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Leveraging IoT for Logistics

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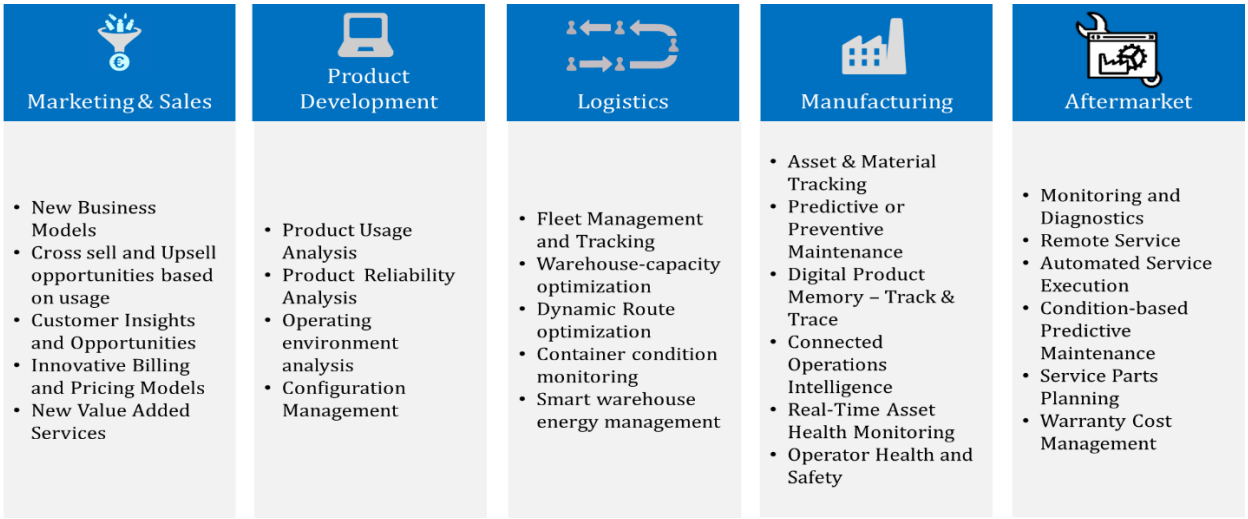
1. Introduction

"IoT" is no more a buzz word which is fascinating today's world but has become reality and has started touching and impacting our daily lives. To highlight few examples we are seeing a paradigm shift where our homes, cars, watches, air conditioning systems are becoming smart by virtue of connectivity to internet. Our cars are reminding us to fix appointment with service dealers based on the current condition of the car. Based on the outside temperature air conditioning systems can adjust themselves in order to provide the right ambience temperature. Uber is an excellent example who brought drivers, cars, end users banks, and payment gateways on a single platform and leveraged technologies such as sensors, mobility, middleware, big data and analytics, machine learning to completely change the way we travel now. What Uber has done is connected the devices (cars, mobile phones) developed interfaces (interoperability) with other systems such as banking, GPS satellites, users and workflows (find rides/accept rides, payment to drivers etc.). Business rules are also implemented where the drivers when over speeding get warning and customer feedback is critical to remuneration to the driver. The benefits are increased transparency, ease and comfort, 24X7 availability of travel services.

IoT has not only impacted our day to day personal lives but has also impacted the way business have been run. By leveraging IoT insurance companies like Progress have been offering insurance plan based on the driving pattern of the driver. A safe driver will be paying less premium than a reckless driver. This has been only been possible by capturing and analyzing the driving data by leveraging IoT technologies (sensors, protocols, middleware, visualizations, business rules engines, analytics etc. In retail IoT beacons/proximity sensors are being used for proximity marketing and better customer experience while earlier the use was limited to curb pilferage and thefts. Similarly manufacturing companies are also leveraging IoT to solve business problems across the value chain. IoT is enabling manufacturers by increase service revenues by developing new business models, improving operational visibility & efficiency, improving reliability due to predictive maintenance, reduce cost of ownership (service costs) etc.

Few IoT use cases applicable across manufacturing value chain

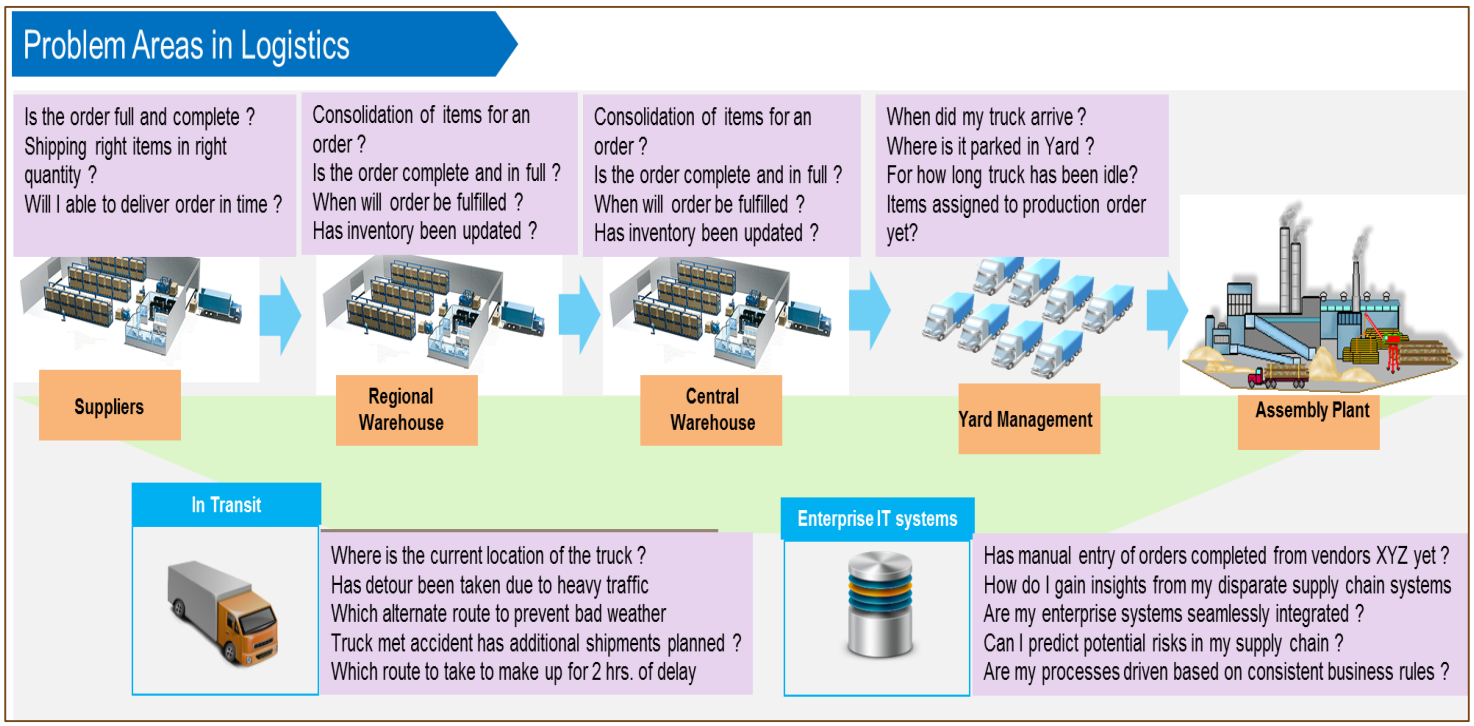


Logistics is a key business area for every manufacturing company and plays a critical role in achieving supply chain goals and objectives. In this whitepaper we will be focusing on identifying business problems faced in Logistics and how IoT can be leveraged to solve these business problems.

2. Problem Statement

A supply chain comprises of various activities like sourcing and procurement, production, distribution and logistics. “Logistics is that part of supply chain management that plans, creates and monitors the efficient, cost-effective flow and storage of goods, semi-finished items and manufactured products as well as related information between the point of origin and the point of consumption in order to meet customers' requirements.” (Council of Supply Chain Management Professionals | CSCMP, 2007).

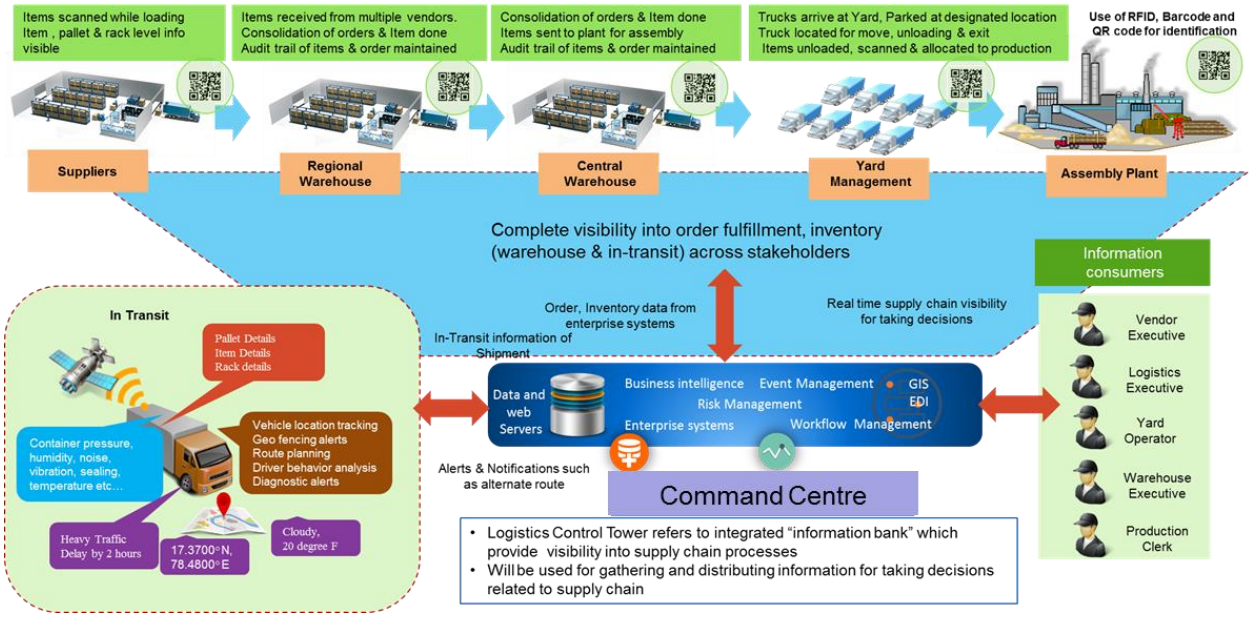
Supply chains of manufacturing companies are becoming complex day by day. Logistics is critical to ensure that products are delivered to customers at right time and right place. Global presence and diverse product portfolio further adds to complexity.



Visibility is a key challenge in logistics as there is need for accurate and timely information on shipments. Today, identifying what’s in transit, where it is, when it will arrive, and how much it will cost, requires piecing together information from internal paperwork, carrier websites, and phone calls – a time consuming, inefficient process. There is need of visibility into logistics operations in order to streamline the processes, eliminate redundant processes, reduce errors and optimize cost of operations

3. Solution

In order to solve the visibility related issues in logistics manufacturing companies are looking for a Logistics Command Centre solution. Logistics Command Centre is a centralized information repository or bank, which leverages IoT to provide end to end visibility into complex logistics operations. The Command Centre builds on the existing enterprise systems along with sensors technologies, identification technologies (e.g. barcode, QR code, RFID), gateways and communication technologies (e.g. GSM, 3G, Wi-Fi), cloud storage and complex event processing, business rules, business intelligence and visualization technologies etc.
Logistics Command Centre aims collecting and aggregating all orders, shipments, inventory, asset etc. information at centralized data bank. The centralized information along with enterprise systems to provide end to end visibility in real time to business users including suppliers, warehouse, yard, drivers and production



Technology enablers for Logistics Command Centre

1. Sensors

Sensors are the primary building block for IOT solutions. They are primary source of data responsible for transmitting from the physical objects (things in IoT) involved in logistics. Sensor technologies enable efficient, cost-effective utilization of sensing in production and logistics processes and environments. In last few years the cost of sensors have been declining and this is leading to greater acceptance industry wide. There are multiple sensors which are capable to capture information such as acoustic, vibration, humidity, speed, acceleration, throttle, pressure, torque, position, angle, displacement, force, density, thermal, heat, temperature, proximity. There are industrial sensors such as gas sensors from safety perspective (CO, SO_2, NO_2 etc.). Now a days sensors of mobile phones are also being used extensively.

The capabilities of sensor technologies can be segregated into four categories – 'Identification capability', 'Position & navigation', 'Condition based monitoring' and 'Communication'

	Identification	Position & Navigation	Condition Monitoring	Communication
GPS				
4G				
Camera				
Wi-Fi				
Bluetooth				
RFID				
Gyro				
Temperature				
Humidity				
3D Barcode				

2. Communication Technologies

Communication technologies play important role in enabling the sensors to send information to cloud storage and processing. There are a number of ways to connect your sensors to the internet but it depends on various factors such as range, data rate, power, frequency, security etc. Bluetooth (BLE), Wi-Fi, Zigbee, 3G and GPRS are few popular ones which have gained significant acceptability from users

3. Cloud based services

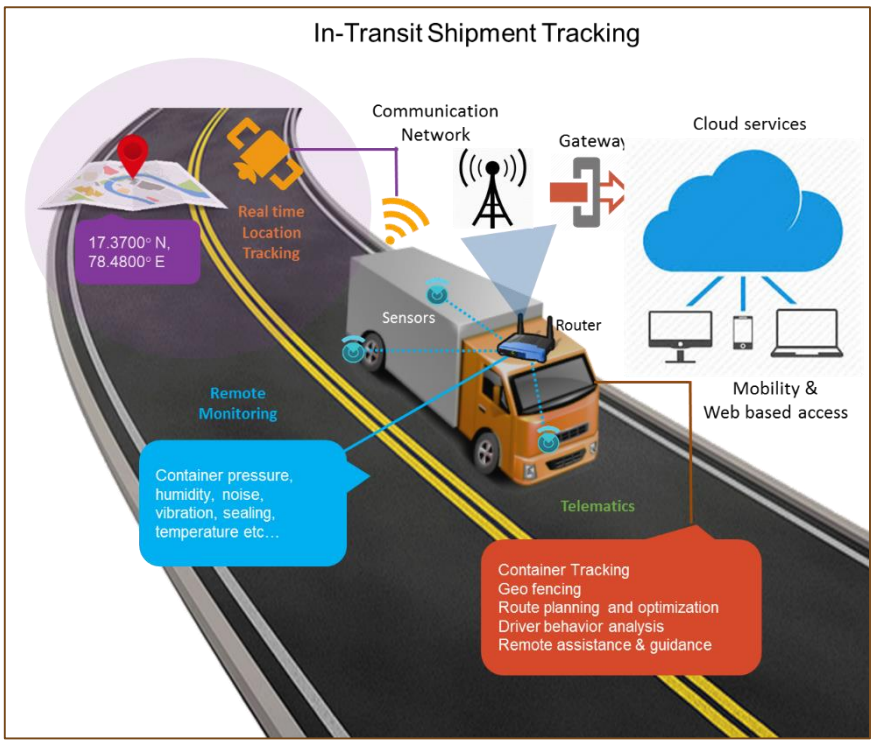
Once the data from sensors are captured, the next logical step in to process the data which would help in informed decision making. The processing tasks includes continuous connectivity, data cleansing, remote monitoring of sensor, executing business rules and algorithms, performing analytics, identifying patterns, generating alerts and notifications , reporting and visualizations Apart from that this there are also requirements such as network connectivity, infrastructure and data center management etc.

Cloud based services for IoT

Let's look at few solution areas where IoT can be leveraged to ensure visibility into specific logistics process or functions

Solution Areas 1: In-Transit Monitoring

In order to track the container and trucks during transit which either could be inbound logistics (including milk runs) or outbound logistics. In-transit visibility solution leverage cloud-based GPS Radio Frequency Identification (RFID) technologies, Geographical Information Systems (GIS) and communication technologies such as 3G or GPRS to provide identity, location, and other tracking information. By capturing such data visibility of an item is provided all the way from the supplier (tier 1, tier 2, tier n), warehouses, manufacturing plant to wholesaler, retailer and end user. For the manufacturers adopting Just in Time philosophy it is critical to know as when will the parts & assemblies sent by suppliers and vendors would arrive at production plant. In-Transit monitoring will help in identification of potential risks such as delays due to accident, severe weather condition, law and order problem etc. Production schedules impacted by the delays could be identified and alternate arrangement could be made. For example, providing information about a traffic jam and potential delay before the trip starts has much higher value than getting that alert when one is already stuck in the traffic. This context-aware intelligence can enhance the supply chain visibility by implementing IoT. Manufacturers are also using IoT for condition monitoring of the containers or shipment which have requirement of maintaining parameters such as temperature (in case of chemicals, gases). In-Transit monitoring also helps in analyzing driving habits by driver-specific data (i.e., driving pattern, average speed, over speeding, braking etc.



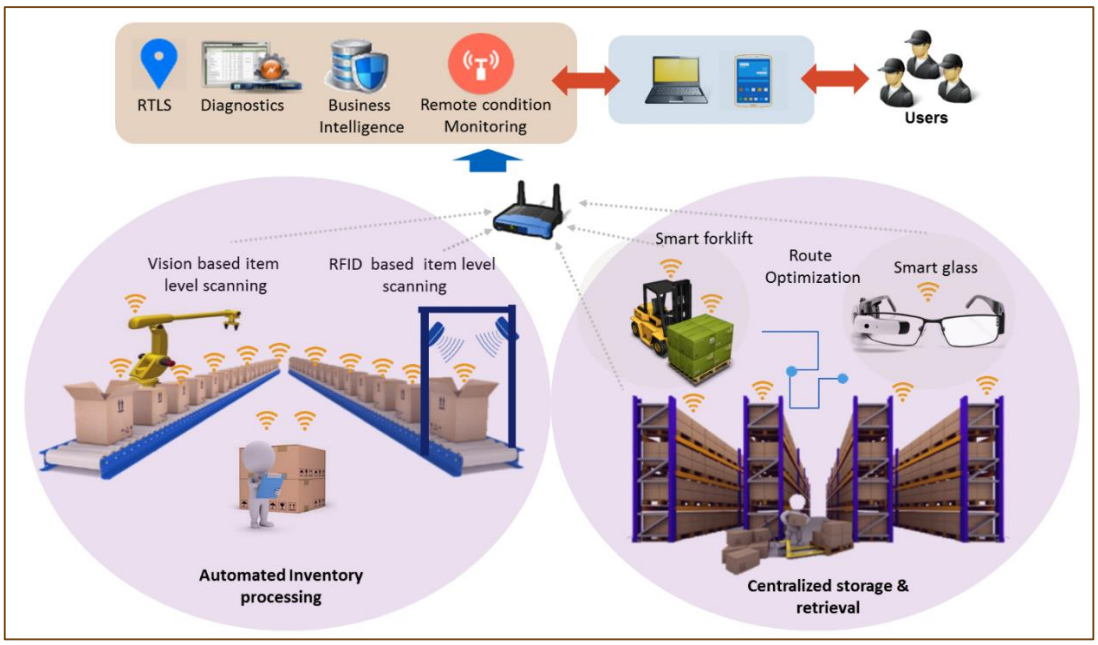
NTI Solution: Logistics Data Bank

LDB is a web based application that integrates various multiple data points available with various Supply chain trading partners to provide detailed real time information. The application was developed by NTI from scratch LDB to enable real time tracking and monitoring of Container shipment movement. Solution would also provide value added services including comparative metric based analysis. **Benefits:**

- Real time End-to-end visibility of container movement through a single platform
- Reduction in transportation lead time and cost by sharing container movement information on real time basis among all Supply chain trading partners
- Provides analytical capability to assess comparative performance and identify inefficiencies & bottlenecks
- Application architecture designed to cater future extensibility and performance

Solution Area 2: Warehouse Visibility (Receiving, Putaway and Cycle counting)

Warehouse management is a critical logistics function which determines the success of supply chain today. Not only we have to keep the costs down but also provide flexibility and scalability based on market demand. Today manufacturing companies are facing multiple challenges such as low inventory accuracy, limited location visibility of items and shelves, optimizing warehouse space and layout, eliminating redundant processes and improving picking operations. Though the manufacturing companies are automating warehousing functions by using identification technologies (barcode, QR and RFID) but there is need for single view of data. By leveraging IoT technologies such as identification, proximity sensors, vision devices (such as Cognex) manufacturers are able to solve above challenges



Pallets, crates, shelves, racks, cylinders, forklifts, trucks and warehouse personnel can be tracked with identification tags like Barcodes, QR codes, RFID. Receiving function in warehouses have been completely automated by use of vision devices. Inbound items received from vendors or other warehouse put on a conveyor belt where vision devices are installed. These devices can scan barcodes, QR codes at much faster pace than a warehouse executive. In cases the items are tagged with RFID tags, RFID receivers can be placed on such conveyors which can capture the receiving details of item.

Once the data of tags is captured and stored on IoT platform, business rules defined help in ensuring that Picking and Putaway of items are validated to ensure right item is stored at right place. Once items/pallets are moved to the right location, tags transmit signals to the WMS to provide real-time visibility into inventory levels, thus preventing costly out-of-stock situations. If any item has been misplaced, sensors can alert the warehouse manager, who can track the item's exact location for corrective action. For quality management, sensors monitor the condition of an item and alert warehouse managers when the temperature or humidity thresholds are about to be compromised. From ergonomics

Nowadays Real-time locating systems (RTLS) are gaining wide acceptance in warehouses as they can be used to automatically identify and track the location of objects or people in real time. This is achieved by attaching Wi-Fi RTLS tags objects or personnel in the warehouse. Fixed reference points in the warehouse receive wireless signals from Wi-Fi tags to determine their location. It is also being used for route optimization and utilization of forklifts

IoT helps in providing real-time information about the **'location'** of assets in and around the warehouse will have huge impact on the efficiency of warehouse operations. By assets, we include everything which is worthy of a location tracking sensor to be attached. Location of pallets, boxes, crates, inventory, and fork lifts to work force can be obtained in real-time. This functionality would be valid for assets like conveyor belts [motion/idle, weight sensors], fork lifts [motion/idle, weight sensors], trucks [motion/idle, capacity available], work force [motion/idle].

The assets are connected to a central system which enables the warehouse managers to monitor the assets in real-time. Custom alerts can be generated for varying requirements. Eg: when there is an overload on the conveyor/fork lift, if the work force are working in close proximity to a hazardous environment.

Solution Areas 3: Yard Management

One the logistics functions manufactures have been struggling for ages has been Yard management. Manufacturers have to deal with hundreds of trucks standing in their yards for inbound and outbound shipments. Usually majority of the trucks enrolled for logistics are owned by third party logistics providers, so if their shipments are not unloaded within a specified time manufacturers have to penalty for the time it has stayed in the yard. Frequent unplanned movements of trucks within the yards also leads to unnecessary wastage of effort and fuel costs. Unplanned and unnecessary moves in the yard may lead safety issues (injuries, accident etc.) both for truck as well as yard personnel. Though most of the manufacturing companies have been using some yard management systems they have failed to gain complete visibility in yard operations

Till now there were limited mechanisms (phone call, sms etc.) to inform arrival of trucks in yard but by leveraging IoT in yard management, yard personnel could be alerted well in advance before arrival of trucks in the warehouse (say 30 miles away from warehouse, ETA 15 mins) by using geo fencing technique. Once the trucks less than 30 miles away, automatic events will created and assigned to yard personnel as workflow. Yard personnel can prioritize the arrivals and assign appropriate place which would be near the warehouse gate to restrict unnecessary moves. Once the shipment (items and assemblies) arrives in yards, production managers and other stakeholders are updated regarding availability of material for production schedules. By leveraging RFID or RLTS Wi-Fi tags location of the truck in yard can monitored continuously.

While entering the yard drivers will be allocated designated place in yards to park the trucks. In case drivers don't park the truck in allocated place it will automatically create an event and yard personnel can intimated about it to take further action. By adopting such approaches unnecessary movement can be reduced while proving complete visibility into arrival of shipments and real time location in yard as click of a button.

Today manufacturers are also using GIS based technologies to create parking layout in yards (grids using latitude and longitude) and then assign, monitor and manage these parking lots in yards

4. Business Benefits

1. Real time tracking and visibility into inventory, assets and vehicles

By leveraging IoT in logistics one can achieve real time visibility into end to end supply chain operations right from when the suppliers send shipments till it is delivered to customer. Due to visibility into real time physical movement of goods, potential risks (such as delays) could be identified and appropriate risk mitigation can be done. This visibility in case of assets can help to improve asset utilization and productivity

2. Reduced cost of logistics and warehouse operations

With the use of IoT in Logistics, manufacturing companies can save significantly by increased automation leading to reduced effort and re-work. For instance, during transit congested routes can be avoided with the help of tracking GPS devices, GIS information and sensors. This will help them in saving on the fuel costs and timely delivery

3. Improved safety and reduced theft & pilferages

Location and condition monitoring of shipments through IoT will provide a new level of transport visibility and security. Telematics sensors in trucks and multi-sensor tags on items transmit data on location, condition, and if a package has been opened (to detect possible theft or pilferages). IoT can also help in improving workplace and operator safety by use of environment monitoring sensors (such as SO_2 CO, CO_2)

4. Better energy management and reduced carbon footprint

Concept of Smart Warehousing is talk of the day in SCM arena. IoT can help to optimize energy consumption by remote monitoring and command center of logistics and warehouses such HVAC, Sensors like Proximity Sensors (Efficient Lighting), Equipment Monitoring Sensors for compressors and utilities networks, forklifts, and conveyors helping vastly to enable optimal energy usage.

Significant costs can be reduced by regulating lighting, heating, and ventilation in warehouse. The resulting reduction in energy consumption cuts overhead costs along with the carbon footprint of the warehouse

5. Conclusion

As IoT based solutions are set to disrupt traditional business practices, business models are also going to evolve accordingly. Manufacturing companies are realizing huge benefits which IoT brings on the table such as visibility and transparency into operations, improved productivity and reduced cost of operations in logistics function. IoT will enable manufacturers in transforming the current business processes in terms of improved track and trace of shipments, inventory, orders, resources and adherence to health and safety best practices.

Manufacturers and logistics providers should analyze their business requirements and prepare themselves by understanding what kind of cloud service, analytics capability and sensor technologies that would suit their business. High cost of implementation which has been a major roadblock of IoT, has also reduced significantly over the years due to availability of inexpensive sensors, communications, cloud and data visualization technologies.

6. About The Authors

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	**Rakesh Kumar Dubey** **Supply Chain Professional** Rakesh has over 10 years of Industry experience across Manufacturing and Healthcare Domain. He has been involved in multiple business consulting assignments in Automotive, Industrial and Discrete Manufacturing. He has been also involved in identifying, conceptualizing and building Internet of Things (IoT) based solutions across manufacturing value chain. His area of expertise includes CRM, Asset Management, Field Service Management and Warranty Management