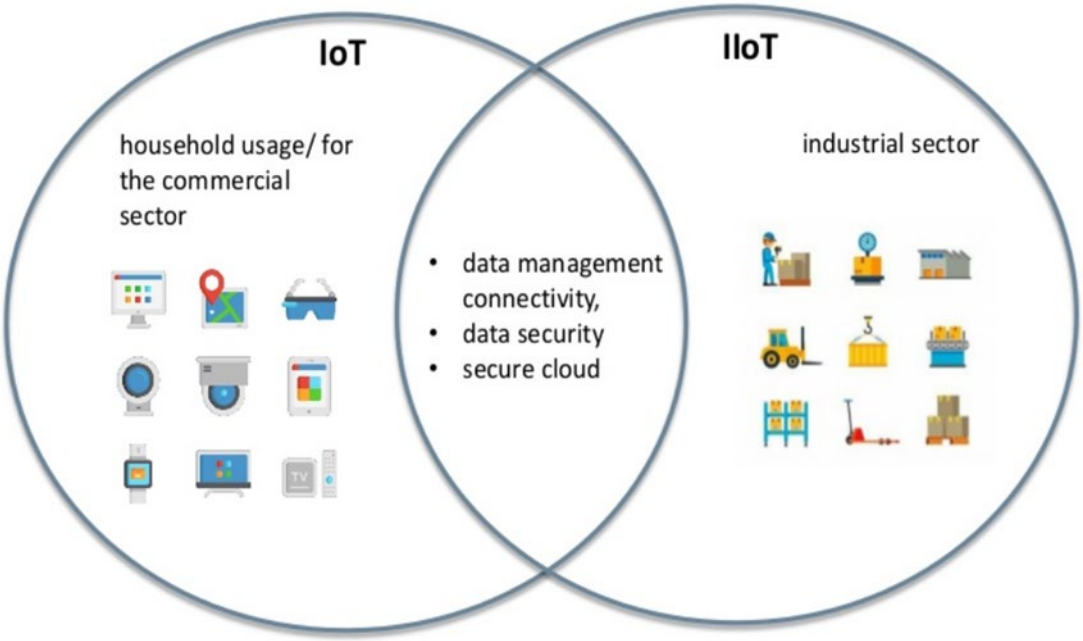

Figure 1: Areas covered by IoT and IIoT. (2019)

The expression "IoT" includes all elements of IIoT as well as consumer use cases such as smart home technologies and wearable gadgets. The focus of IoT it is the "consumer perspective". So, IIoT is a subcategory of IoT. More clearly, IIoT is the use of IoT technologies in the manufacturing and industrial sector. Industrial internet in manufacturing includes machine learning, big data, sensor data usage, automation and machine-to-machine communication technologies. Especially in production, the IIoT eco-system has great potential to create quality control, sustainable and green practices, supply chain management and overall efficiency (Kumar and Iyer, 2019). The basic idea behind IIoT is that smart machines are superior to people at catching and transmitting information precisely. Briefly, IIoT is about making machines more effective and simpler to follow.

3. Industry 4.0

The expression “Industry 4.0” represents the fourth industry revolution. It is perceived as a higher degree of organization and command over supply chains. To be more precise, industry 4.0 is based on the technological concepts of cyber-physical systems and Internet of Things (IoT). Fourth industry revolution happened to guarantee the accessibility of current data progressively by combining all components engaged with the value chain.

Today, from furniture to wood industry every sector and company are operating different. Yet, a common problem is faced. It is the need to access information across processes, products and people simultaneously. Here, Industry 4.0 does not just play the role of investing in technologies and improving tools for manufacturing efficiency—it is about to bring a new concept to the how whole business or company operates and grows (Tuncel et al. 2017; Ocak et al. 2018; Tuncel et al. 2018a; Tuncel et al. 2018b; Tuncel et al. 2019).

4. Use Cases for Industrial IoT

Successful implementations of Industrial Internet or Industrial Internet of Things (IIoT) are the building stones of digital transformation. Most businesses, use IIoT as a method for accomplishing goals by saving time, increase profitability and empower organizations to jump in front of competitors. IIoT is already demonstrating its welfare and flexibility with live deployments in various businesses. Here are the most common IIoT use cases.

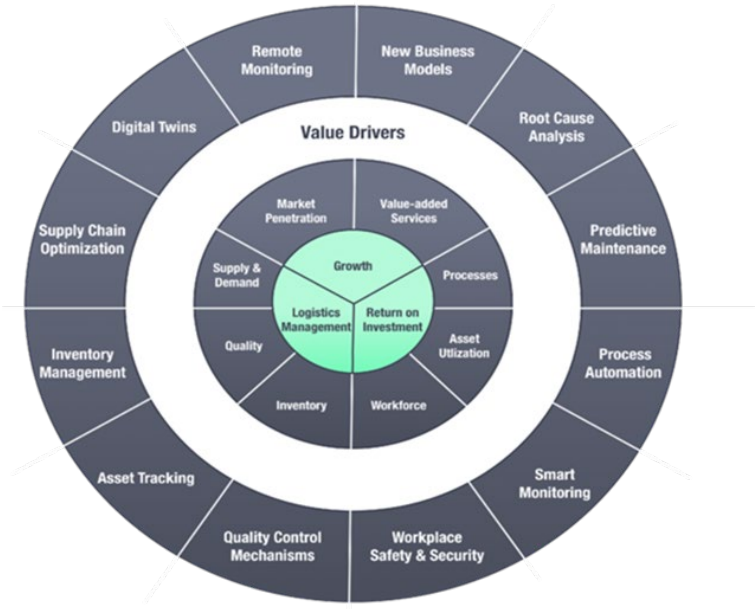

Figure 2: Industrial IoT Use Cases (Doyle, 2020).

Predictive Maintenance: These technologies track all the activities of hardware and increase granular perceivability over all tasks. Producers utilize this review to decrease the chances of system disappointment and hardware degradation. With the utilization of sensors, cameras and data analytics, directors of businesses can know when an equipment will fail before it does.

Smart Metering: Smart meters have gotten a great deal of prominence over the world as of late. Enterprises are recognizing the advantages of smart meters. A smart meter is an internet-capable gadget used for measuring energy, water or natural gas consumption of a building or home (Silicon Labs, 2018). Smart meters additionally give power utilization perceivability right to the meter, so utilities can streamline energy dissemination and make a move-to-move request load.

Simultaneous Asset Tracking: In recent studies it is discovered that an expected $1.9 trillion of monetary worth could be planned by the utilization of IoT gadgets and asset tracking solutions in supply chain and logistics area (Top 5 Industrial IoT Use Cases. 2020). Industrial IoT empowered asset tracking is playing out a more extensive part in the advanced economy than at any other time. The majority of the organizations that have their properties distributed over immense geological areas need to confront a large group of issues that influence their profitability, operational expense, and staffing in addition to other things. The purpose of simultaneous asset tracking is to allow an organization to locate and monitor important assets, ensure quality issues, prevent theft, and maintain stock levels.

Fleet Management: For organizations that depend on transportation as a major aspect of their business, fleet management encourages them to eliminate or limit the dangers related with vehicle venture, improving effectiveness and profitability while reducing generally transportation and staff costs. Shipping services are the best examples of this. They use real-time traffic feeds and efficiency algorithms to convey more packages more efficiently, with less mileage.

4.1. Potential of IIoT Use in Forest Products

Focusing on the provision of inter-machine communication in production facilities, machine learning and the best use of big data, IIoT enables the wide use of IoT in sectoral applications and enables the business to work more efficiently and securely. In fact, IIoT is beyond the work of machines and physical objects connected with IoT over the internet. It refers to the data flow between the software, information technologies, CNC and PLC controls, operational technologies and the networking of all processes. In addition to these, end-to-end data flow and traceability of the supply chain, the monitoring and control of the sub-breakdown of production, logistics and operational functions, and the ability to provide remote access as well as smart sensors bring great ease of use.

The effects of instantaneous data from sensors and other sources on decision processes will be a factor in the enterprise's ability to make accurate and healthy analyzes with the least amount of time, and therefore to work more efficiently. In a manufacturing enterprise, the ability to make cost control by analyzing the financial data coming from the internet or the network as well as the data coming from the

machines and looms instantly, the correct determination of the capacity of the enterprise with all the data on production planning and the most optimum use of the capacity thanks to this accumulated data. Knowing the stops in advance will minimize the lost times and contribute positively to the profitability of the business. In addition, instant tracking of financial fluctuations will be used as an important resource in creating future scenarios.

All of the cost analyzes currently made in many sectors are made with foresight, not in line with net measurements. This creates negative differences compared to the actual cost. Therefore, there is a possibility of loss of business here. By seeing exactly these problems, Tuncel and Candan (2017) is able to calculate the real cost instantly by analyzing all the data obtained from the field and within the enterprise in his study (GE-547285), which was developed for "Smart Cost Analysis" (2017) and whose patent procedures were initiated in the same year. This is one of the concrete results that will be achieved with IIoT. This and similar applications will be very easily applicable not only in the forest products industry but also in all sectors. This study will be used not only in costing but also in many areas such as maintenance planning, line optimizations, and workforce optimizations.

We believe that the technological predisposition of the forest products industry will provide rapid transition in adapting IoT and IIoT applications to businesses. The important thing is for the systematic infrastructure to be designed correctly on an enterprise basis, which will facilitate this transition.

The forest products industry is the 4th largest industry in the economy of Turkey. Under this main roof; furniture industry, wood-based composites industry (plywood, particleboard, MDF, OSB, LVL, sandwich panel, CLT, GLULAM etc.), paper products industry, parquet industry (solid wood parquet, laminate flooring, laminated parquet), joinery industry (door and window production), solid wood industry, wooden packaging industry (pallets, crates etc.), wooden craft industry, wood-based stationery industries (pencil, etc.) take part.

Especially in recent years, due to the widespread use of the Internet, the increase in information technologies, the diversification and complication of production and customer demands, all these sub-sectors have come to the point of using IoT and IIoT technologies. All investments to be made in this regard are not expected to be arbitrary, but to become a necessity for the business to compete in the near future. This investment should not be perceived as equipment and machinery. Since all personnel (engineers, industrial designers, technicians, etc.) working in the factory will be involved in this process, technological investment should be made in human resources..

5. IIoT Challenges

Organizations are profiting by embracing the Industrial Internet of Things (IIoT) advancements. They get better insight, more reliable, dynamic, more efficient, and improved operating. However, those prizes accompany some challenges. In the end, the system is getting more complex and these devices deal with sensitive systems. Below are primary industrial IoT challenges:

• Data Storage&Management: Data storage is a significant challenge for organizations. The information which was put away in past are now utilized for estimations. It is obligatory for organizations to embrace an appropriate arrangement for a safe storage of information before running IIoT in full mode.

Sensors and actuators coordinated with modern gadgets create an great amount of detected data streams with high speed. The detected data is stored in heterogeneous IIoT gadgets. Handling, transmission, accessibility, and capacity of detected data is a difficult errand and require enormous work. To cup with these difficulties, proficient data management models are required (Khan et al., 2020).

• Security on IIoT: There had been various instances of digital attacks before and the effective adoption of IIoT based frameworks by the business clients is influenced by the trust on IIoT systems. IIoT is in its early stages and the greater part of the ongoing researches indicates security and protection as a significant challenge faced by the organizations.

• Actuators and Sensors: General requirements from all edge devices. For example, energy consumption, latency, security, stability from the viewpoint of the industrial user (Gubbia, J., Buyyab, R., Marusic, S., Palaniswami, M., 2013). Pertinence of detected data, particularly that originating from outside the processing plant is vital if it is to be utilized inside an automatic industrial control.

• Economy: A need for an economic case that will obviously demonstrate advantages of presenting new IIoT improvements on sensors and actuators is really important. Moreover, deciding on viable models for paying for the provision to detected data. More examination is additionally needed to help financial appraisals that show up in the commercial area.

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Conflict of Interest Statement

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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