TRACEABILITY

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Omnex provides training, consulting and software solutions to the international market with offices in the USA, Canada, Mexico, China (PRC), Germany, India, the Middle East, and SE Asia. Omnex offers over 400 standard and customized training courses in business, quality, environmental, food safety, laboratory and health & safety management systems worldwide.

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Contents

A BRIEF INTRODUCTION TO OMNEX

Omnex Introduction

- International consulting, training and software development organization founded in 1985.
- Specialties:
  - Integrated management system solutions.
  - Elevating the performance of client organizations.
  - Consulting and training services in:
    - Quality Management Systems, e.g., ISO 9001, IATF 16949, AS9100, QOS
    - Environmental Management Systems, e.g., ISO 14001
    - Health and Safety Management Systems, e.g., ISO 45001
- Leader in Lean, Six Sigma and other breakthrough systems and performance enhancement.
  - Provider of Lean Six Sigma services to Automotive Industry via AIAG alliance.

About Omnex

- Headquartered in Ann Arbor, Michigan with offices in major global markets.
- In 1995-97 provided global roll out supplier training and development for Ford Motor Company.
- Trained more than 100,000 individuals in over 30 countries.
- Workforce of over 700 professionals, speaking over a dozen languages.
- Former Delegation Leader of the International Automotive Task Force (IATF) responsible for ISO/TS 16949.
- Served on committees that wrote QOS, ISO 9001, QS-9000, ISO/TS 16949 and its Semiconductor Supplement, and ISO IWA 1 (ISO 9000 for healthcare).
- Former member of AIAG manual writing committees for FMEA, SPC, MSA, Sub-tier Supplier Development, Error Proofing, and Effective Problem Solving (EPS).

Omnex Worldwide Offices

Omnex is headquartered and operates from the United States through offices in Michigan.

The company maintains international operations in many countries to provide comprehensive services to clients throughout Western Europe, Latin America and the Pacific Rim.

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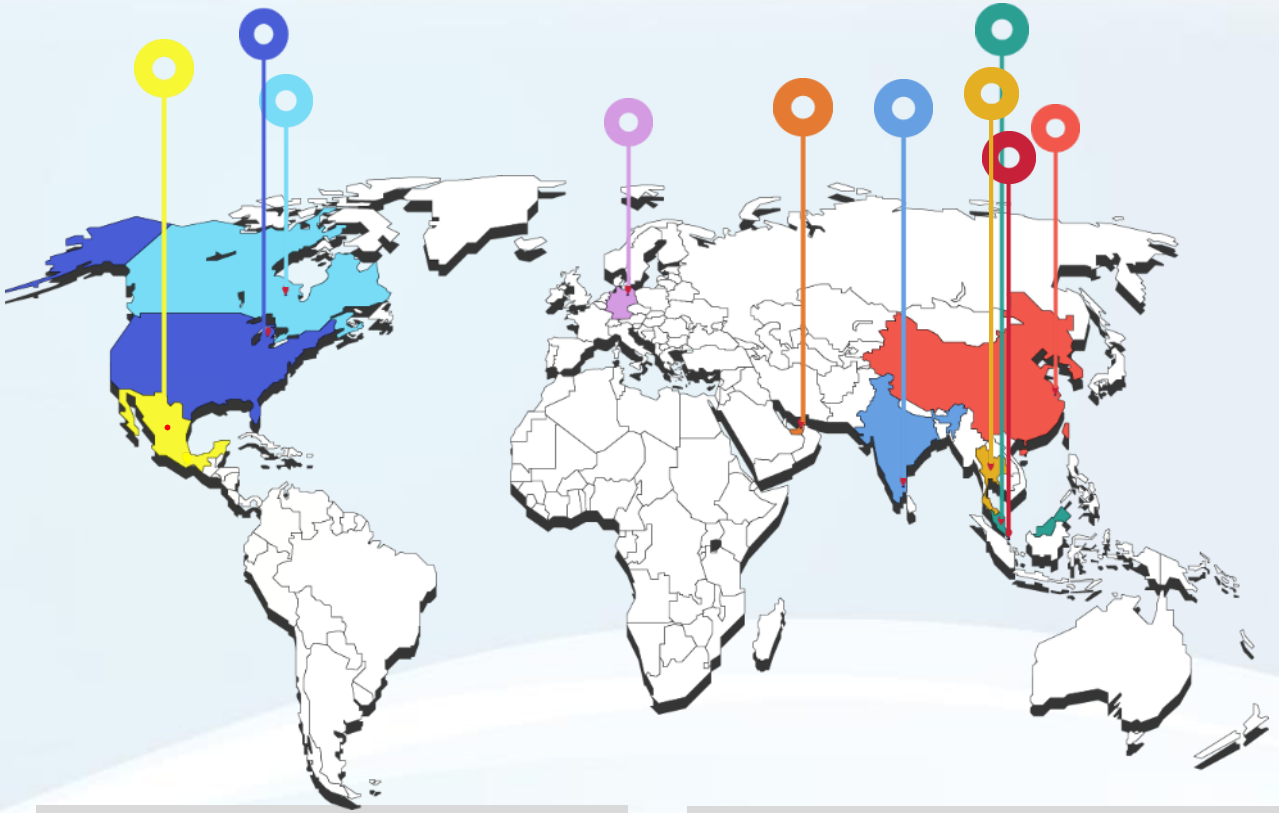


- Omnex Global Head Quarters (Michigan, USA)
  West Coast Operations (San Jose, CA)
- Asia Pacific HQ (Chennai, Pune, Delhi, Bangalore)
- China (Shanghai, Guangzhou, Wuhan, Chengdu)
- Canada (Mississauga)
- Europe (Berlin, Germany)
- Middle East (Dubai, Saudi Arabia, Bahrain)
- Thailand (Bangkok)
- Mexico (Monterrey)
- Singapore
- Malaysia (Kuala Lumpur)

OMNEX

Rules of the Classroom

- ✓ Start and end on time
- ✓ Return from breaks and lunch on time
- ✓ All questions welcome
- ✓ Your input is valuable and is encouraged
- ✓ Don’t interrupt others
- ✓ One meeting at a time
- ✓ Listen – and respect others’ ideas
- ✓ No “buts” – keep an open mind
- ✓ Phones in Do Not Disturb (silent) mode
- ✓ No e-mails, texting or tweeting during class

If you must take a phone call or answer a text please leave the room for as short a period as possible

Icebreaker

- Instructor Information:
  - Name
  - Background
- Student Introductions:
  - Name
  - Position / Responsibilities
  - What is your involvement in the Quality Management System and the auditing process?
  - What do you expect to take away from this class?
  - Please share something unique and/or interesting about yourself.

Chapter 1

Traceability

Traceability

Traceability is the ability to trace all processes from procurement of Raw Materials to Production, Consumption and Disposal to clarify "when and where the product was produced by whom."

Due to improving product quality and the rise in safety awareness in recent years, traceability has been increasing in importance and spreading into a wide range of fields, such as automotive, electronics, food and pharmaceutical.

You may ask
Is it worth putting a traceability on each of the 10 - 20,000 parts or components that make up in an automobile

Answer is Yes

Traceability in Automotive industry

Traceability for the automotive industry is a process that documents the genealogy of the parts and sub-assemblies associated with a specific vehicle or range of vehicles. The type of information tracked will vary, but some of the more commonly collected information include –

* Source Manufacturer
* Place of origin
* Lot number
* Model number
* Components used in assembly
* Manufacturing or assembly facility
* Production time and date
* Part number / Serial number
* Documents
* Expiration date, etc.

All of this data can be accumulated and combined into a traceable code (barcode) and marked on the part. Barcode readers then decode the data through out the part's lifecycle and reliably transfer the information into an Enterprise Resource Planning (ERP) software system ensuring full traceability for each part of a finished vehicle.

While Setting Objective

- The objective of Traceability Standard is to assist organizations and industries in the design and implementation of traceability systems of standards.
- The objective must be intended to help organizations and industries to achieve global supply chain traceability
- Enabling lifetime imperishable communication across supply chains by providing consistent ways to identify traceability to parts or system
- At a strategic level, the standard shall aims to provide key insights and knowledge for organizations or industries that are developing long-term traceability goals.
- Providing a methodology for organizations while designing requirements of traceability systems
- Serving as the foundational stone

While Setting Scope

The scope of the traceability system of a part will depend on the role of the organization and the traceability questions that need to be addressed.

Some elements that define the scope of a traceability system are:

- How many tiers up and down your supply chains will you need to share data?
- Will you need to interact with only direct supply chain partners, or will your system require a broader scope?
- Will you track main ingredients only, or also packaging and indirect materials?
- Will your system need to integrate data sharing with final consumers / end customers?
- Will your system need to integrate data coming from supply chains
- Which process steps need to be captured?
- What is the most cost effective way to capture the data?

Why is “Traceability” Important

Minimizing Customer complaints, warranty, rejects and recalls

- How much it could cost to find the problem, fix it, and then find and fix all of the affected parts.
- If the part makes it further downstream to the assembly plant, it could cost exponentially more to fix, as well as damage the supplier’s quality rating with the automaker.
- Should the problem reach consumers while the automobile is in service, the total recall costs can be XX times that.
- With a solid traceability program in place, these costs remain at the minimums with the least disruption

Why is “Traceability” Important

- Monitoring process control, CC & SC characteristics
- Real-time tracking systems can help reduce lead times and optimize the supply chain by providing information about work movements from zone to zone. These tracking systems are based on work in process (WIP) identification and associates the data with other management and control systems.
- If, or when you find a bottleneck or problem, you will know
- what - it is as well as
- Where - it is within the process

Why is “Traceability” Important

- Implemented error proofing methods
- Traceability poka-yoke (an error proofing mechanism used in a lean manufacturing process) improves quality by ensuring that the appropriate processes are performed in the correct sequence on the right parts. In addition to eliminating manual part number data entry errors
- Code reading can also assist in data logging for safety, liability, and warranty issues, and satisfy regulatory requirements for permanently identifying high-value parts that are subject to theft or counterfeiting.

Ice Breaker

- What do you check on the product when you go to a super market and bring it to your house?

- One thing we all know is Price and Discount. Based on the daily / weekly requirement what are the other check and activity you do?

Ice Breaker

When we go to Store shelf?

: we check for date of manufacturing, we pick the product with more time period
: we check the batch number and with it we find where was the product manufactured
: we check for ingredients and even Google for the preservative added
: we check for certification number from legal body
: we check for quantity, colors and flavors
: we check for dosages requirement
: we check the storage condition

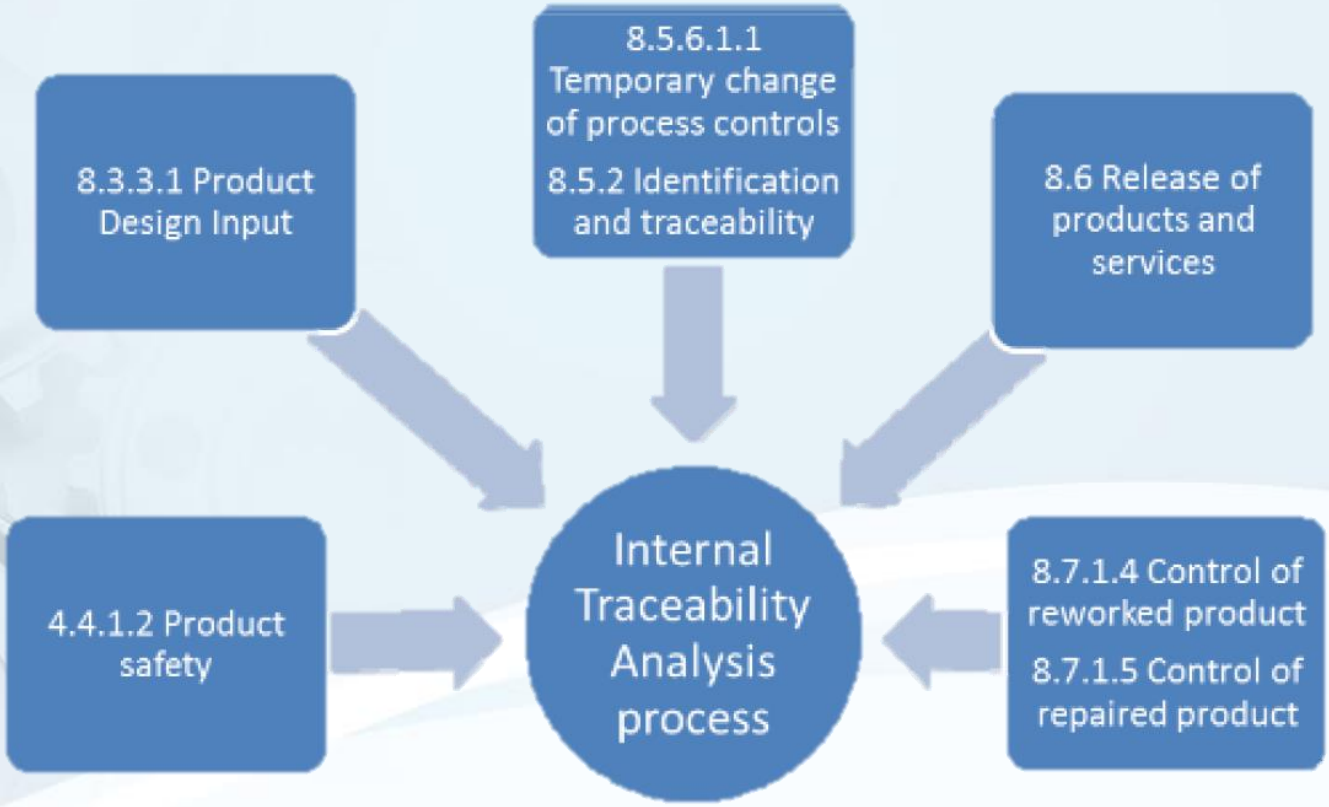
When we go to Billing counter?

: operator can operate the counter only if he keys his ID & password or scan his I card
: bill get generated only once all the items are entered.
: we compare the price mentioned on the shelf and on the bill
: we check the products purchased are placed properly in side our bag or baskets

When we store in our house?

: we keep it at desired location
: we keep new product below the old product or keep it alone until we use the old one
: some bottles have identification on the containers
: we do not destroy the shelf life information till we consume the product

Requirements in IATF requirement 16949 - traceability



Chapter 2

Traceability – System Application

Traceability – System Application

- We all know manufacturing is becoming increasingly more efficient, customized, modular, and automated, but we and the manufacturers are slow in adopting the technology as it needs new investments.

- As industrial technology requires increasing auditability and digitization, the manufacturing industry will need to continue to embrace new technology.

- Even though there are different system and technologies in a manufacturing process, one of the answer to this is ‘Traceability’, lets go one by one to see how traceability is applied

Traceability – System Application

Application where traceability can be applied

- Product R&D
- Supplier Management & Sourcing
- Operations Monitoring & Data
- People Management
- Maintenance Data
- Quality Assurance (QA)
- Warehousing
- Transport

"If you always do what you always did, you'll always get what you always got."
Henry Ford

Traceability – System Application

Product R&D

- The product development process has become a matter of managing complexity of the product development process.
- Traceability like the life of a product and its requirement is one key tool to manage the complexity challenge.
- When traceability is carried out correctly, teams can accurately assess
  - The impact of changes.
  - Track the full history of product development.
  - Keep everyone in sync in project and
  - Consistently improve the quality of the products being developed.

Traceability – System Application

Supplier Management & Sourcing

- Once a product design is finalized, the next step is planning how it will be made
- As there is continuous demand for flexibility, speed and seamless integration across multiple system a robust supplier management solution is a need for converging day-to-day requirements in the automotive industry.
- A Typical traceability involves all the activities followed by your company like
  - Suppliers and manufacturing location
  - Basic materials used
  - Performance on Development, Quality & Delivery against order
  - Real-time inventory
  - Packing and Transportation etc.

Traceability – System Application

Operations Monitoring & Machine Data

- Traceability in manufacturing ensures processes and product quality standards are met and give real-time information about production and equipment.
- Tracking production information back to the exact date, time, supplier components, operator and machines used will help organization
  - Increase customer satisfaction and safety
  - Improve product and process accuracy
  - Increase operational productivity
  - Reduce warranty claim costs and generate revenues
  - Protect your brand and bottom line

Traceability – System Application

People Management

- What manufacturing looks like has changed drastically in a short time, people on the plant floor also need to be much more skilled than they were in the past
- Tracking the efficiency and safety of manpower and availability of the workers will boost the operation productivity and skills of industrial worker & drastically reduce the physical toll of repetitive work
- Tracking also helps in predictive to intervene before risk of injury or incident where manpower is still needed for some hazardous and dangerous tasks

Traceability – System Application

Maintenance Data

- Customers expect manufacturers to provide excellent quality, reliable delivery and competitive pricing. This demands that the manufacturer's machines and processes are highly reliable.
- In order to possess highly reliable machines to make sure smooth manufacturing process, tracking organizations Maintenance will help enable the machine and tool to maximize the effectiveness of equipment
- By tracking maintaining the organization can optimize relationship between people and their machines with added advantage of reducing time delays, added costs, and waste

Traceability – System Application

Quality Assurance (QA)

- In mass production, checking whether every product is meeting specification is a very tiresome job and tracing / tracking any error in the product once it has left the station or plant is limited to human weakness
- Traceability in quality helps organization in tracing / tracking product, process as well as calibration of equipment's and instruments

Traceability – System Application

Warehousing

- As computer based ERP along with IIOT planning, fewer people and display boards will be needed in sorting, standardizing, and arranging the material in wear house
- A computer based system will
  - Count the number of boxes in a pallet
  - Count the quality in each boxes
  - Identify the packing condition etc.

Traceability – System Application

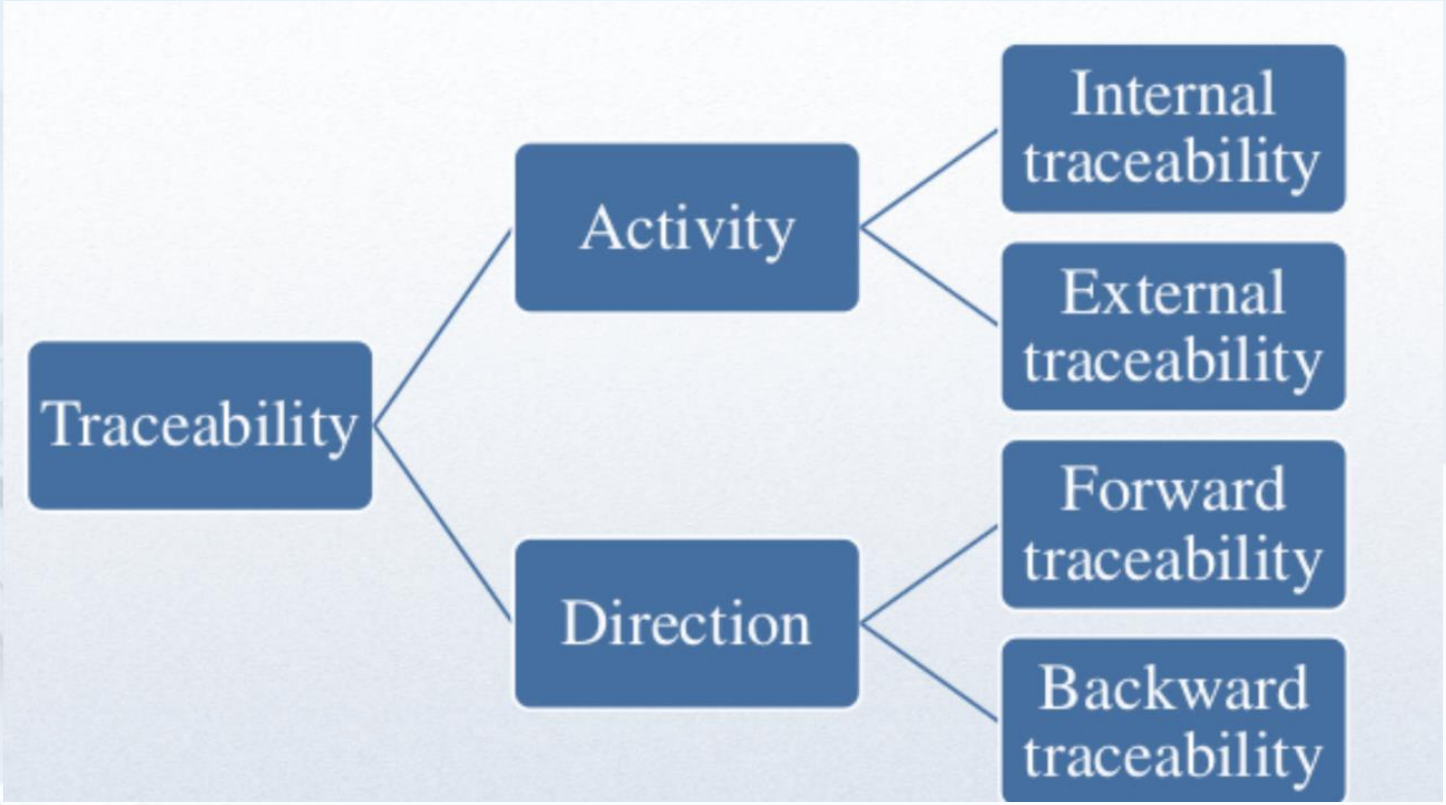
Transport

- In general, there is poor awareness about where items are in real time throughout the supply chain, once the product is packaged and palletized, getting it delivered to customer in an efficiently way is a daunting task
- With addition of IIOT and fleet telematics, organisation can track
  - The real time movement of the products
  - Route information used by the transporter
  - Pick up and deliver date and timings etc.

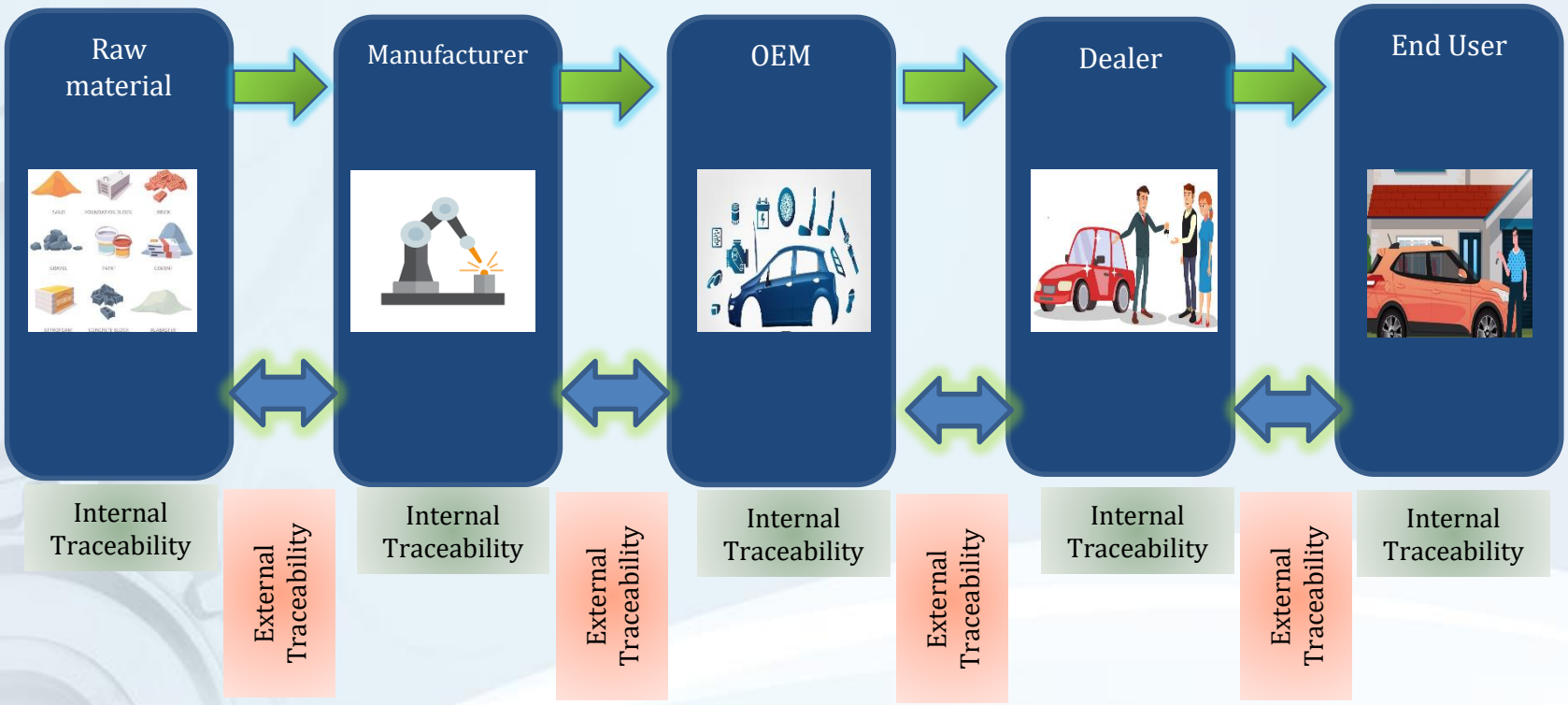
Chapter 3

Traceability - Internal, External, customer and supplier (tier 2,3..) logistics

Traceability Type



Traceability Flow



Tracing (Backward traceability)

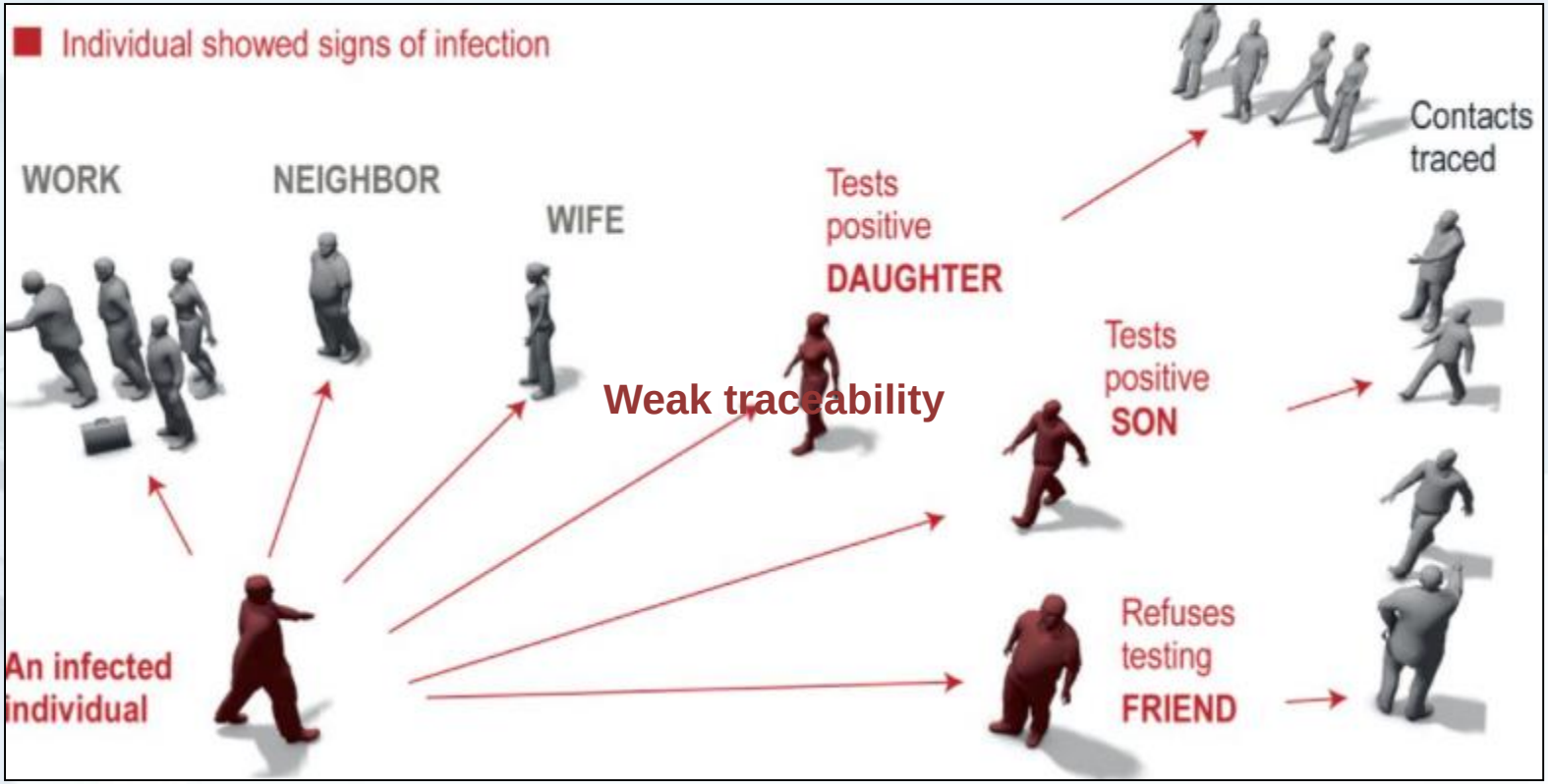
Backward Chain traceability Forward

Tracking (Forward traceability)

Physical Flow

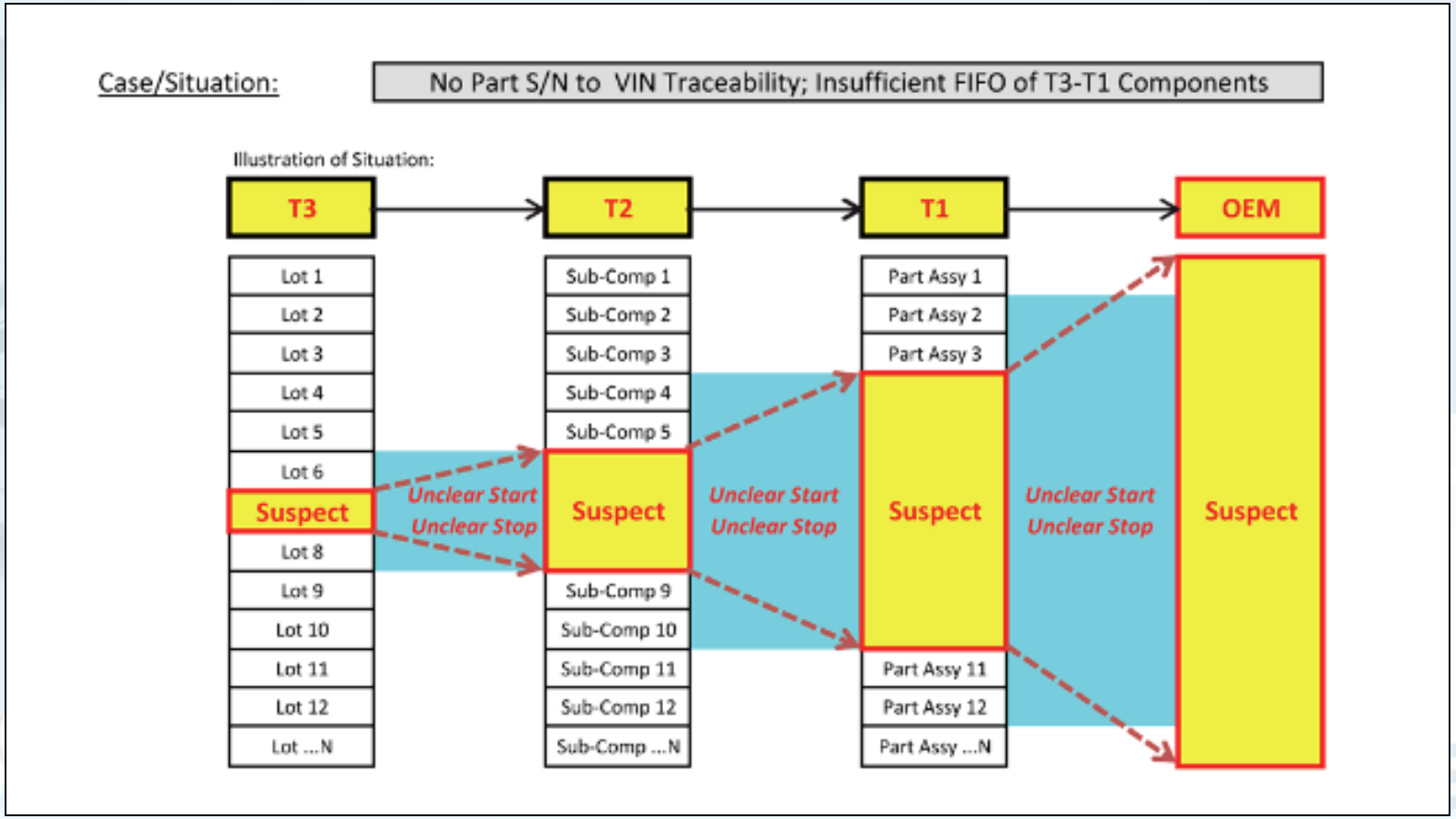
Information flow

Looking at the present scenario

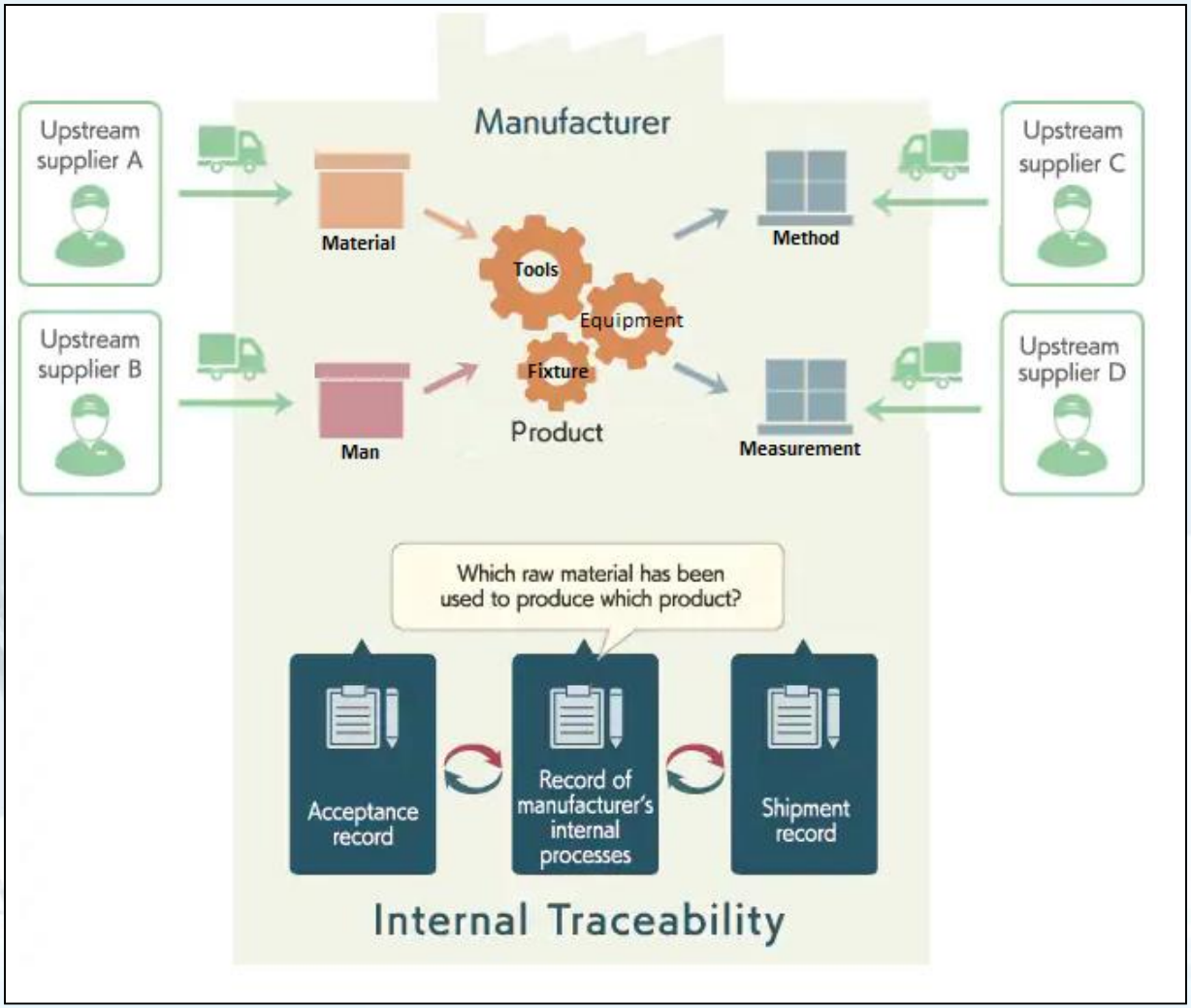


Weak Traceability

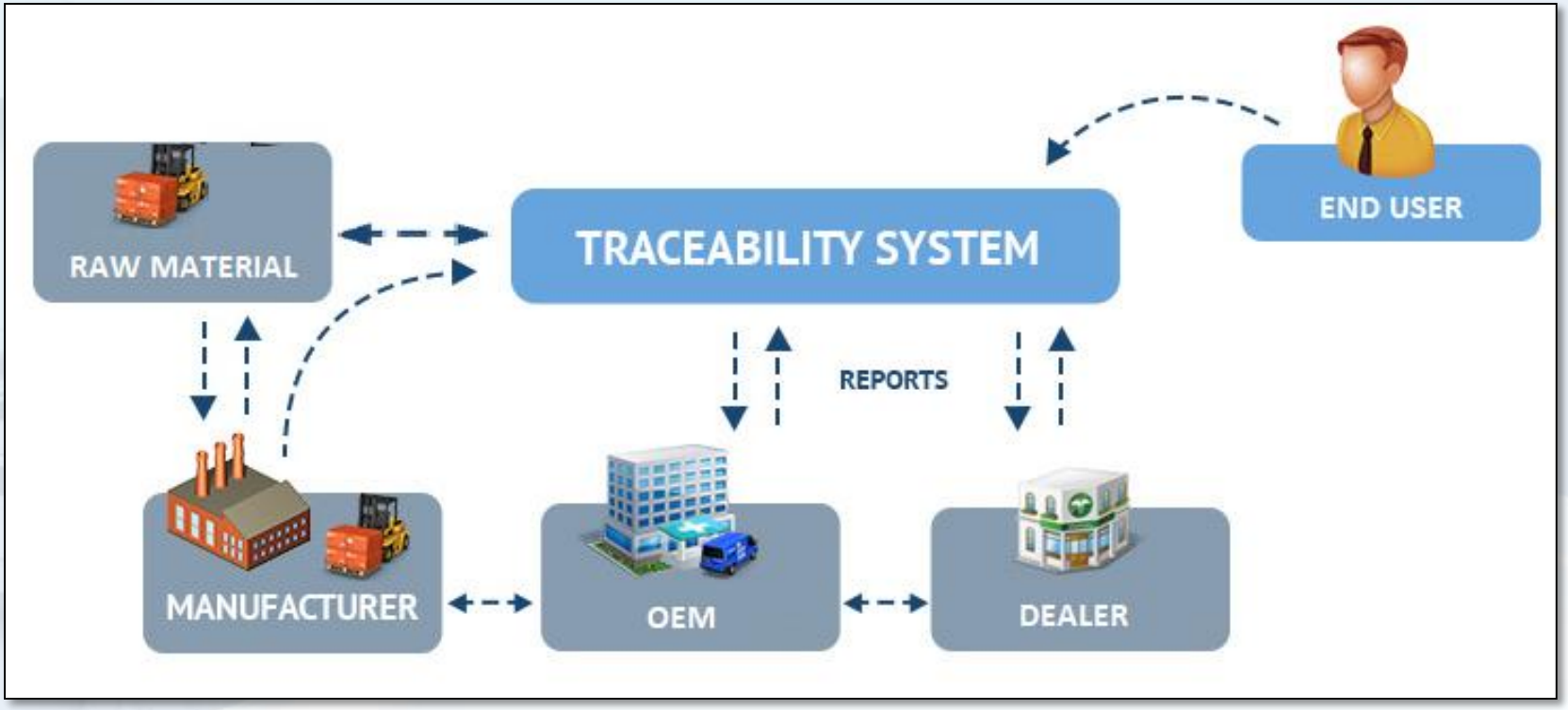
Similar



Internal Traceability



External Traceability



What is Product Traceability

It used to be that auto manufacturers' success was based on their ability to DEVELOP efficient and profitably design, produce, sell and ship products.

But in a fast-changing world, with more complex engineering and the outsourcing of sub-components, manufacturers now have to consider the quality and safety of their products as well.

The automotive industry has been the most impacted by product recalls in recent years with insurance claims over US$10 million per recall event. The impact of recalls can be far-reaching, causing not only financial but reputational damage.

With stringent inventory and regulations, automotive manufacturers need to have business systems in place that can trace back and forward, and detail of any modifications done to a product through its lifecycle. A solution should enable traceability of:

- Suppliers and their products that you use
- Items and processes used in your production process
- Products shipped to customers

What is Product Traceability

Traceability refers to the capability for tracking products along the distribution chain on a batch/lot number or series number basis capturing below details but not limited to -

- Raw material and sub part lot number used for each part
- 4M used for each part
- Change management start date and part ID number
- Supplier connected to the RM or sub part or assembly etc.

What is Product Traceability

Why is it Important? – to give quick response when

- recall product(s) deemed as unsafe/adulterated
- Allow OEM to track product(s) back to the source
- Allows suppliers to track products during containment and analysis
- To identify the methods of disposal of product at the End Of Life

Production Traceability

With a traceability system in place, manufacturers can not only verify the location, history and application of items moving through their production process, but information from the system can be used to improve efficiency and correct processes where needed.

To implement a robust traceability, collaboration is required among different teams in the organization to identify the materials and items that require traceability, and decide what information needs to be recorded during the manufacturing process, such as:

- what raw materials went into the product
- how long, where, and under what conditions items were stored in the warehouse,
- important documentation such as specifications, changes, certifications and quality records.

Production Traceability

- For full visibility and compliance, you need to have traceability from
  - Raw materials and parts to shipment, and the reverse.
  - Shipment to raw material or parts receipt.

- If the system is part of an integrated ERP solution, you can test that traceability works across all the departments and processes of your business.

Production Traceability

- With the risk of product recalls on the rise, auto manufacturers should implement a recall management system -
  - To gives access to all the critical information needed to track a suspect product through its lifecycle,
  - Supply the information needed to identify, isolate and action activities that occur within a predetermined recall time, and
  - Ensure that regulatory reporting requirements are met.

To prepare for recall events, a recall management system mock recall practice allow you to generate reports of mock and get ready for actual recalls and comply with legislative requirements

Shipment Traceability

Even after a product leaves the factory, you still need to be able to track the product.

In past, it was done by calling the driver or the security gate.

Now a days special scanning technology, advance shipment notice, shipments via barcodes and a smartphone camera can do the same work.

If you have a tracking solution that supports mobile devices it's much simpler and cheaper to track products anywhere in transit.

Your organization cannot manage customer shipment delays these days by phone calls.

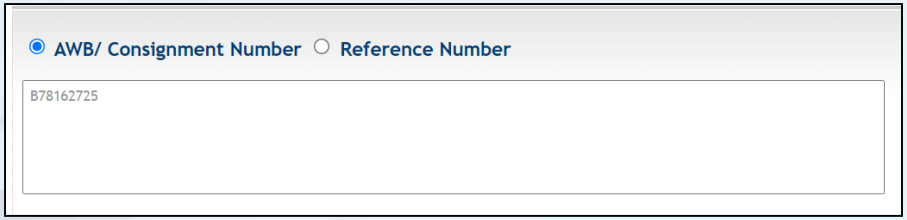
Shipment Traceability

An effective customer shipment delivery system not only supports the capturing, management and resolution of complaints, but also simplifies the process of reviewing and escalating service issues. The information can also help with quality control and enable you to improve the supply and manufacturing process.

With greater traceability in both the product lifecycle and supply chain, auto manufacturers can mitigate the impact of product.

Using an ERP system that includes full traceability and product shipment management, can give you a greater chance of avoiding customer dis-satisfaction and processes to ensure the chance of such events re-occurring is reduced or eliminated.

Shipment Traceability



Summary Results

Shipment Summary — Raise your Query | NotifyMe | Mail Me | Print

Tracking No.	B78162725	**Last Status Date**	07th jul'21
Reference No.	122336916624	**Last Status**	Out For Delivery
Booking Date.	06th jul'21		

Shipment Details

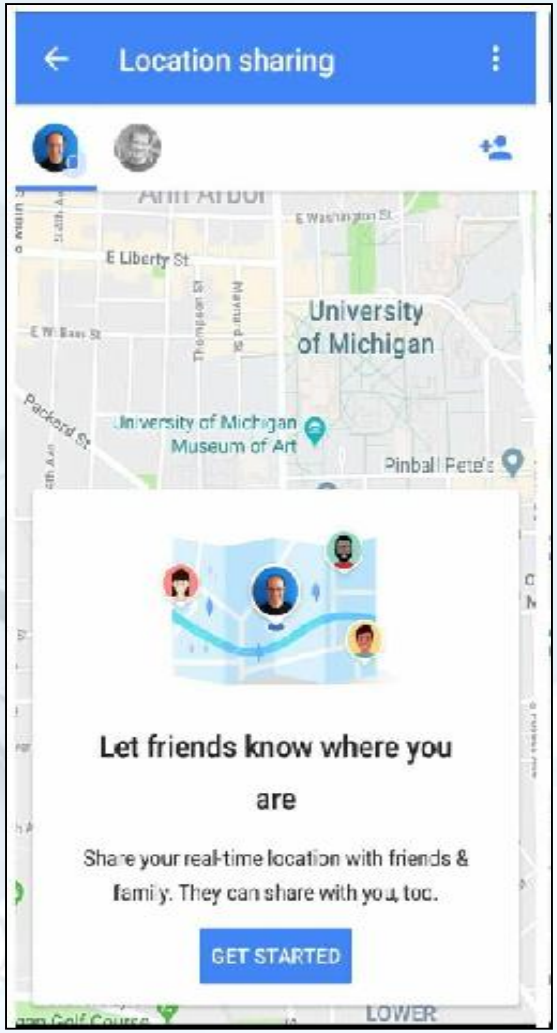
Origin	Bangalore	**Destination**	Chennai	**Destination Pincode**	600097
No. of pieces	1	**Service Type**	Lite		
Package contents	Others2				

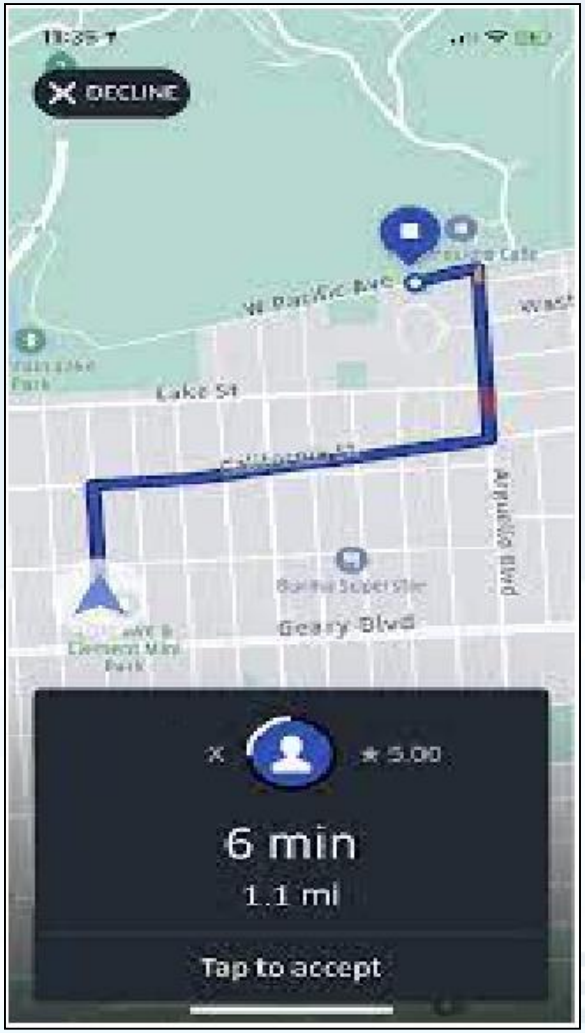
Shipment Tracking History

Pick Up → Booked & Dispatch → In Transit → At Destination → Out for Delivery → Delivered

Date	Activity	From	To
Wed,07th Jul'21|14:20 Hrs	Out For Delivery	Pallikkaranai Master Franchisee(THURAIPAKKAM)	
Wed,07th Jul'21|13:35 Hrs	Received At Facility	Chennai Apex	Pallikkaranai, Chennai
Wed,07th Jul'21|13:31 Hrs	Received At Facility	Chennai Apex	Pallikkaranai Master Franchisee
Wed,07th Jul'21|13:30 Hrs	Received At Facility	Chennai Apex	Pallikkaranai Master Franchisee
Wed,07th Jul'21|12:35 Hrs	Processed & Forwarded From Hub	Chennai Apex	Pallikkaranai Master Franchisee
Wed,07th Jul'21|12:33 Hrs	Processed & Forwarded ToHub	Chennai Apex	Pallikkaranai Master Franchisee
Wed,07th Jul'21|12:33 Hrs	Processed & Forwarded To Hub	Chennai Apex	Pallikkaranai, Chennai
Wed,07th Jul'21|11:16 Hrs	Received At Hub	Domlur Branch	Chennai Hub
Wed,07th Jul'21|11:12 Hrs	Received At Hub	Domlur Branch	Chennai Apex
Wed,07th Jul'21|11:11 Hrs	Received At Hub	Chennai Apex	Chennai Apex
Tue,06th Jul'21|21:32 Hrs	Received At Hub	Domlur Branch	Bangalore Yehalanka Apex
Tue,06th Jul'21|20:07 Hrs	Processed & Forwarded From Facility	Domlur Branch	Bangalore Yehalanka Apex
Tue,06th Jul'21|19:39 Hrs	Processed & Forwarded ToFacility	Domlur Branch	Chennai Apex
Tue,06th Jul'21|19:37 Hrs	Processed & Forwarded To Facility	Domlur Branch	Chennai Hub
Tue,06th Jul'21|18:26 Hrs	Booked At Facility	Domlur Branch	Booked To CHENNAI
Tue,06th Jul'21|15:23 Hrs	Softdata Upload	First Mile	Booking Initiated

Shipment Traceability





Note: the data and case study is only for training purpose

Supplier Traceability

The trigger for a product quality issue, recall or return is usually an issue within raw materials to finished goods. Therefore it's important to have an efficient method to make sure defective items are identified, quarantined and returned to or repaired by a supplier.

There must be a full tracking of the item during process till End of Life of the product.

Manufacturers need to have full visibility of product when it comes to manufacturing, quality, issue of rework or repair activities and be assured that they are being handled correctly and efficiently. This is not only important for traceability but also to enable quality control in the procurement and supplier process.

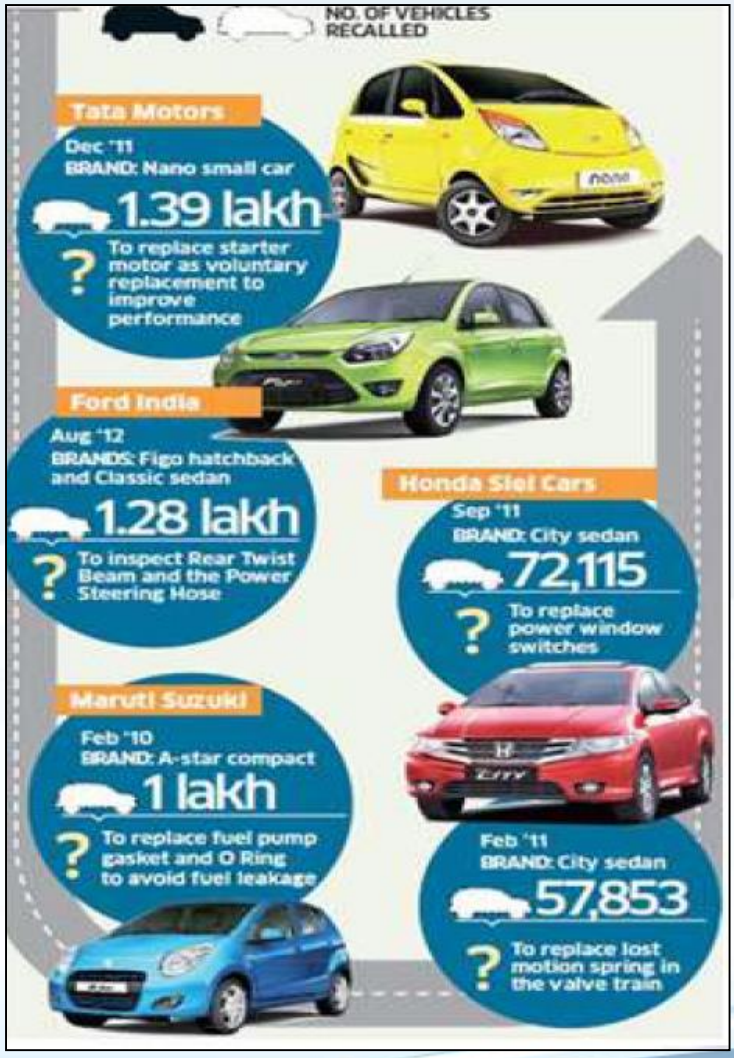
With the availability of online systems organizations can look at automating the creation of requests to suppliers, scheduling, tracking product and process, controlling quality etc. via systems it self.

Supplier Traceability

Returns and recalls don't just impact the product and supply chains but also brand image and some times even call for action by legal team (Government or Regulatory authority)

The advantage of an integrated ERP system helps you to track & trace all the he original order, so you have traceability of the product history, other accounting items, cost variances, goods received notes, credit notes, and purchase orders.

On the inventory side, you will need to ensure that returned goods are quarantined as they may have to be returned to the supplier. You will also need efficient traceability of stock by tracking serial numbers, lots and bins across warehouses so you can isolate any remaining defective stock.



Note: Data and case study is only for training purpose

Document and Record Traceability

Design Documents	Drawings
	Technical requirements
	Safety requirement SC / CC
	Change management

Verification & Validation Documents	DFMEA ,
	DVP&R
	Homologation
	Inspection report of test rigs

Incoming Documents	Supplier Inspection reports
	Material test certificate,
	Lot identification markings
	Sub supplier v/s QTY supplied

Document and Record Traceability

Process Documents	lot size / Quantity produced per day
	Individual part readings & markings
	Bill of material / parts used and their batch number
	Line, machine and fixture number used, operator and his shift etc.
	Record related to production period

Final inspection Documents	Inspector name and his shift
	Date & time of inspection for each product
	Test result including dimensions, fit and function during process and at final inspection area
	Process control charts for each individual lot/ batch or product and it markings

Document and Record Traceability

Dispatch Documents	Packing and labeling
	Invoice and it tracking to lot / batch number
	Quantity shipped and on which vehicle with its number

Product Markings	Identification on product that have passed all test in process and final inspection

Case Study

Ford Kuga burning crisis

- In December 2015, one person was burnt to death in his 1.6-litre Eco Boost Ford Kuga in South Africa. Since then a recorded 51 Kugas have caught alight across the country, and two more in Swaziland and Botswana.

- One Year after the incident Ford recalled 4,556 1.6-litre Eco Boost Kugas in South Africa manufactured between December 2012 and February 2014.

- The fire is considered to have occurred by a lack of coolant circulation and the superheated surfaces which could lead to cracking of the cylinder head, exhaust manifold, the turbocharger and the catalytic converter resulting in an oil leak and subsequent fire in the engine compartment

Note: Data and case study is only for training purpose

Case Study

Toyota reaches $1.2 billion settlement to end probe of accelerator problems

- It took the company eight years to recall 7.7 million vehicles after a number of crashes and deaths.
- It's therefore clear that the sooner a company reacts to a problem, the less of a negative impact there will be on customers, the brand and the bottom line. And, in addition, that if it makes a super effort to address the problem it can even build brand and customer loyalty like never before.

Note: Data and case study is only for training purpose

Exercise: Creating Requirements List

The traceability mandate demands efficient, demonstrable traceability one step forward to your finished product customers and one step backward to your sub assembly and raw material suppliers. Broadly speaking, this means maintaining comprehensive and accessible records on your sub assembly, child parts and raw material including suppliers, all sub assembly , parts and raw materials received, each step of the manufacturing process, rejects, repairs and rework, inventory and storage, dispatch and shipping to customers.

Exercise: Creating Requirements List

Based on the above, team need to Brain storm and make a check list on what are the data which needs to be part of traceability from each department starting from development till dispatch, some examples are given below –

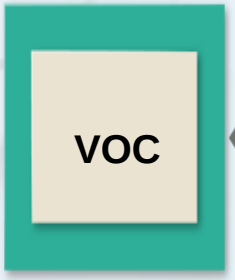
- Ingredient receiving records, unique ID and quantities used in the batch.
- Packaging records, unique ID and quantities used in the batch.
- Production batch sheet
- Rework or over-run added / created
- Waste
- Finished product Lot ID and quantities
- Storage and inventory records
- Current location of all quantities produced
- Dispatch and shipping records
- The test duration

Chapter 4

Traceability – Design, verification and Validation Requirements

Traceability – Design Requirements

Voice of the Customer(VOC) to Testing Plan to PPAP



Inputs to design the product and its requirements

- Direct discussion and MOM,
- Market surveys,
- Customer specific requirements,
- Quality Issues, warranty data, field reports, etc.

Requirement Flow Down

Tool used to identify causes of failure modes, or reduce their rate of Occurrence

- Identified Potential product failure modes.
- Identified Critical Characteristics and/or Significant Characteristics.
- Design actions to reduce severity or improved design
- Eliminate the causes of product failure modes etc

Prevention Controls and detection controls

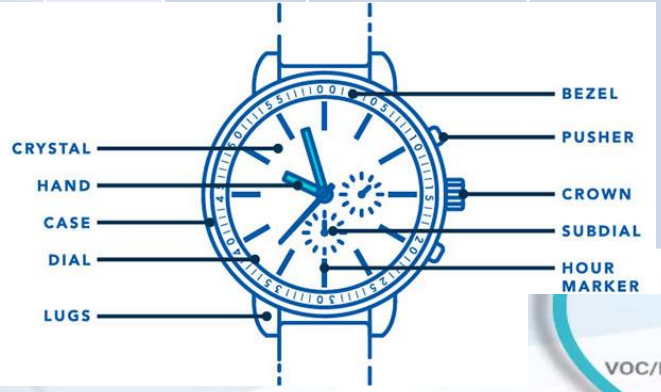
Tool is most often used in conjunction with DFMEA

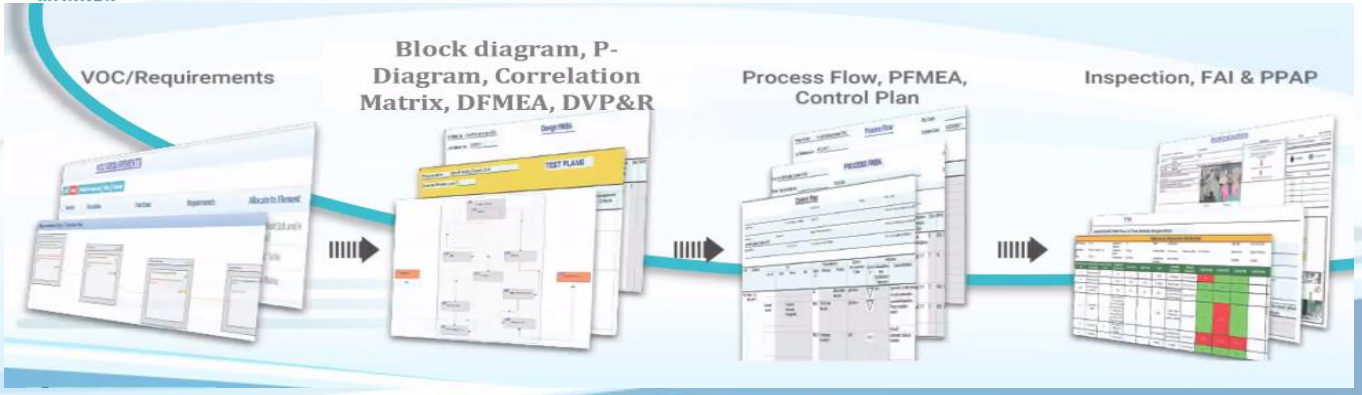
- Performing tests as part of a problem solution or root cause analysis (RCA)
- Plan and document test information to validate product performance w.r.t design requirement
- Testing during NPD, recertification for regulatory requirements for change or improvement if any

Traceability – Design Requirements

Let us take an example of a Waterproof Watch

Requirement ID	System Function	Function requirement ID	System Requirement	Sub System Requirement ID	Sub System requirement	Component requirement ID	Component requirement
A	The watch must be water proof	A 1	The watch should function even if the user, uses for a prolonged time	A 1.1	Swims in cold water	A 1.1.1	Water entry from Bezel
						A1.1.2	Water entry from Crown & Pusher
						A1.1.3	Water entry from Back cover
				A 1.2	Bath in hot water	A1.2.1 A1.2.2 A1.2.3	
				A 1.3	Work in hazardous environment	A1.3.1 A1.3.2 A1.3.3	

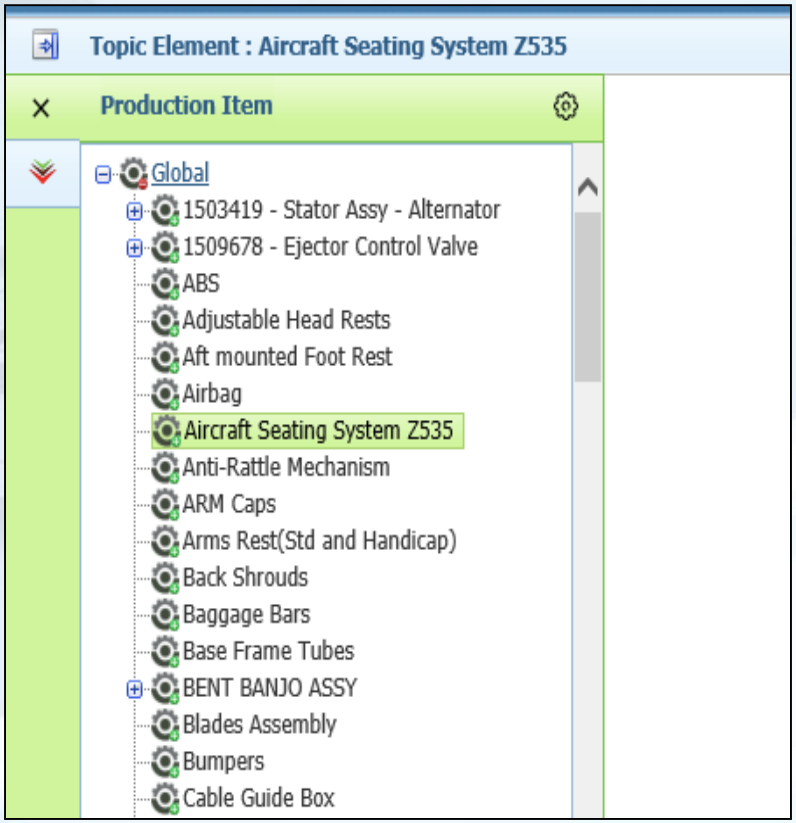




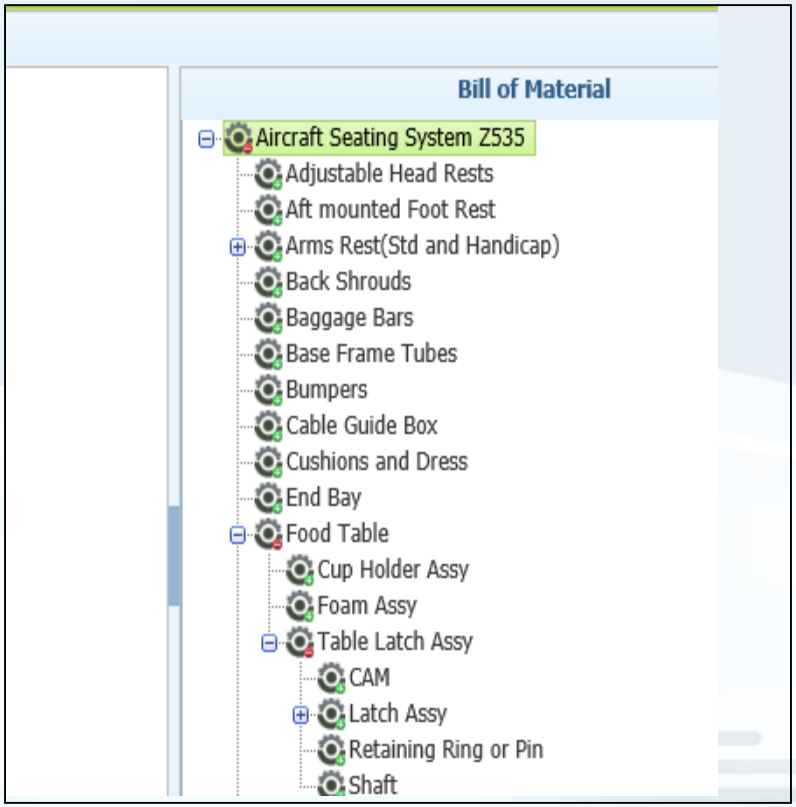
Traceability – Design Requirements

To meet the Requirement Flow Down we need assembly and it's bill of material data

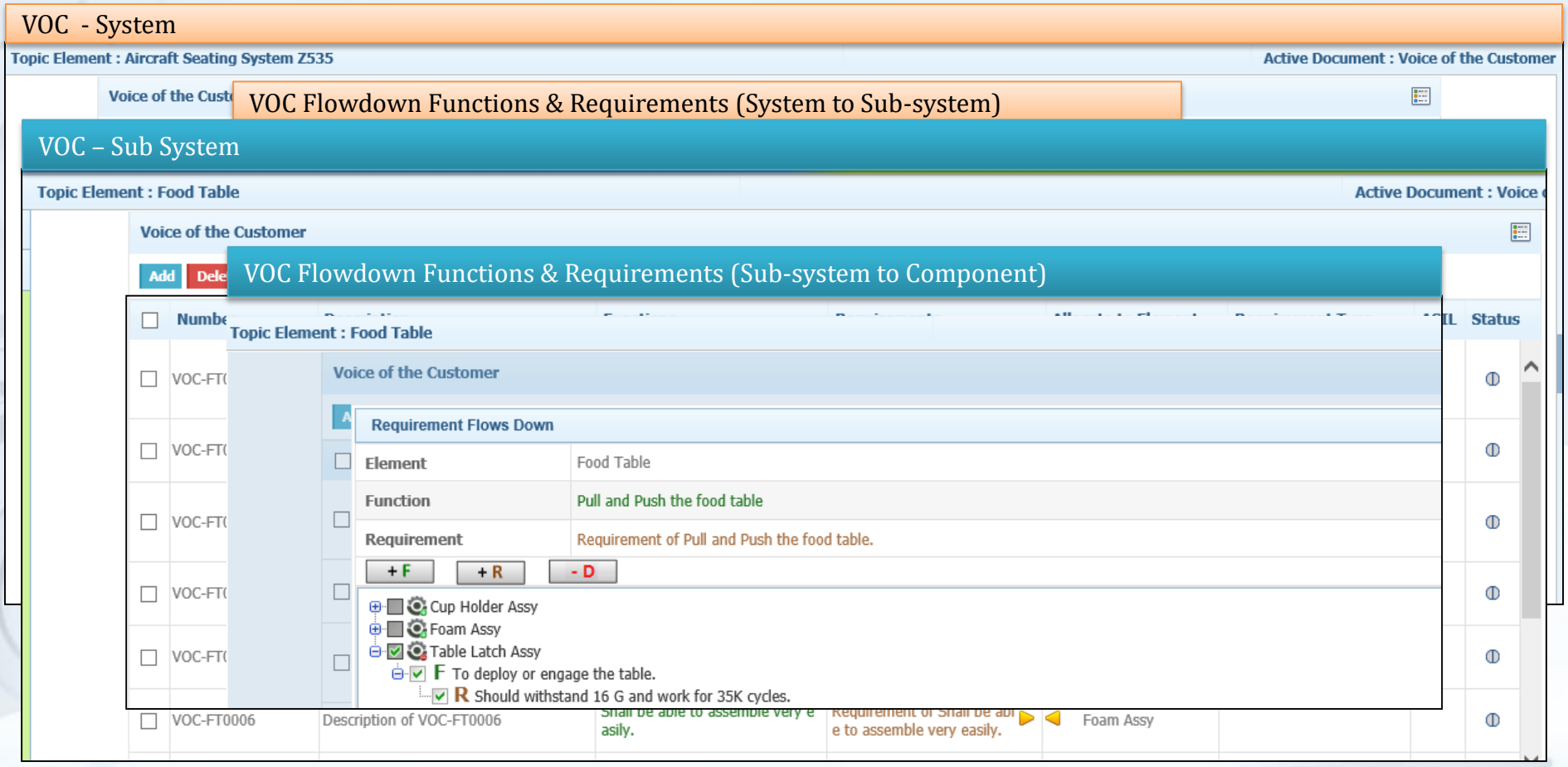
Part Structure View



Bill of Material Structure

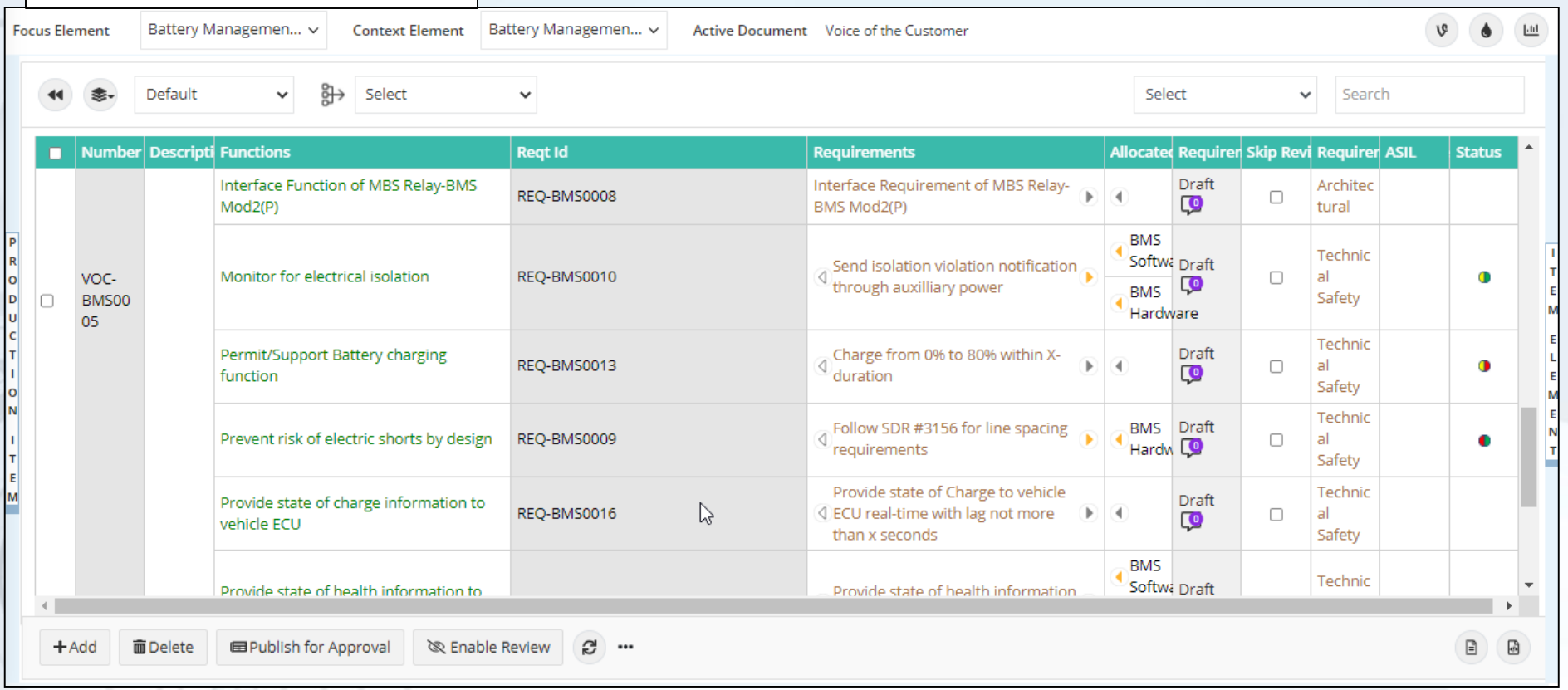


Traceability – Design Requirements



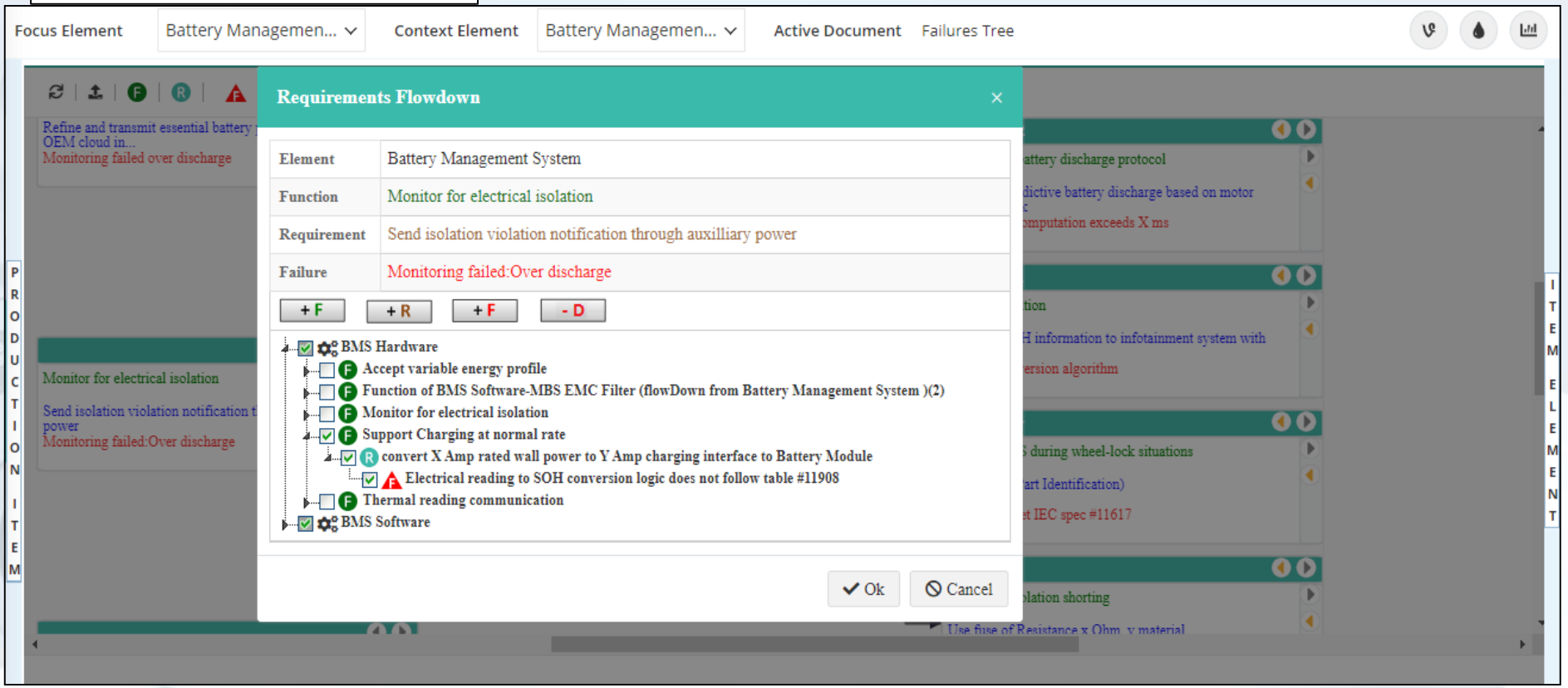
Traceability – Design Requirements

Requirement Tree



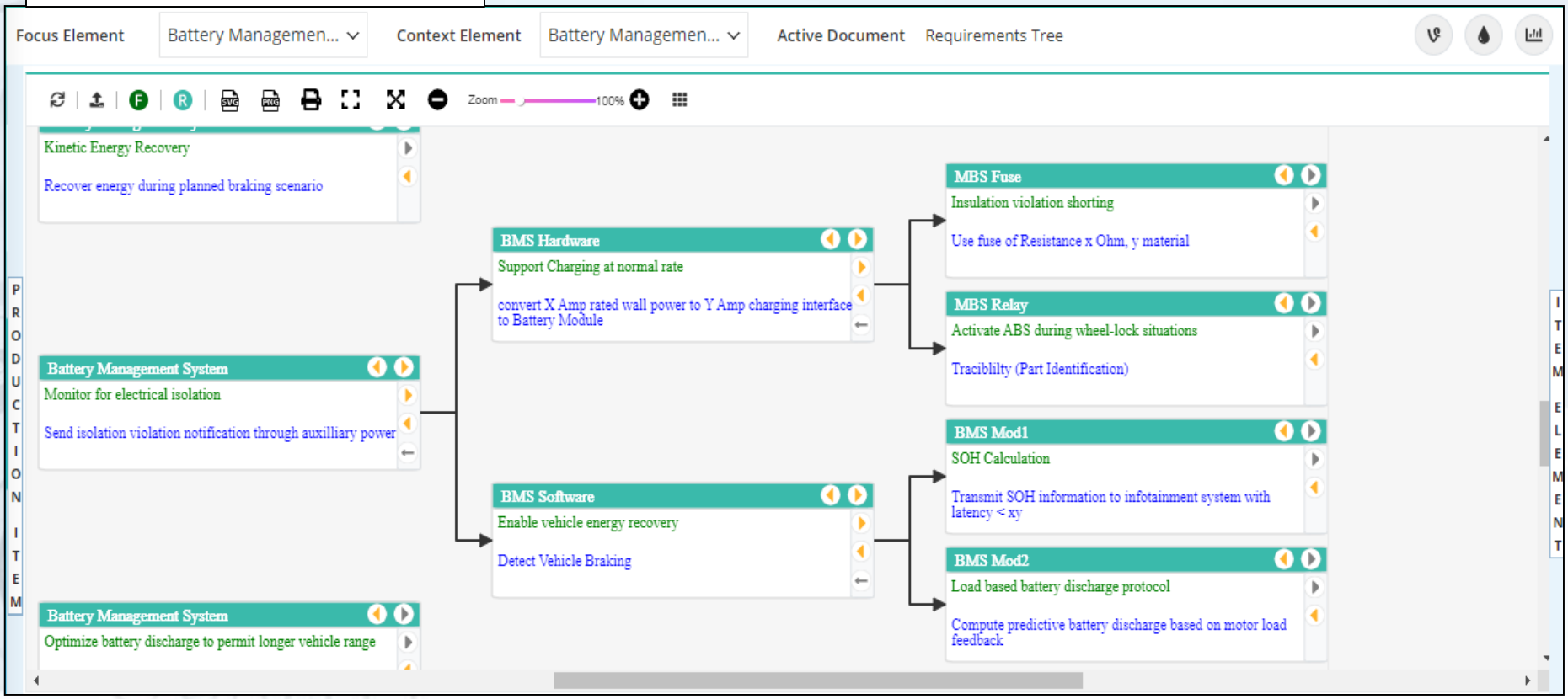
Traceability – Design Requirements

Failure Tree



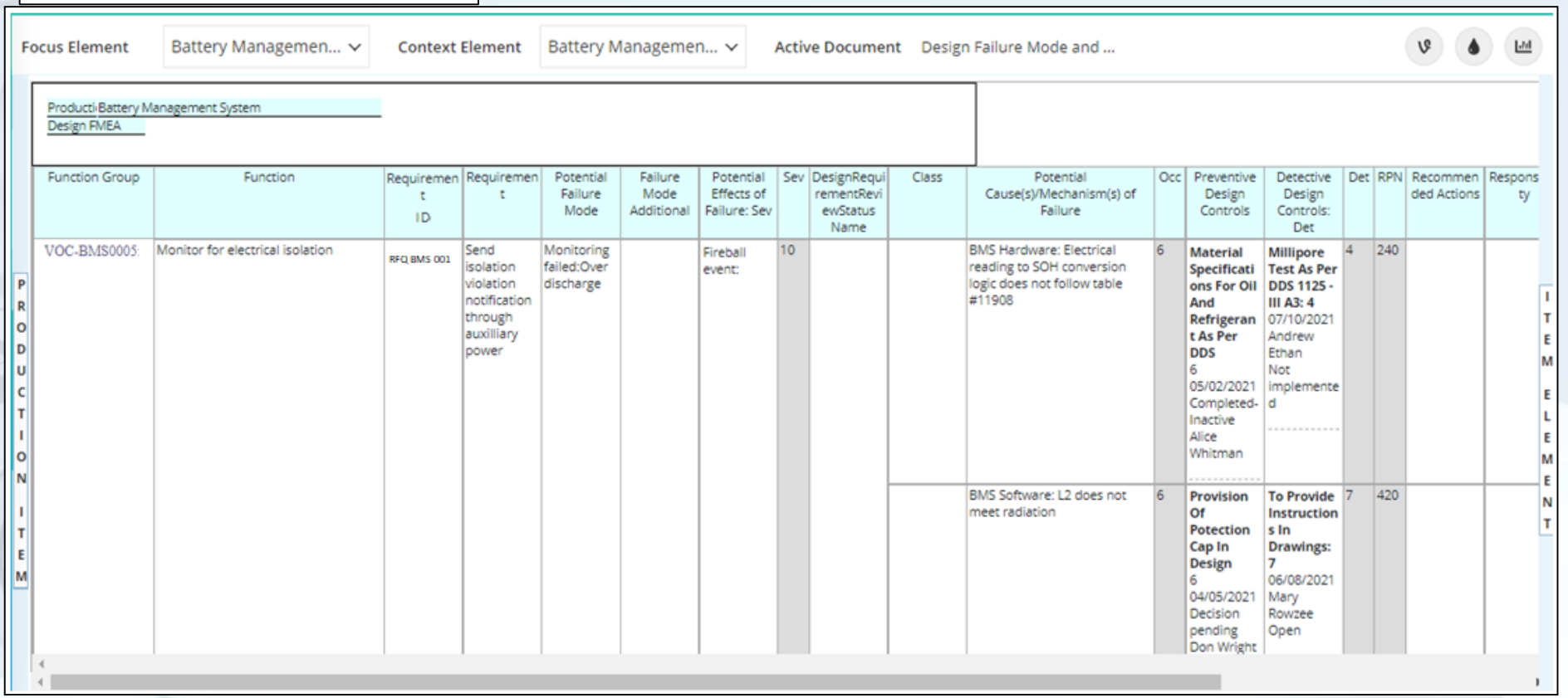
Traceability – Design Requirements

Failure Flow down



Traceability – Design Requirements

DFMEA



Focus Element: Battery Managemen... | Context Element: Battery Managemen... | Active Document: Design Failure Mode and ...

Product: Battery Management System
Design FMEA

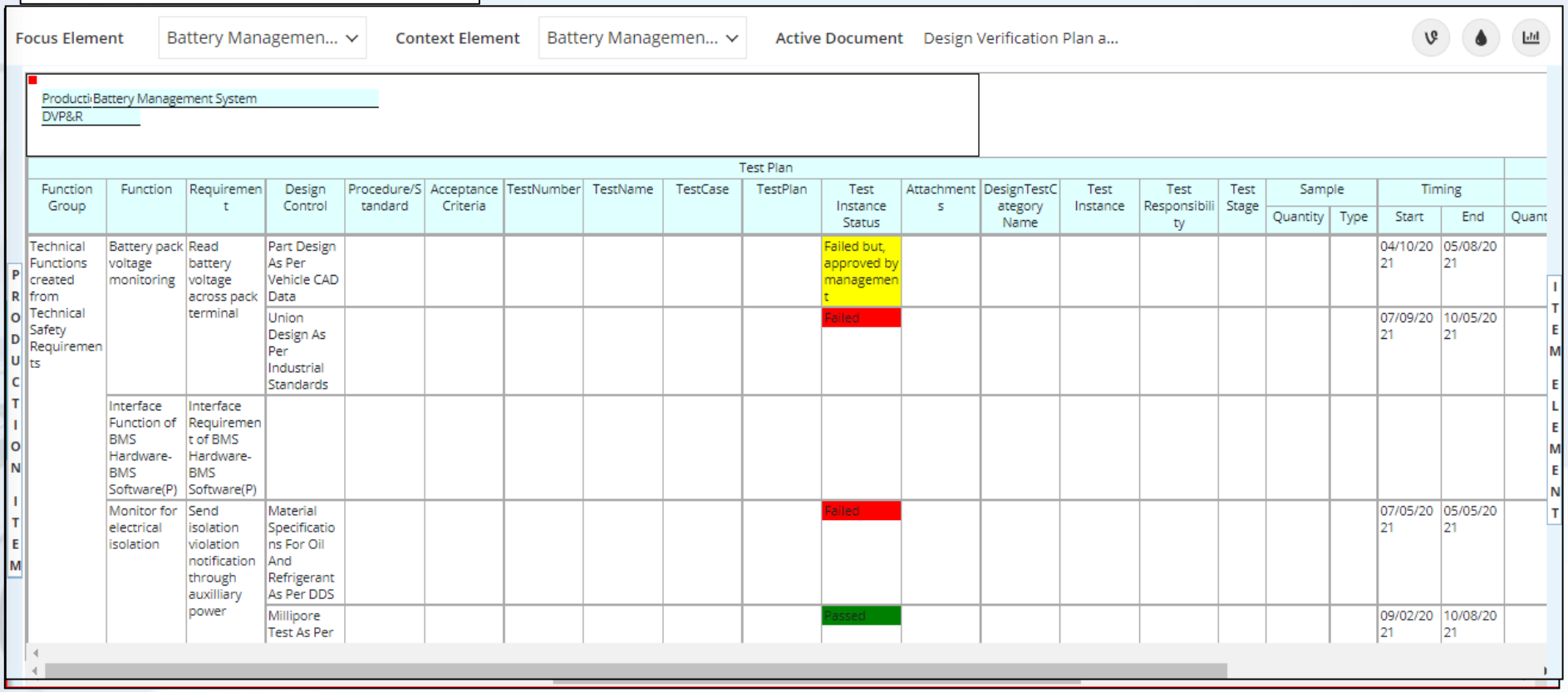
PRODUCTION ITEM

Function Group	Function	Requirement ID	Requirement	Potential Failure Mode	Failure Mode Additional	Potential Effects of Failure: Sev	Sev	DesignRequirementReviewStatus Name	Class	Potential Cause(s)/Mechanism(s) of Failure	Occ	Preventive Design Controls	Detective Design Controls: Det	Det	RPN	Recommended Actions	Responsty
VOC-BMS0005:	Monitor for electrical isolation	RFQ BMS 001	Send isolation violation notification through auxilliary power	Monitoring failed:Over discharge		Fireball event:	10			BMS Hardware: Electrical reading to SOH conversion logic does not follow table #11908	6	**Material Specifications For Oil And Refrigerant As Per DDS** 6 05/02/2021 Completed-Inactive Alice Whitman	**Millipore Test As Per DDS 1125 - III A3: 4** 07/10/2021 Andrew Ethan Not implemented	4	240		
										BMS Software: L2 does not meet radiation	6	**Provision Of Potection Cap In Design** 6 04/05/2021 Decision pending Don Wright	**To Provide Instructions In Drawings: 7** 06/08/2021 Mary Rowzee Open	7	420		

ITEM ELEMENT

Traceability – Design Requirements

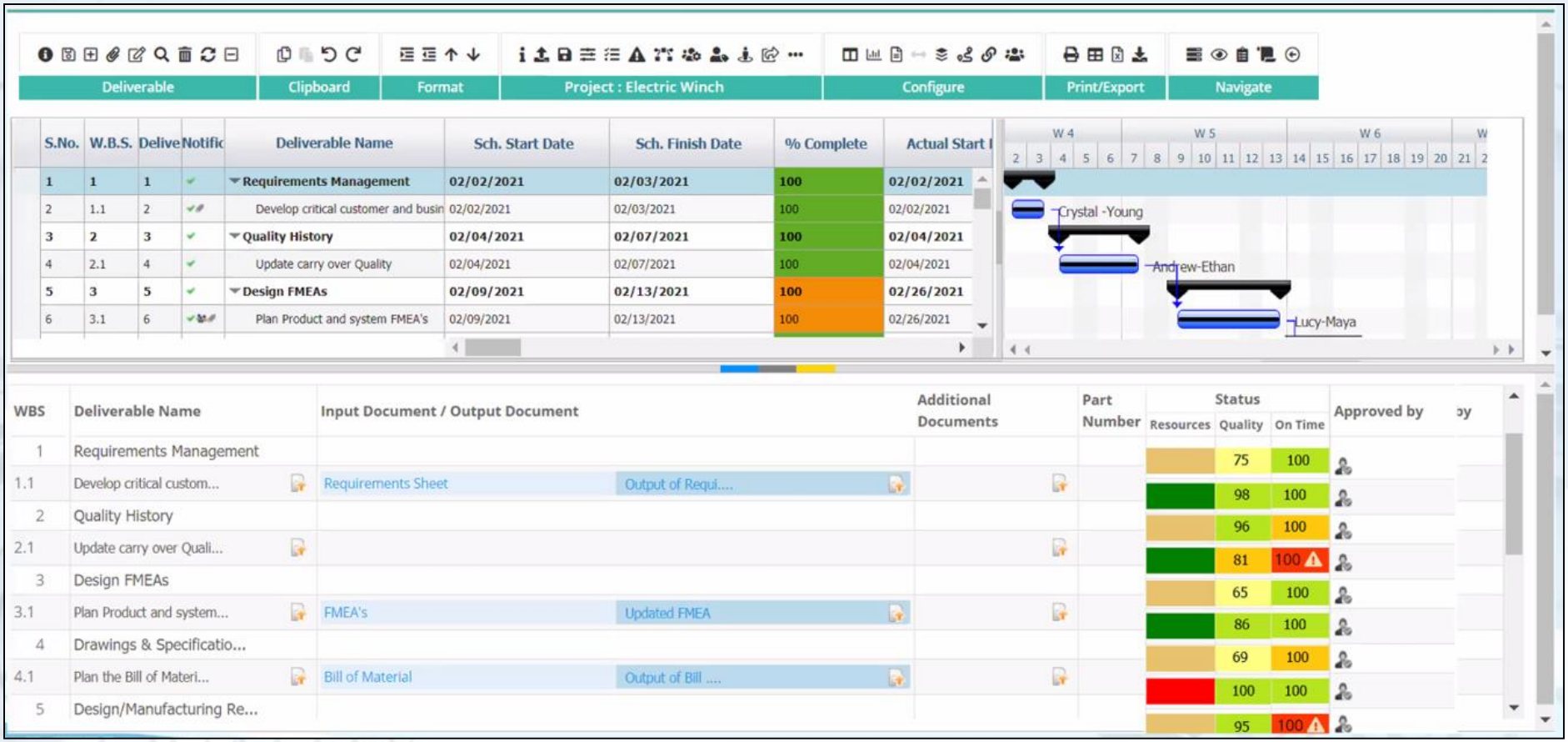
DVP&R



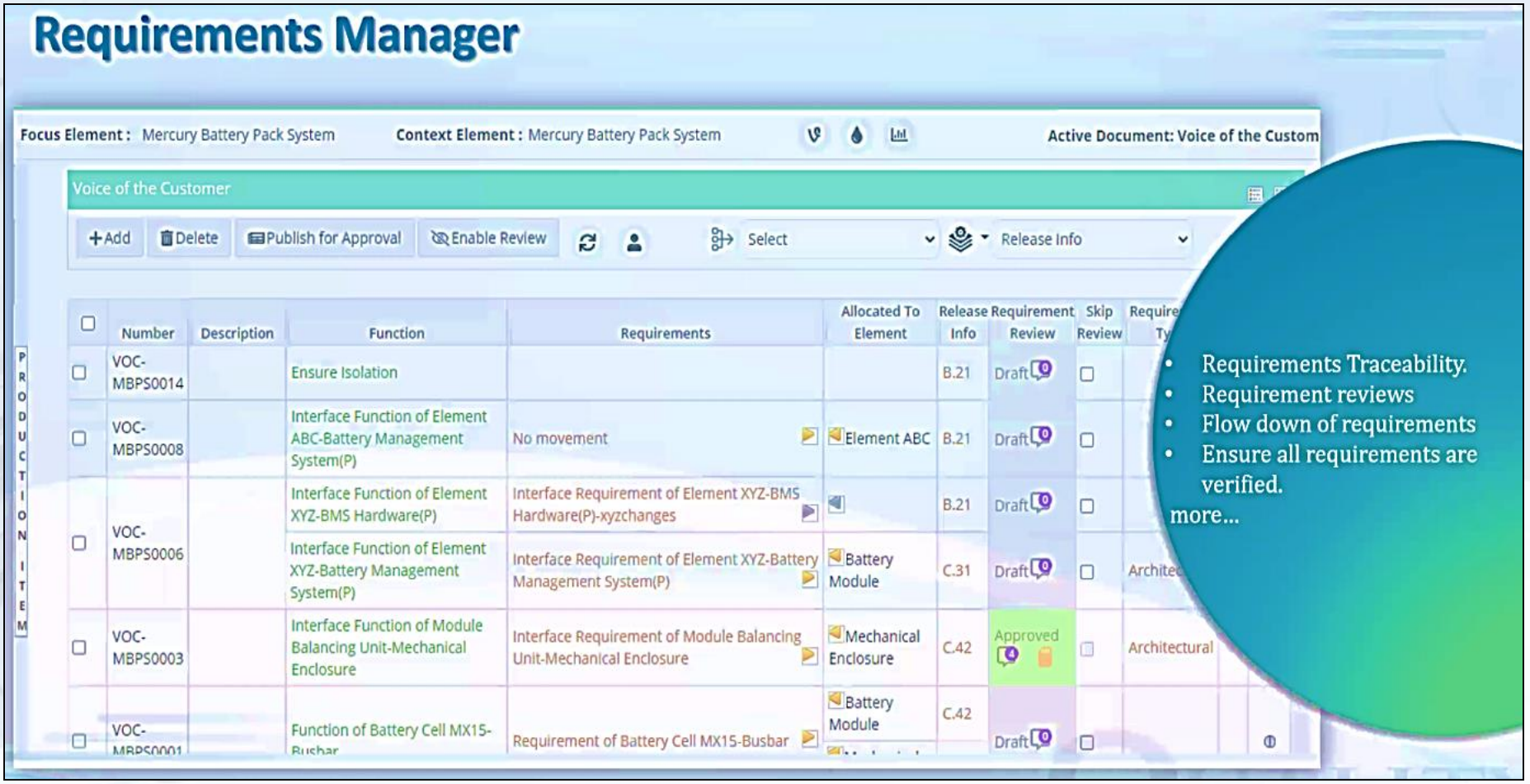
Test Plan																			
Function Group	Function	Requirement	Design Control	Procedure/Standard	Acceptance Criteria	TestNumber	TestName	TestCase	TestPlan	Test Instance Status	Attachments	DesignTestCategory Name	Test Instance	Test Responsibility	Test Stage	Sample		Timing		
																Quantity	Type	Start	End	Quant
Technical Functions created from Technical Safety Requirements	Battery pack voltage monitoring	Read battery voltage across pack terminal	Part Design As Per Vehicle CAD Data							Failed but, approved by management								04/10/2021	05/08/2021	
			Union Design As Per Industrial Standards							Failed								07/09/2021	10/05/2021	
	Interface Function of BMS Hardware-BMS Software(P)	Interface Requirement of BMS Hardware-BMS Software(P)																		
	Monitor for electrical isolation	Send isolation violation notification through auxilliary power	Material Specifications For Oil And Refrigerant As Per DDS							Failed								07/05/2021	05/05/2021	
			Millipore Test As Per							Passed								09/02/2021	10/08/2021	

Verification and validation tests can be defined for any layer of requirements.
Test scripts can include other tests and run external tools to collect automated test results.
If a test step fails it can be linked to the system.

Traceability – Design Requirements



Traceability – Design Requirements



Case Study of 737 MAX Airplane

In October 2018, 189 passengers perished when Lion Air Flight 610 crashed a few minutes after taking off from Jakarta.

Initial Analysis mentioned :- human error and embarked on a process meant to update the online training software administered to pilots

A few months later, in March 2019, Ethiopian Airlines Flight 302, a second airplane of same type, the 737 MAX model, carrying 157 passengers.

Note: Data and case study is only for training purpose

Data as received from
Sustainability 2020, 12, 8994; doi:10.3390/su12218994 www.mdpi.com/journal/sustainability

Case Study of 737 MAX Airplane

Background

Company planned to design a brand-new airplane to substitute the aging fleet of 737 and due to competition in the market company mentioned the new model was simply a derivative of the traditional 737 aircraft.

But it was not the case

The new model were installed with larger engines and shifted their location forward, which disrupted the plane's aerodynamic structure, causing it to become susceptible to stalling under certain flight conditions

To obviate this problem, manufacturer developed the MCAS system, which pushed the plane's nose down to stabilize the aircraft. When needed, the system engaged automatically. The pilots could not deactivate, even if pilot was able to deactivate, the system would have reactivated by itself after few seconds.

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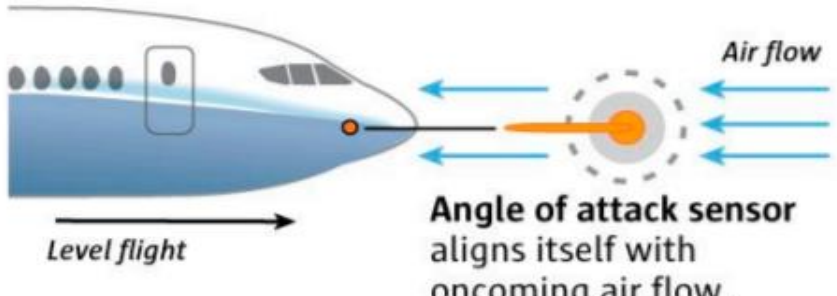
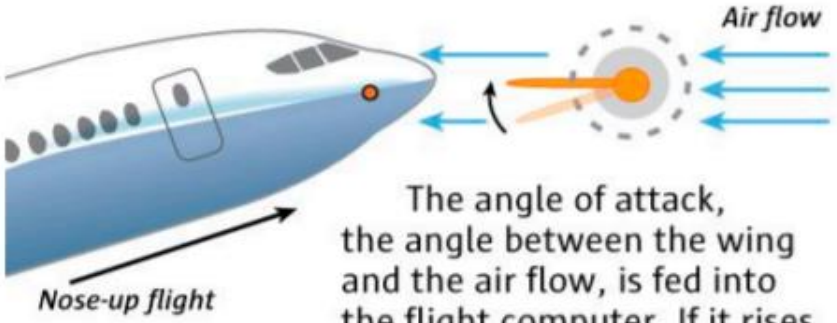
Data as received from
Sustainability 2020, 12, 8994; doi:10.3390/su12218994 www.mdpi.com/journal/sustainability

Case Study of 737 MAX Airplane



Angle of attack sensor aligns itself with oncoming air flow.



The angle of attack, the angle between the wing and the air flow, is fed into the flight computer. If it rises too high, suggesting an approaching stall, the MCAS system activates.

MCAS (Maneuvering Characteristics Augmentation System)

The MCAS system automatically swivels the horizontal tail to move the nose down. In the Lion Air crash, the angle of attack sensor fed false information to the flight computer.

Horizontal tail

Sources: Boeing, FAA, Indonesia National Transportation Safety Committee, Leeham.net, and The Air Current.

Reporting by DOMINIC GATES,
Graphic by MARK NOWLIN / THE SEATTLE TIMES

Company CEO replied: "I think about that decision over and over again. If we knew everything back then that we know now, we would have made a different decision

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Data as received from
Sustainability 2020, 12, 8994; doi:10.3390/su12218994 www.mdpi.com/journal/sustainability

Case Study of 737 MAX Airplane

Findings

Work Pressure

Due to intense competition in the aviation industry and enormous pressure on the manufacturer to produce a new plane as quickly and inexpensively as possible. The company decided to update an outmoded design without properly testing a prototype.

Safety System

In order to meet the requirement for the 737 aircraft to be fuel-efficient, several technical changes were needed. The manufacturer shifted the engines forward which changed the aerodynamics.

Management and Supervision

The third antecedent of the plane disasters was the ignoring of pilots' warnings. A search of the Aviation Safety Reporting System [30] reveals that the MAX anti-stall system was activated on at least two prior incidents as quoted.

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Data as received from
Sustainability 2020, 12, 8994; doi:10.3390/su12218994 www.mdpi.com/journal/sustainability

Case Study of 737 MAX Airplane

Findings

Competence
Lack of training for the pilots on the new modifications to the 737 MAX. When the MAX jet was under design, the company engineers concluded that pilots could fly the plane without new training, because it was an upgrade of the previous 737 model and decided that the 737's new features could be learned from an iPad orientation.

Risk
Both flights lacked safety features that were offered to the manufacturer for an additional price. Safety features include communication and navigation systems that are necessary for the plane's cruise control.

Procedures and Rules
The crash was due to the accelerated certification that the FAA awarded to the 737 MAX without due accuracy.

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Data as received from
Sustainability 2020, 12, 8994; doi:10.3390/su12218994 www.mdpi.com/journal/sustainability

Exercise : Tracking Documents

During the last decade products have become more and more complex. In order to master these challenges manufacturing companies have provided approaches for reusability, adaptability, and variety of product and partial design solutions. Fundamental problems of such approaches are lack of design solutions understanding and the danger of mistakes during solution adaptation and integration. The problems are mostly caused by insufficient design documentation, and inadequate support to the tracing of design evolution.

Collect all the SOP, Document and Records from all departments involved in New Product Development. Team shall report which are the document which are incomplete or not available.

Exercise : Tracking Documents

Team connected -

- Product design
- Process design (ME)
- Purchase and SQA
- Logistics, Store and Packing
- New Product Development
- Quality and validation
- Production
- Maintenance and line set up team etc.

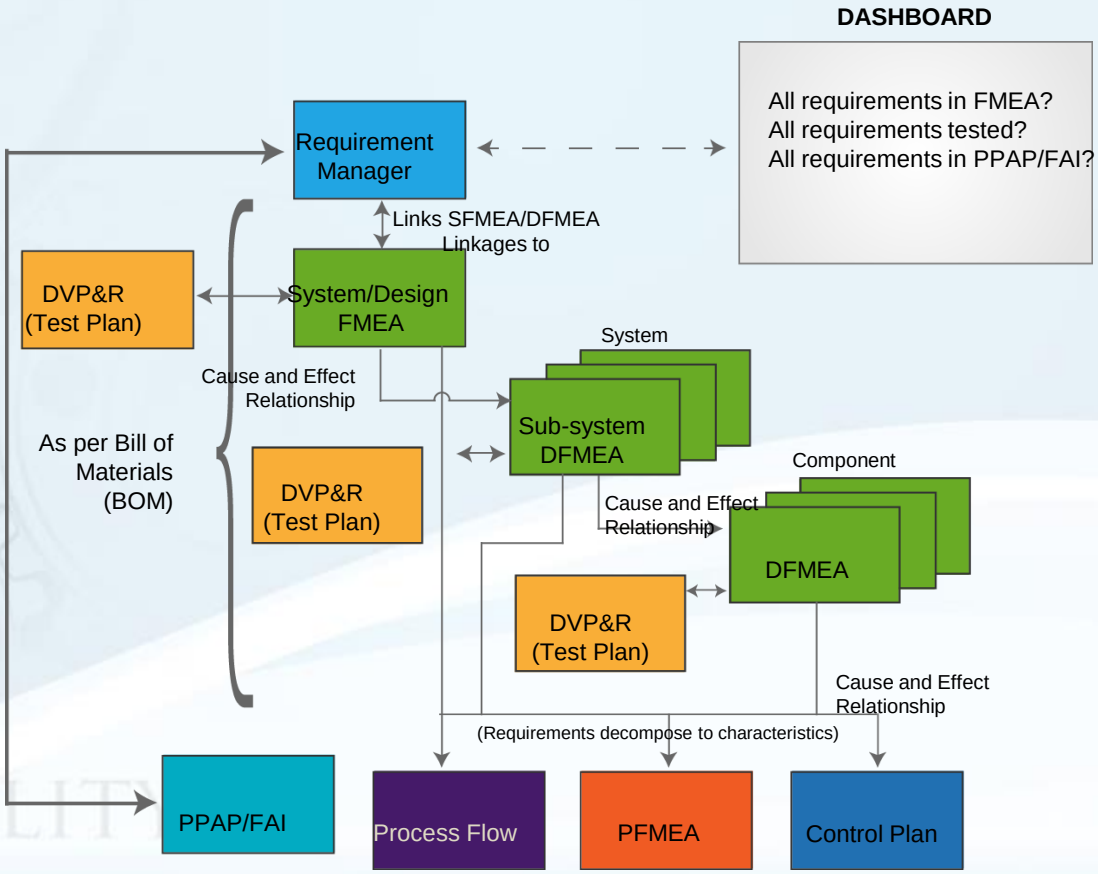
Based on the findings, fine tune your question created during brain storming.

Chapter 5

Traceability – Requirement linkage to PPAP (PFMEA and CP)

Requirement traceability

Flow Down to PFMEA, Control Plan and Inspection report



Requirement traceability

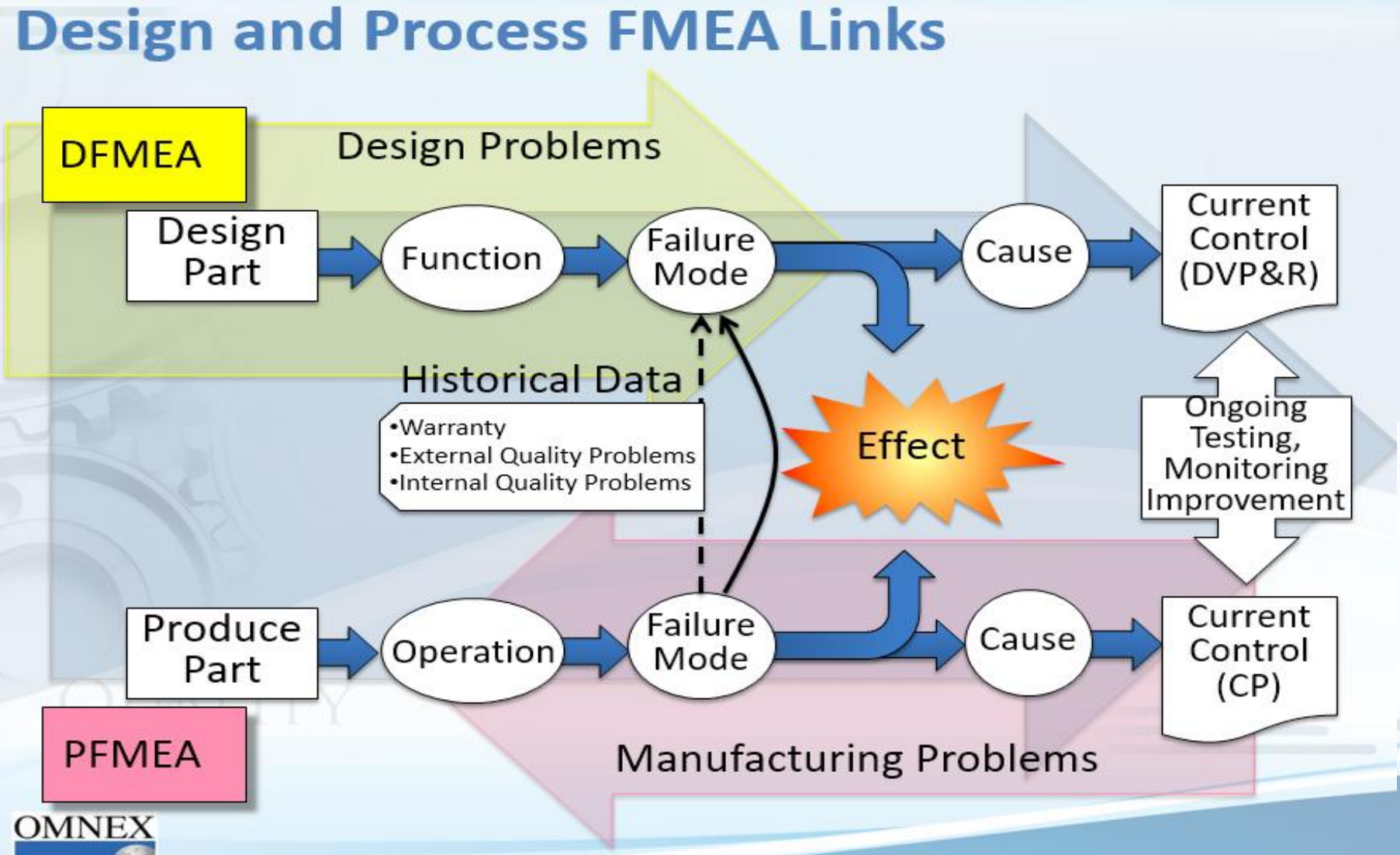
Requirements traceability

Requirements traceability is the tracking of requirements throughout the product development lifecycle.

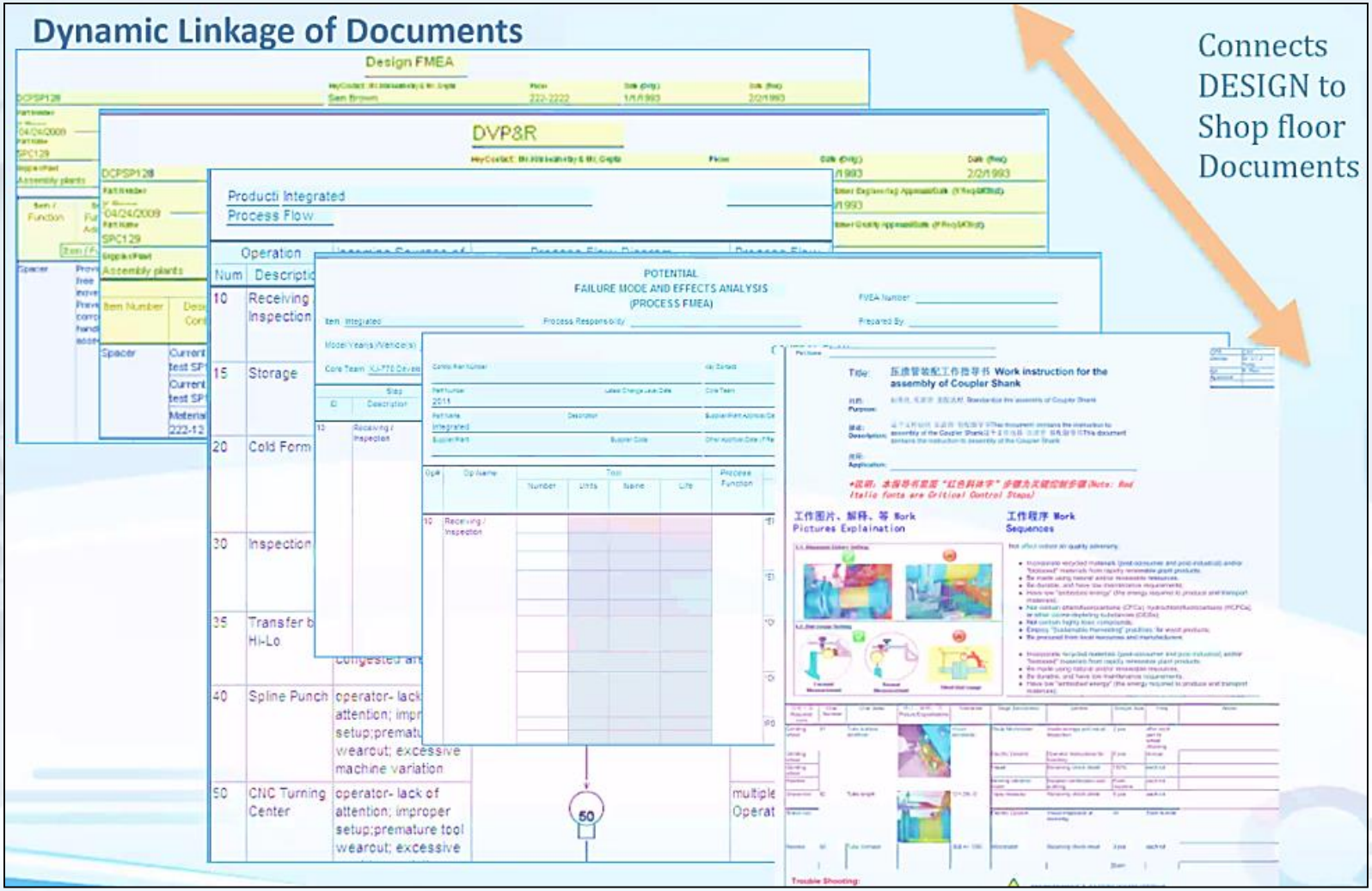
It is a documented thread that provides forward and backward visibility into all activity surrounding each requirement (including design, development, testing, and support).

Requirements traceability helps minimize the risk of negative outcomes and maximize productivity. Its benefits include greater team efficiency, easier regulatory compliance, and higher-quality products.

Requirement traceability

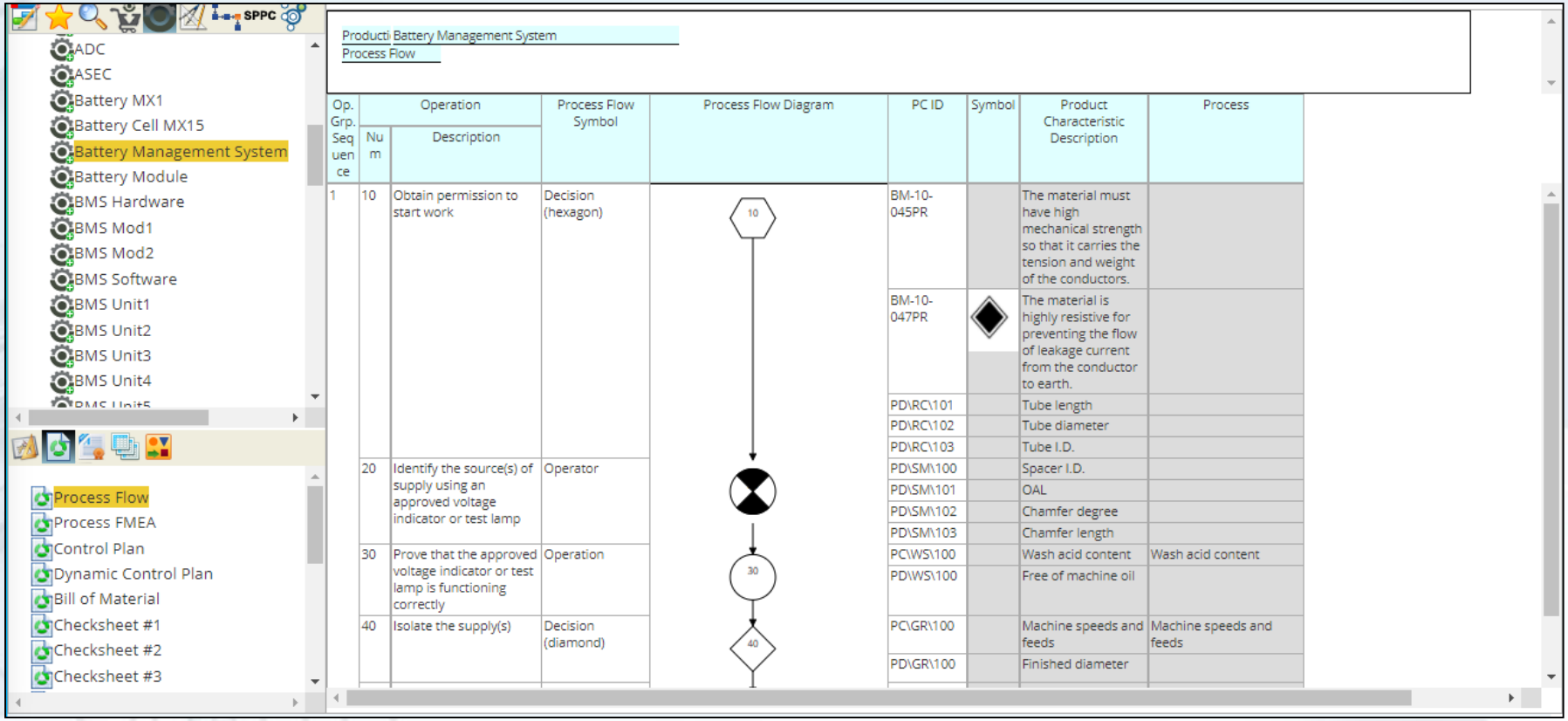


Requirement traceability



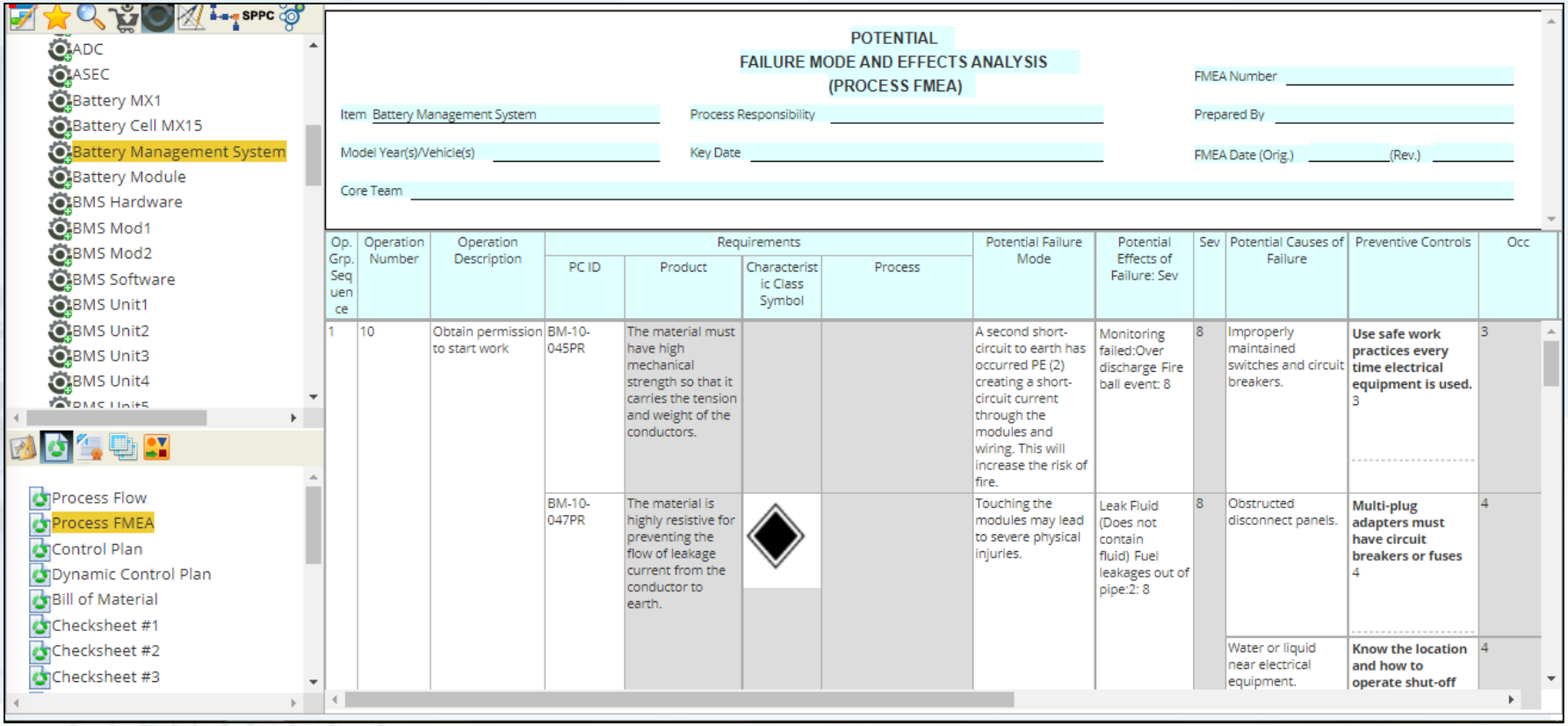
Requirement traceability

Process Flow Document



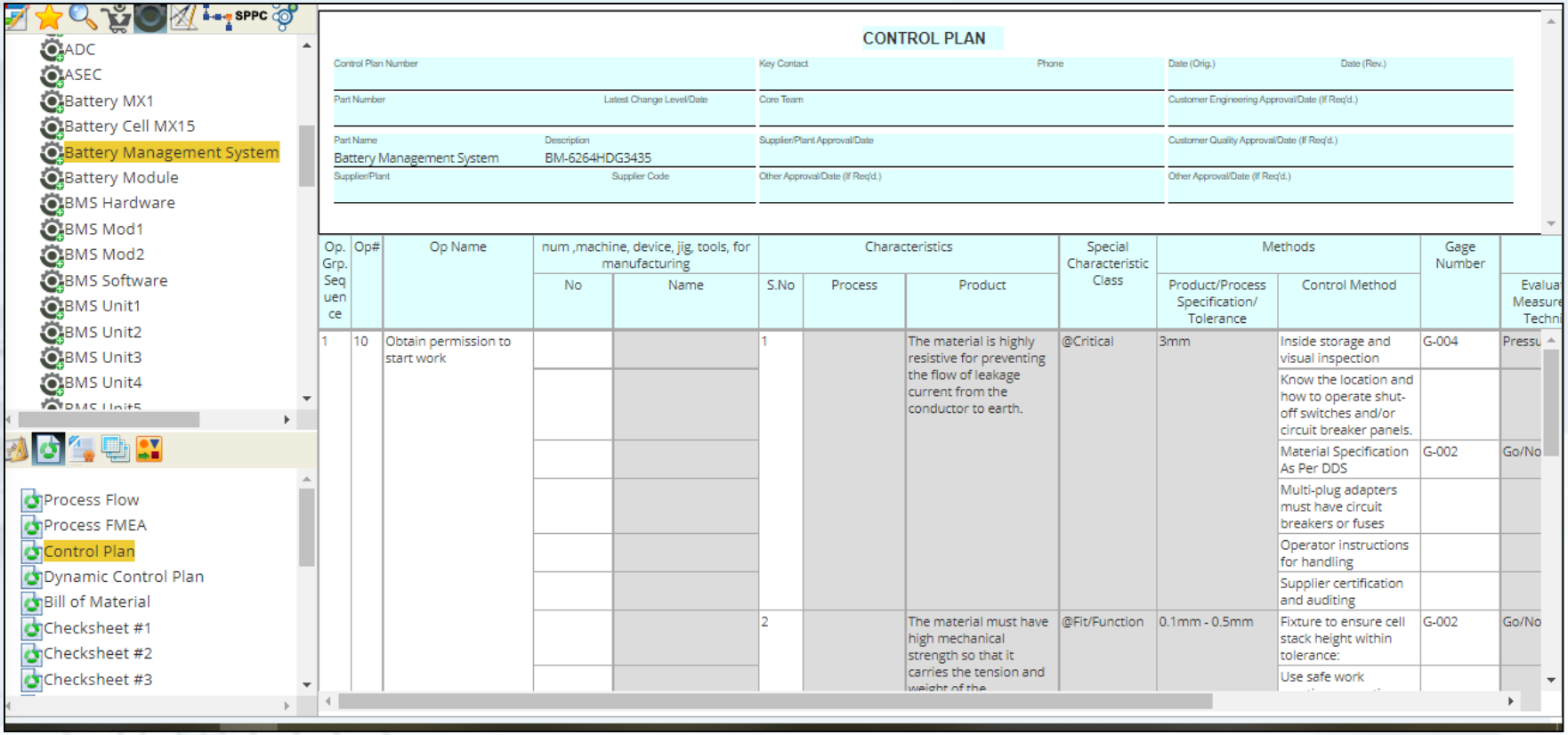
Requirement traceability

Process FMEA Document



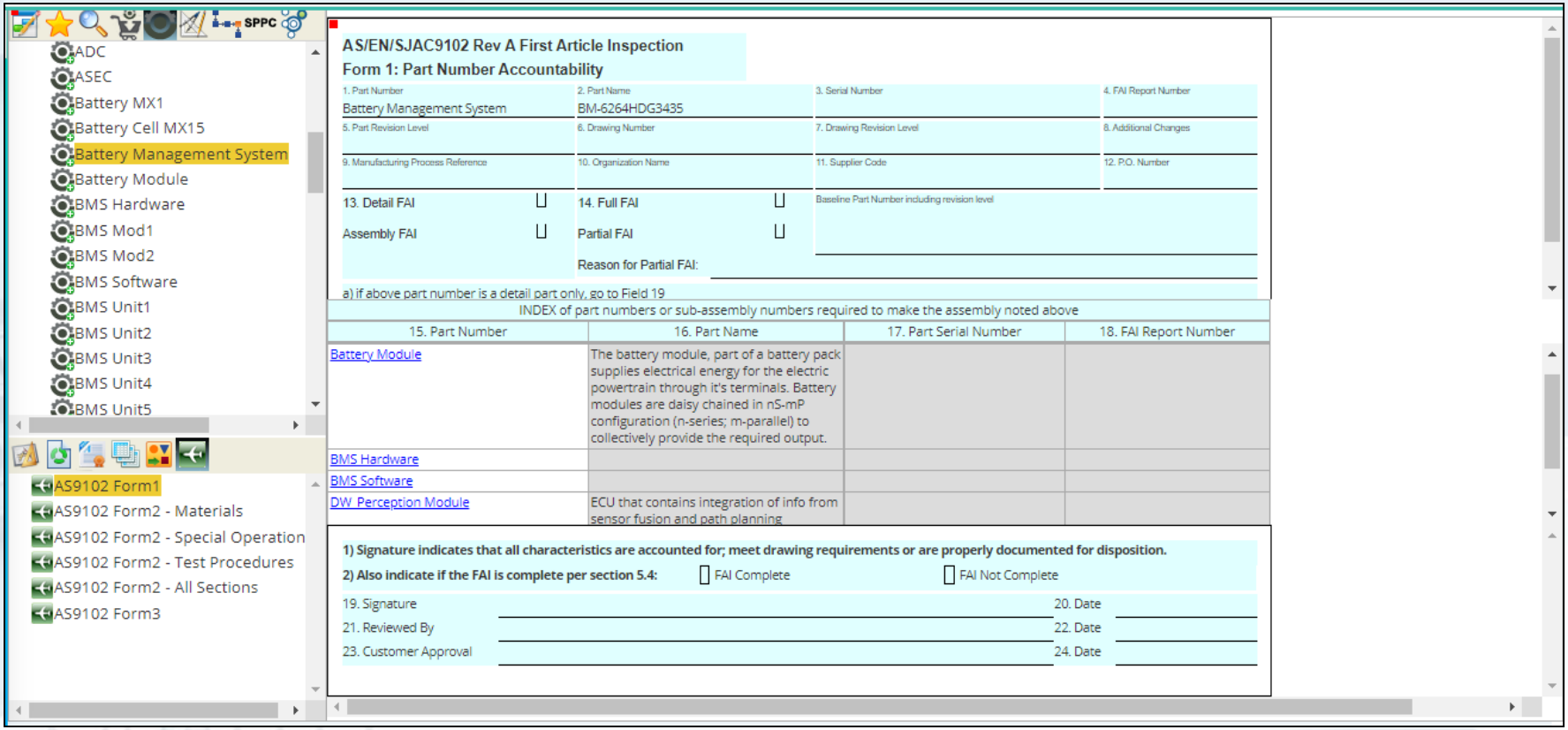
Requirement traceability

Control Plan Document



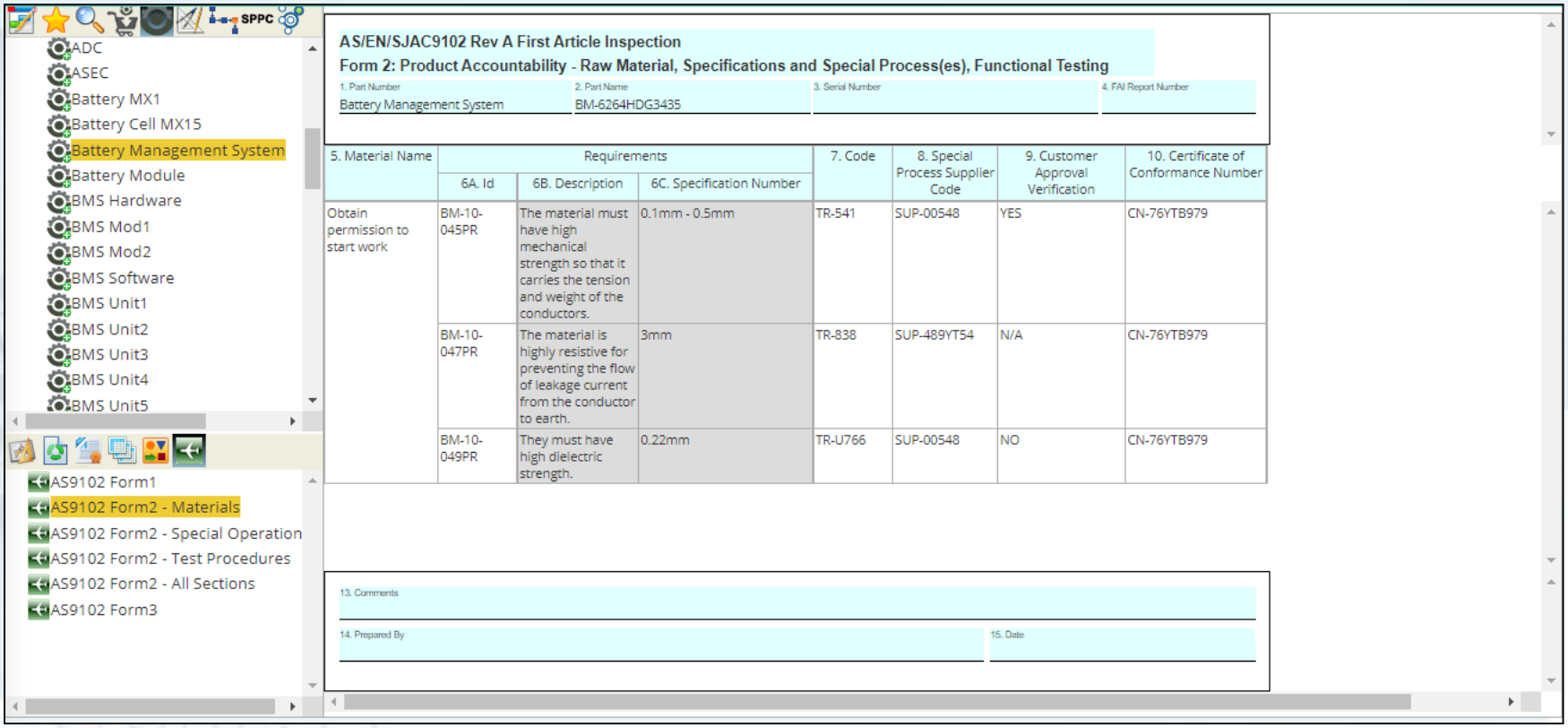
Requirement traceability

FAI- Form 1: Part Number Accountability



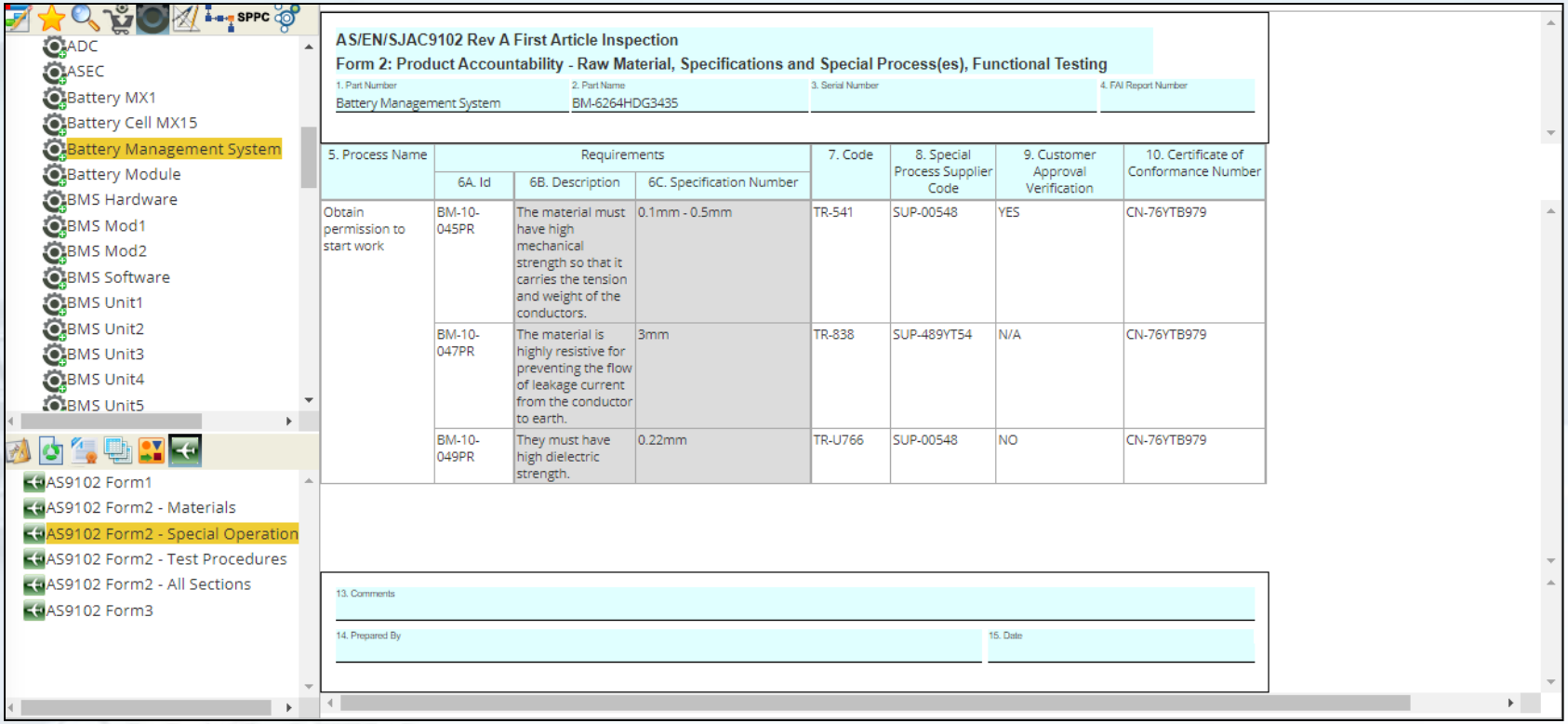
Requirement traceability

FAI - Form 2: Material



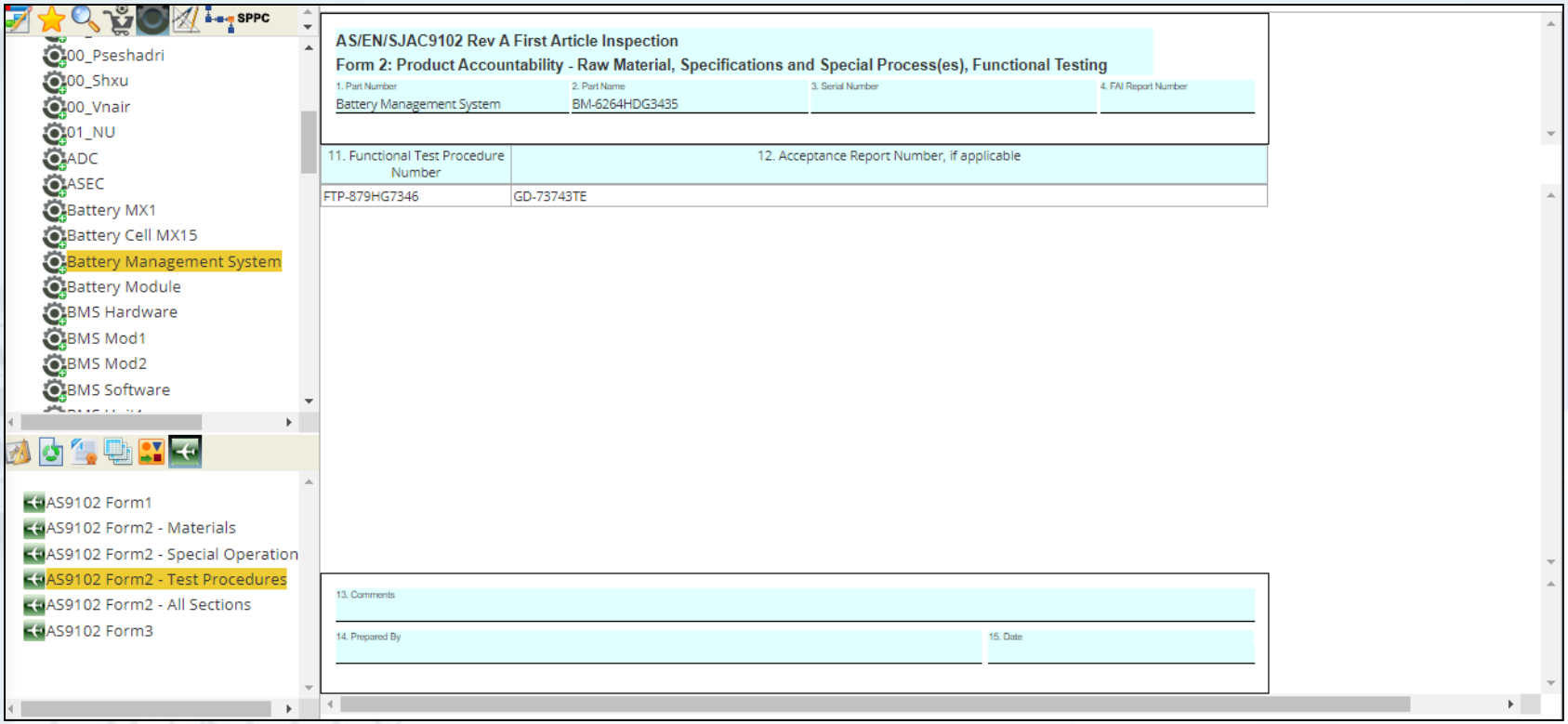
Requirement traceability

FAI - Form 2: Special Operations



Requirement traceability

FAI – Form 2: Test Procedures



Requirement traceability

FAI – Form 2: All Sections

AS/EN/SJAC9102 Rev A First Article Inspection

Form 2:Product Accountability - Raw Material, Specification and Special Process(es), Function Testing

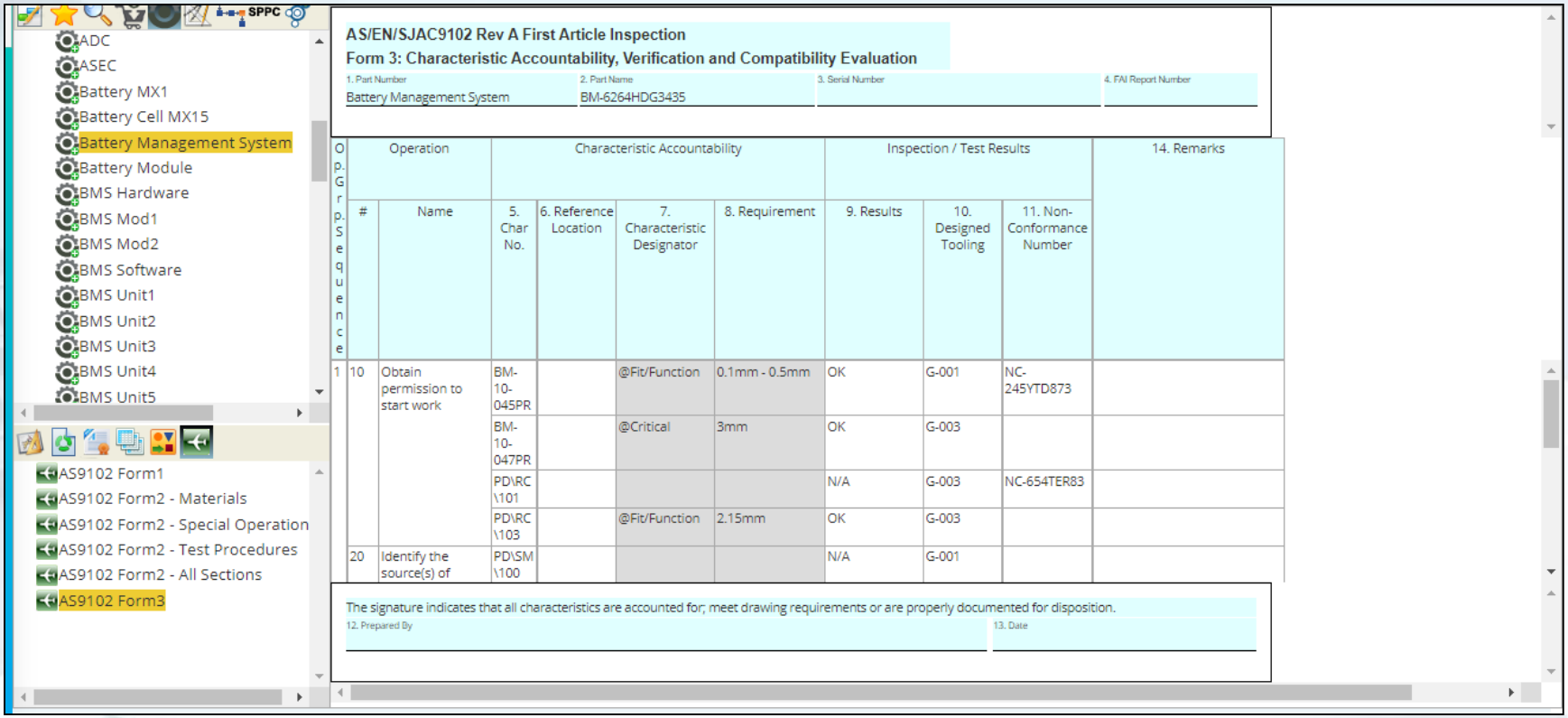
1.Part Number	2.Part Name	3.Serial Number	4.FAI Report Number
Battery Management System	BM-6264HDG3435		

5. Material or Process Name	Requirements			7.Code	8. Special Process Supplier Code	9.Customer Approval Verification	10.Certificate of Conformance Number
	6A. Id	6B. Description	6c. Specification Number				
Obtain permission to start work	BM-10-045PR	The material must have high mechanical strength so that it carries the tension and weight of the conductors.	0.1mm - 0.5mm	TR-541	SUP-00548	YES	CN-76YTB979
	BM-10-049PR	They must have high dielectric strength.	0.22mm		SUP-00548		
	BM-10-047PR	The material is highly resistive for preventing the flow of leakage current from the conductor to earth.	3mm		SUP-489YT54		
Obtain permission to start work	BM-10-045PR	The material must have high mechanical strength so that it carries the tension and weight of the conductors.	0.1mm - 0.5mm	TR-541	SUP-00548	YES	CN-76YTB979
	BM-10-049PR	They must have high dielectric strength.	0.22mm		SUP-00548		
	BM-10-047PR	The material is highly resistive for preventing the flow of leakage current from the conductor to earth.	3mm		SUP-489YT54		

11.Functional Test Procedure Number	12.Acceptance Report Number, if applicable
FTP-879HG7346	GD-73743TE

Requirement traceability

FAI – Form 3: Characteristic Accountability, Verification and Compatibility Evaluation



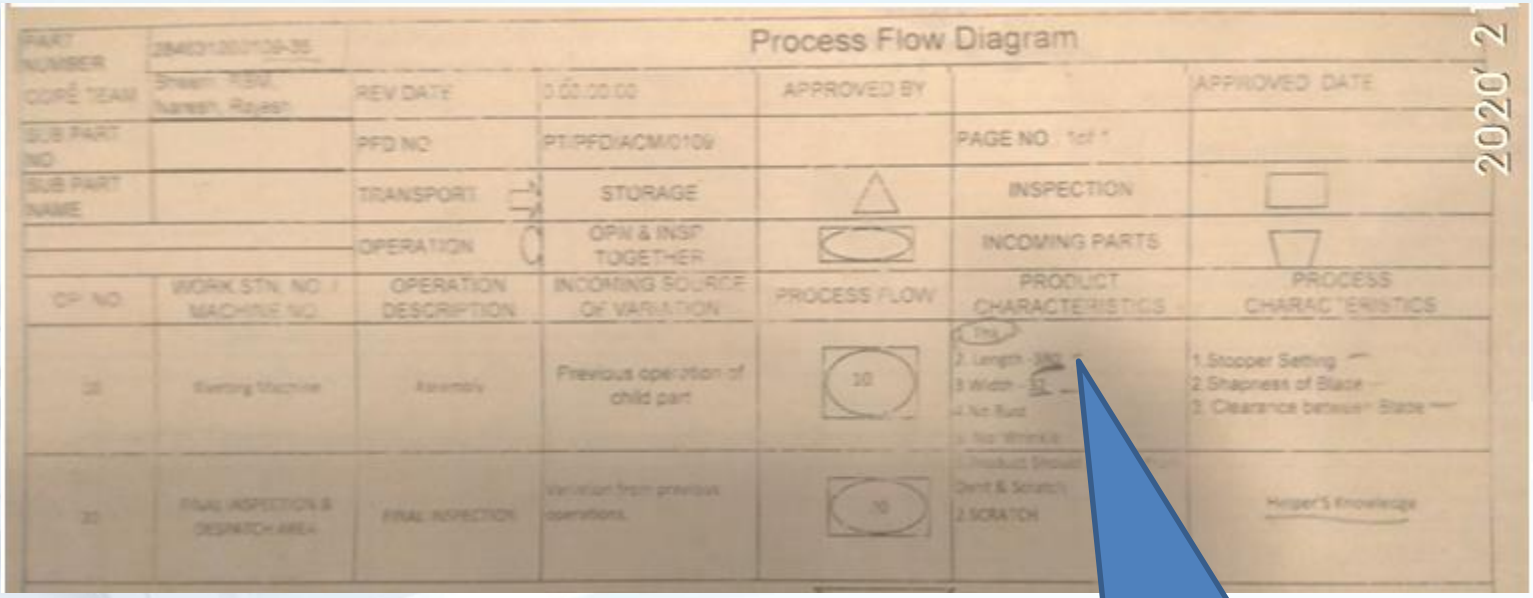
Case Study : Weak Requirement Traceability

Observation during an improvement audit at a supplier works.
The final length in drawing is 741.0 mm +0/ -1 mm.

Note: Data and case study is only for training purpose

Case Study : Weak Requirement Traceability

The final length in drawing it is 741.0 mm +0/ -1 mm



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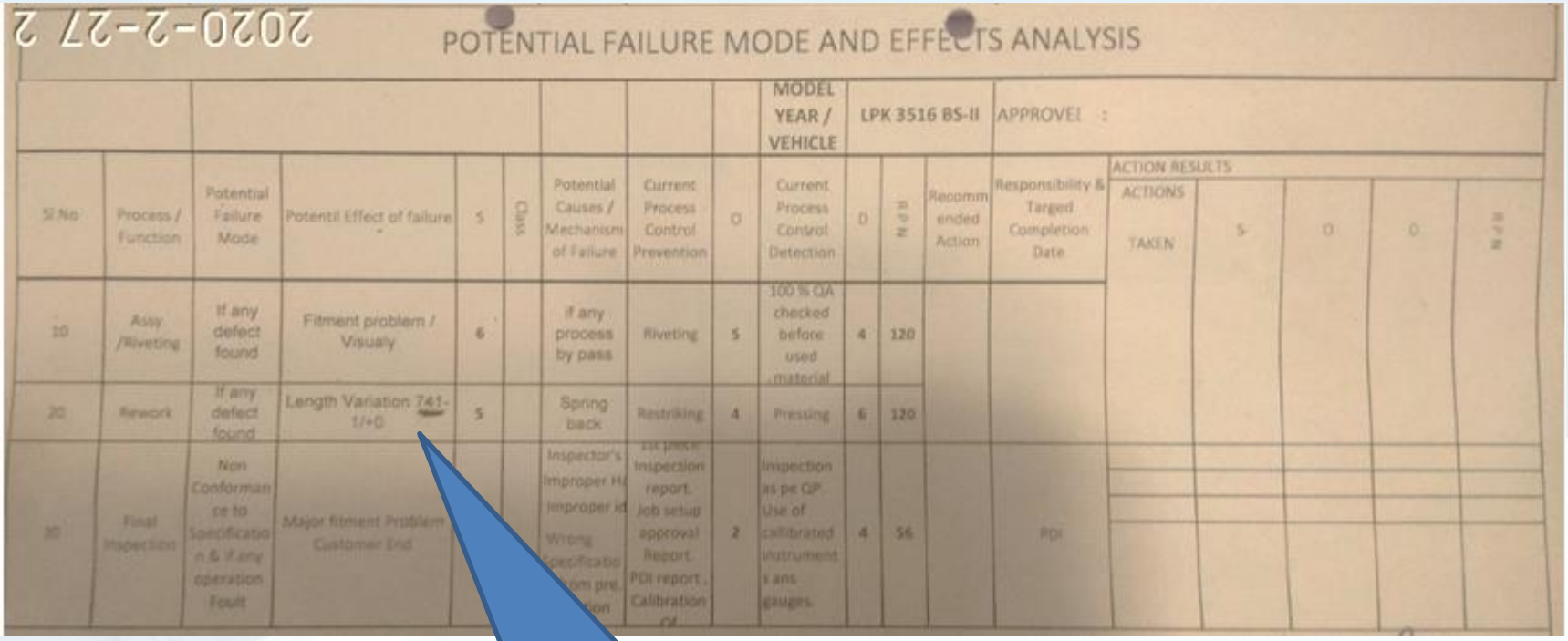
Case Study : Weak Requirement Traceability

The final length in drawing it is 741.0 mm +0/ -1 mm



2020-2-27 2

POTENTIAL FAILURE MODE AND EFFECTS ANALYSIS

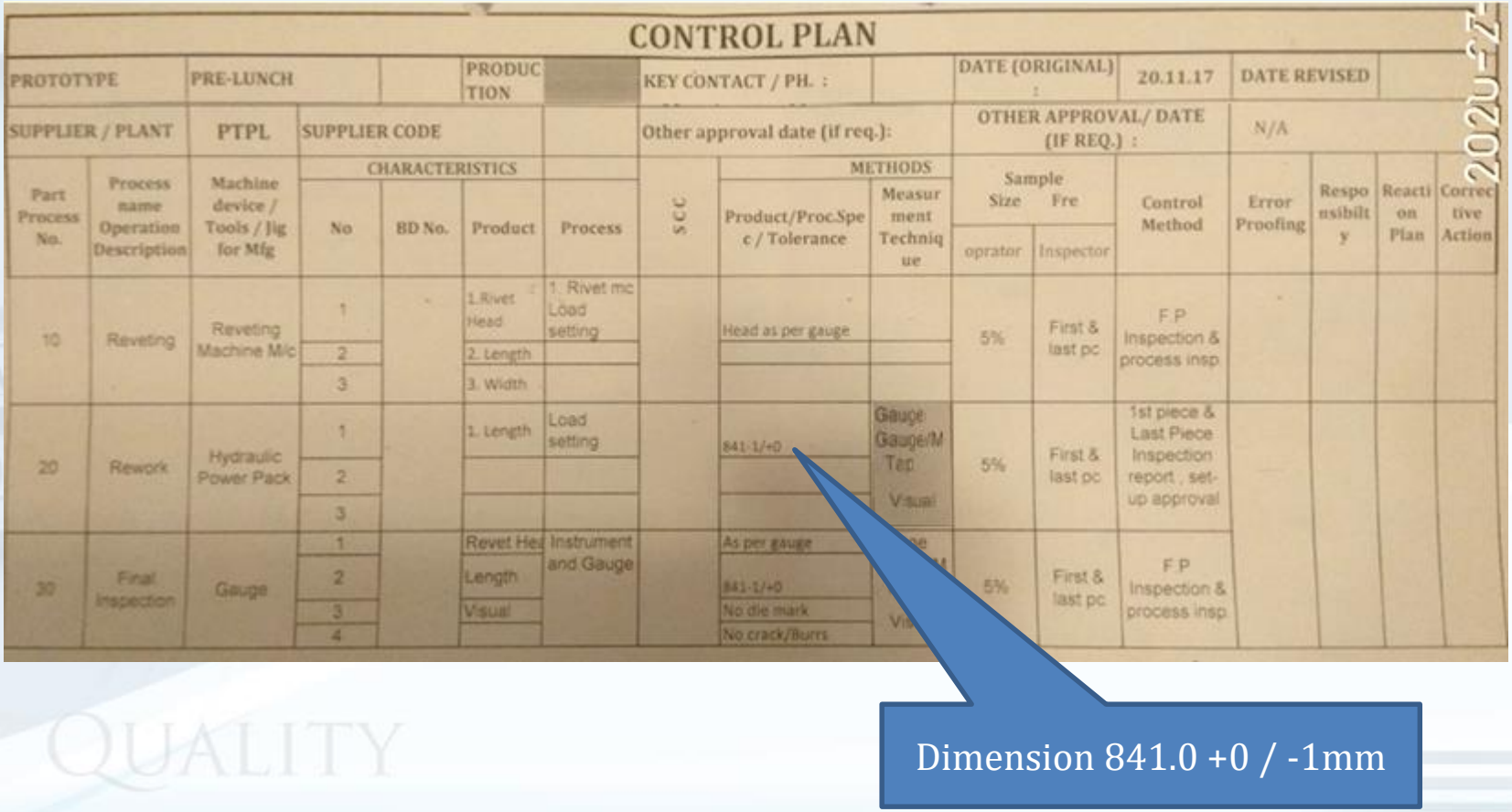
									MODEL YEAR / VEHICLE	LPK 3516 BS-II		APPROVE		ACTION RESULTS				
Sl No	Process / Function	Potential Failure Mode	Potentil Effect of failure	S	Class	Potential Causes / Mechanism of Failure	Current Process Control Prevention	O	Current Process Control Detection	D	RPN	Recommended Action	Responsibility & Target Completion Date	ACTIONS TAKEN	S	O	D	RPN
10	Assy /Riveting	If any defect found	Fitment problem / Visualy	6		If any process by pass	Riveting	5	100 % QA checked before used material	4	120							
20	Rework	If any defect found	Length Variation 741-1/+0	5		Spring back	Restriking	4	Pressing	6	120							
30	Final Inspection	Non Conformance to Specification & If any operation Fault	Major fitment Problem Customer End			Inspector's Improper H... Improper id... Wrong specificatio... mm pre... tion	1st piece inspection report. Job setup approval Report. PDI report , Calibration of	2	Inspection as pe QP Use of calibrated instruments ans gauges.	4	56		PDI					

Dimension 741.0 +0 / -1mm

Note: Data and case study is only for training purpose

Case Study : Weak Requirement Traceability

The final length in drawing it is 741.0 mm +0/ -1 mm



CONTROL PLAN

PROTOTYPE		PRE-LUNCH		PRODUCTION		KEY CONTACT / PH. :		DATE (ORIGINAL) :	20.11.17	DATE REVISED							
SUPPLIER / PLANT		PTPL	SUPPLIER CODE			Other approval date (if req.):		OTHER APPROVAL/ DATE (IF REQ.) :	N/A								
Part Process No.	Process name Operation Description	Machine device / Tools / Jig for Mfg	CHARACTERISTICS No	BD No.	Product	Process	SCC	METHODS Product/Proc.Spec / Tolerance	Measurment Technique	Sample Size	Fre oprator	Fre Inspector	Control Method	Error Proofing	Responsibilty	Reaction Plan	Corrective Action
10	Reveting	Reveting Machine M/c	1		1.Rivet Head	1. Rivet mc Load setting		Head as per gauge		5%	First & last pc		F.P Inspection & process insp				
			2		2. Length												
			3		3. Width												
20	Rework	Hydraulic Power Pack	1		1. Length	Load setting		841-1/+0	Gauge Gauge/M Tap Visual	5%	First & last pc		1st piece & Last Piece Inspection report , set-up approval				
			2														
			3														
30	Final Inspection	Gauge	1		Revet He	Instrument and Gauge		As per gauge		5%	First & last pc		F.P Inspection & process insp				
			2		Length			841-1/+0									
			3		Visual			No die mark									
			4					No crack/Burrs									

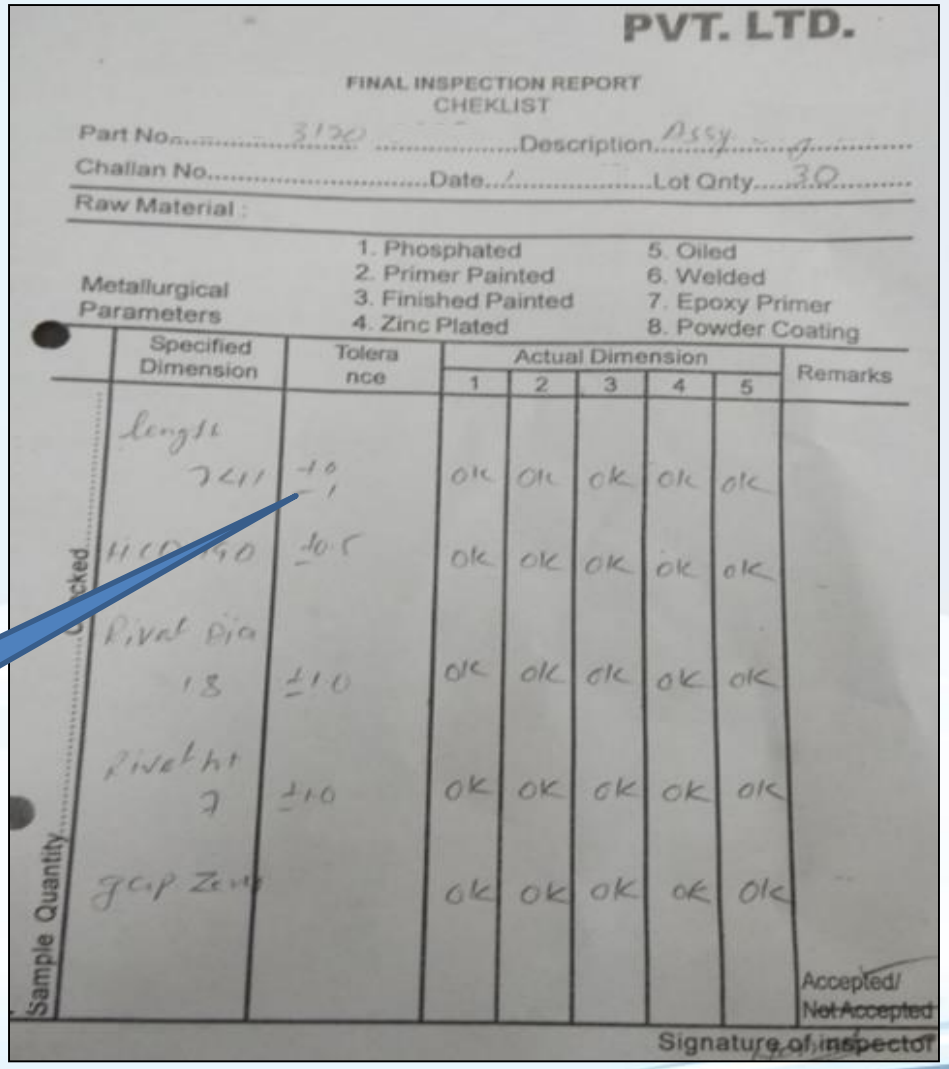
Dimension 841.0 +0 / -1mm

Note: Data and case study is only for training purpose

Case Study : Weak Requirement Traceability

Final inspection

- Just says OK or Not OK
- Standard check list is not available
- Actual measurement is missing
- Instrument used is missing
- Date, Shift, Lot or batch number is missing
- Part marking reference w.r.t the sample taken is seen missing



PVT. LTD.

FINAL INSPECTION REPORT
CHEKLIST

Part No. 3120 Description Assy
Challan No. Date. Lot Qnty. 30
Raw Material :

Metallurgical Parameters
1. Phosphated 5. Oiled
2. Primer Painted 6. Welded
3. Finished Painted 7. Epoxy Primer
4. Zinc Plated 8. Powder Coating

Specified Dimension	Tolerance	Actual Dimension 1	2	3	4	5	Remarks
length 741	+0 -1	ok	ok	ok	ok	ok	
1160 40	±0.5	ok	ok	ok	ok	ok	
Rival Dia 18	±1.0	ok	ok	ok	ok	ok	
Rivet ht 7	±1.0	ok	ok	ok	ok	ok	
gap Zero		ok	ok	ok	ok	ok	

Sample Quantity

Accepted/ Not Accepted

Signature of inspector

Dimension 741.0
+0 / -1mm

Note: Data and case study is only for training purpose

Case Study : Weak Requirement Traceability

Gauge Validation and Verification

There are 2 final gauges available at supplier and one has to be given to customer, when we check the parts in both the fixture some part which gets rejected in the 1st fixture is passing in the 2nd one and visa versa.
Parts which are failing in CMM are passing the final checking gauge and visa versa.

There are some SC dimensions which are not meeting the drawing specification and action plan from supplier is that they check the fitment of part on fixture which is mentioned in drawing, but some part are failing in the fixture also.

Note: Data and case study is only for training purpose

Case Study : Weak Requirement Traceability

Operator and Inspector Skill

Instruction for inspector on how to hold the part and method of inspecting the parts is not available due to which inspection was taking more time and Inspector was regularly looking for instruction from the in-charge.

Drawing, Control Plan and Inspection report is not inline to each other
Requirement in final length in drawing it is 741.0 +0/ - 1

- PFD it is 380 mm
- PFMEA it is 741 .0 +0/ - 1
- CP it is 841.0 +0/ - 1
- Final inspection says only Ok / Not Ok
- There are multiple instrument mentioned on CP to check the dimension
- Instrument used to check is not mentioned on Inspection report
- Gauge used for measurement is not validated and calibrated
- Operators and inspectors are not skilled on the requirement

WHAT WILL BE THE IMPLICATION WHEN IN ANY ISSUE

OMNEX

Note: Data and case study is only for training purpose

Exercise : Checking Linkages

Based on the collected VOC, SOP, Document and Records from all departments involved in New Product Development, Check for the flow and linkage of all the documents.
Are the process been followed at shop floor?

Process connected

- Product design
- Process design (ME)
- In coming and its quality along with Sub Supplier PPAP
- Logistics, Store and Packing
- New Product Development
- Quality and validation
- Production
- Maintenance and line set up team etc.

Based on the findings, fine tune your question created during brain storming

DIGITALIZATION OF QUALITY : Powered by EwQIMS

Chapter 6

Traceability – Marking and Identification

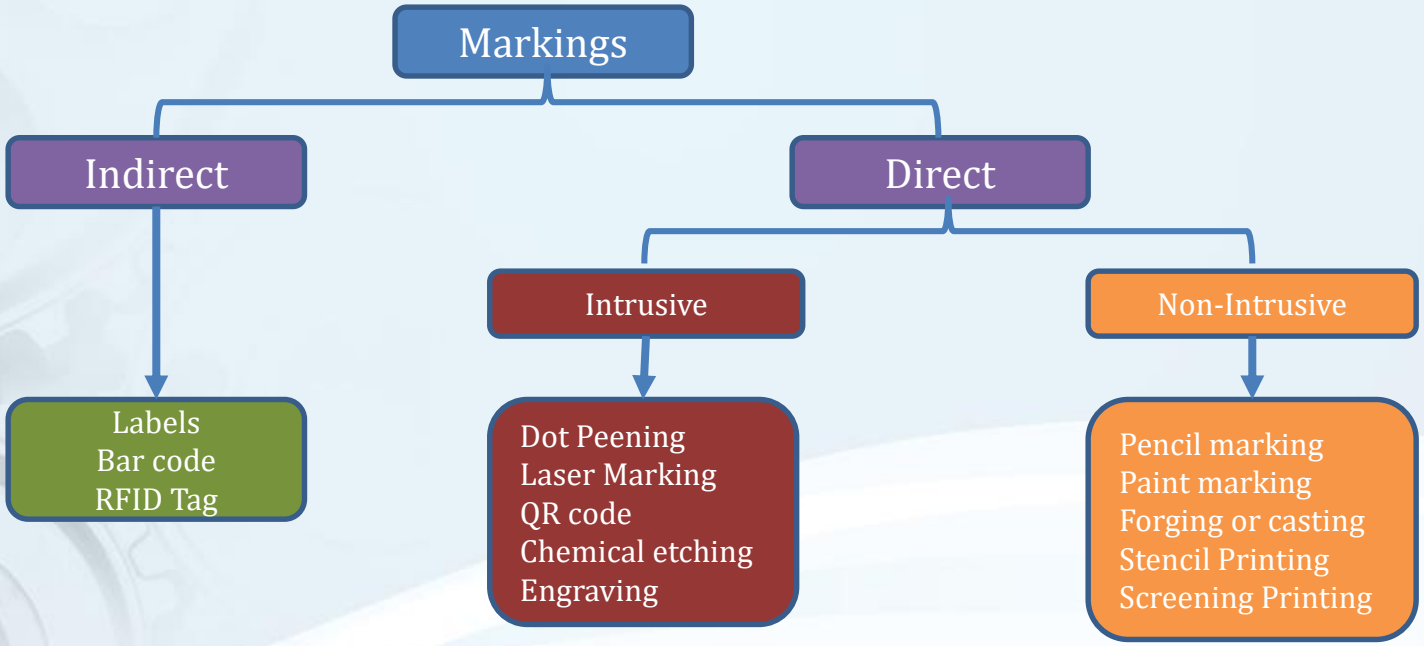
Traceability - Marking and Identification

Part Marking

Part marking is a reliable way to provide lifetime traceability of parts that are exposed to harsh environments, tracking and improving product quality and production processes, improve supplier compliance to quality standards, and better manage product recalls. In the automotive sector, part marking has helped manufacturers improve production and quality, while also providing a way to better manage recalls. With more industries focusing on end-to-end tracking and anti-counterfeiting efforts, part marking is proving just as valuable as other process.

Traceability - Marking and Identification

The heart of any traceability system is the identification of that particular physical or digital object. For any tracking or tracing we need markings



Intrusive Marking Methods

Intrusive marking methods alter a parts surface (abrade, cut, burn, vaporize, etc.) and are considered to be controlled defects. If not done properly, they can degrade material properties beyond a point of acceptability. Consequently, some intrusive markings, especially laser, are generally not used in safety critical applications without appropriate metallurgical testing

Non-intrusive Marking Methods

Marking methods that are non-intrusive to the material are produced as part of the manufacturing process or by adding a layer of material to the surface using methods that have no adverse effect on material properties

Non-Intrusive - Part Marking

Pencil / Paint / Chalk marking

This is traditional method still been used

Example usage

Injection moulded part, rubber compound and components etc.

Stencil Printing

Which create the pattern or image by only allowing the pigment to reach some parts of the surface

Example usage

Metal tubes, extrusion pipes etc.

Non-Intrusive - Part Marking

Forging / Casting / Moulding

In this method the marking is inbuilt inside the mould it self

Example usage

Injection moulded part, casted part and rubber components etc.

Screen printing

Screen printing is a printing technique where a mesh is used to transfer ink onto a substrate, except in areas made impermeable to the ink by a blocking other areas of mesh

Example usage

Glass markings

Intrusive - Part Marking

Dot peening

Dot Peen marking is a marking application that allows manufacturers to make deep, permanent impressions in a variety of materials for identification and traceability. Also known as "pin marking" or "pin stamping.

Laser marking

laser marking is a permanent process that uses a beam of concentrated light to create a lasting mark on a surface.
Typically performed with pulsed, continuous wave, UV laser machine.
Laser marking encompasses a wide variety of applications

Intrusive - Part Marking

Engraving

Engraving is one of the oldest and most important techniques in making. It also make deep, permanent impressions in a variety of materials for identification and traceability.

Chemical etching

Chemical etching is traditionally the process of using strong acid or mordant to cut into the unprotected parts of a metal surface to create a markings in the metal.
Different types of chemicals may be used on different types of material as a method of making.

Intrusive - Part Marking

QR Code

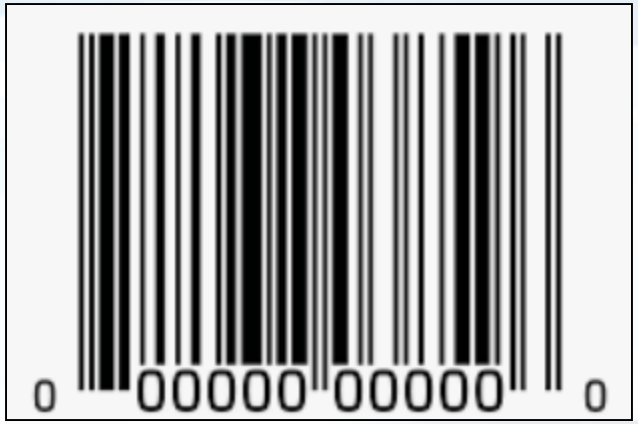
The Quick Response system is became popular in the automotive industry due to its fast readability and greater storage capacity compared to standard UPC barcodes. Applications include product tracking, item identification, time tracking, document management, and general marketing.

Indirect - Part Marking

Labels

Bar Code

A **barcode** or **bar code** is a method of representing data in a machine-readable form, barcodes represented data by varying the widths and spacing's of parallel lines. These barcodes, now commonly referred to as linear or one-dimensional (1D), can be scanned by special optical scanners, called barcode readers.



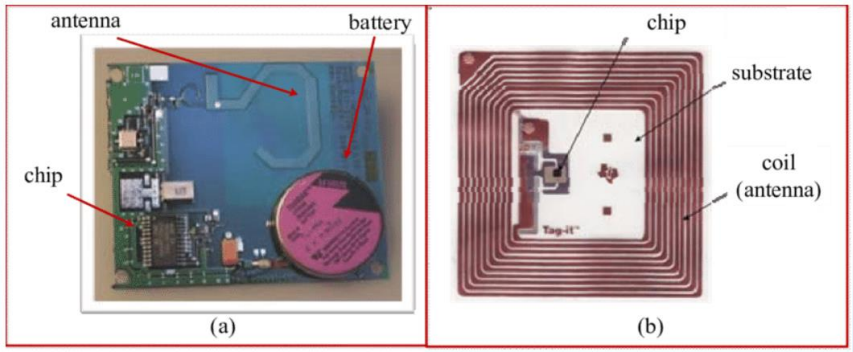
Indirect - Part Marking

RFID (Radio Frequency Identification)

RFID is a technology that enables the electronic and wireless labeling and identification of objects, humans and animals.

HISTORY

Invented in 1948 by Harry Stockman. But initial application was during World War II-when the United Kingdom used RFID devices to distinguish returning English airplanes from inbound German ones. RADAR was only able to signal the presence of a plane, not the kind of plane it was..
It came into commercial use only in 1990s.

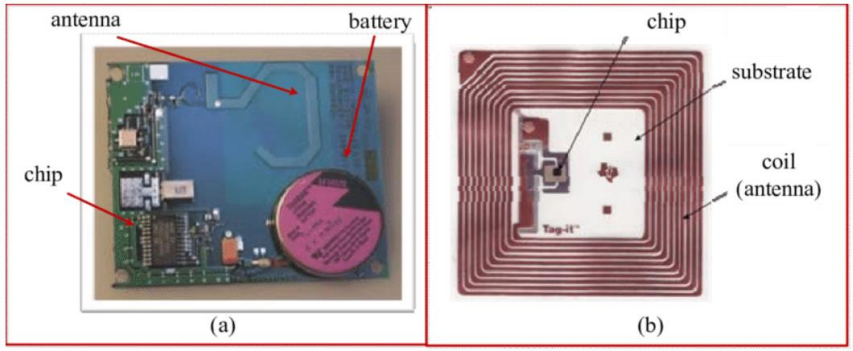


Indirect - Part Marking

RFID (Radio Frequency Identification)

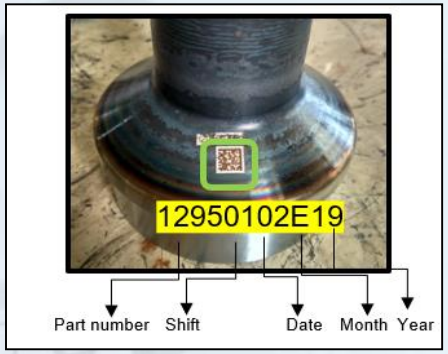
Active tags – Powered by an internal battery – Finite lifetime (because of battery) – Greater range – Better noise immunity – Higher data transmission rates

Passive tags – Operate without battery – Derive power from the field generate by the reader – Less expensive – Unlimited life – Subject to noise – Require more powerful readers

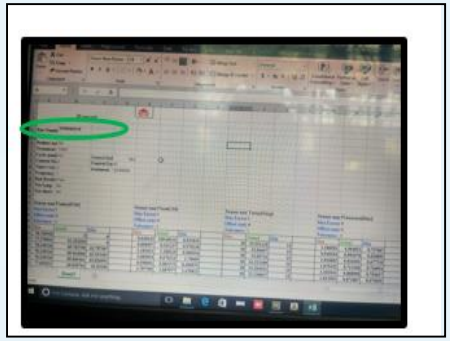


Traceability Use - Part Marking – Case Study

Capturing data and Real time Monitoring – during a Hardening process at Supplier

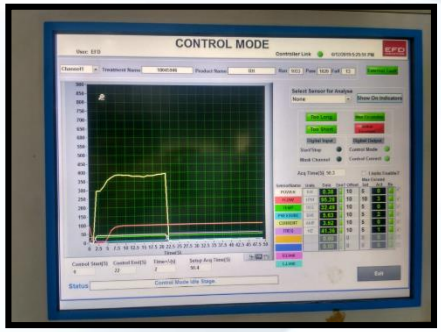


Supplier



Real Time Monitoring

Inhouse - Dashboard



OEM

Benefits:-

1. End to End traceability.
2. Online Tracking of machine and process performance.
3. Utilisation of resources efficiently.
4. Minimisation of Human Efforts.
5. Enhanced Data Collection and reduce paper work and errors.
6. Identification of hidden losses for continuous improvement.

Traceability – Part Marking

Markings : an identification number helps in an activity of collecting and managing information like -

- What has been done in manufacturing processes from acceptance of raw materials and parts to shipment of products
- Information such as work details, inspection results, and test result are linked to this identification number
- Contributes in improvement of production/work efficiency and quality.
- Increased stock visibility and availability.
- Reduces theft in the supply chain.
- Facilities product selection during production, Line of sight is not required
- Easier Identification on recalls , repairs and rework

Exercise: Linking Requirements to Markings

To meet growing customer demands, the XYZ Group needed a solution that would uniquely identify each of its individual bearings to protect against warranty issue, counterfeiting parts and efficiently provide maintenance services for installed bearings around the world.

XYZ Group decided to use a serialized Item Number for protecting the product

XYZ Group now needs to send RFQ to the service provider for embedding the system for which now XYZ Group need to map what are the data they need to collect and what will be the benefits which it will get from the marking system

Exercise: Linking Requirements to Markings

Data to be collected

Information about Incoming part status	Information about manufacturing process and maintenance	Information about shipment
• Quantity Arrived • Date and Time of arrival • Lot and serial number • Supplier details and location • Inspection status • Storage area and qty • Any rejection / rework and segregation details date and time • etc	• Manufacture Quantity from store to final product • Date and time for each stage of production • 4M tracing • Lot / batch number w.r.t each part • SPC value for CC / SC parameters • EOL testing data • Final inspection history • Employee details • etc	• Packing condition and quantity • Shipment quantity • Shipment date and time • Customer and location history • Shipment delivery date and time • Transported name and vehicle details • etc

Exercise: Linking Requirements to Markings

The benefits of part marking for applications include:

- The ability to track items in high-temperatures and other harsh environments
- Providing more accurate and reliable part identification
- Preventing errors in just-in-sequence production
- Eliminating manual data collection approaches for inspections, inventories, and maintenance reports
- Ensuring the lifetime traceability of each part
- Enabling track-and-trace initiatives that provide chain-of-custody tracking and protect against product diversion
- Reducing or eliminating counterfeit parts by providing end-to-end traceability using a method that is difficult to duplicate, and doesn't rely on package marking
- Enabling more comprehensive inventory management

Chapter 7

Traceability – 4M Requirements

Traceability – 4M Method

Continuous processes / manufacturing are usually afflicted with a larger variation in process and product. In such type of processes, the products are progressively operated with minimal interruptions refined through a series of operations [1, 2].

Improvement initiatives are been regularly updated or changed including new process technology and automation to control in processes / manufacturing In processes / manufacturing the variance in key product and process parameters has often remained unchanged, though large investments in automated process control systems has been made to reduce variance

However, to reduce the affect we need systems and tools for studying the impact of changes in the processes as it is vital for reducing the variation.

Traceability – 4M Method

Today's production environment has substantially increased the number of issues that need to be managed in real time prompting the evolution traceability for tracking and tracing covering nearly every issue of shop floor management. These issues include:

- **Method** : like equipment, fixtures, tools etc. are identified, used in production and maintained
- **Man** : production monitoring and control of man orientated process and measurement control including rework and repair management visibility is available at real time bases
- **Materials** : in WIP to assure correct production batch, FIFO etc. are followed
- **Measurement** : to monitor and improve key performance and to reduce causes

Traceability – 4M Method

There are frequent processes found to have too many steps which needs too many sign off and integral activities that does not create values and for which a customer wouldn't pay.

Machine, tools, equipment's, procedure etc. with their underline support system are -

- Frequently mismanaged to achieve output
- Misaligned due to technical error
- Deviated due to inability to meet the desired intended output

Traceability – 4M Method

Process traceability enables manufacturers to provide traceability for specific production events including part and process changes introduced on the shop floor.

This includes any defects captured and the associated repair processes along with operator activity.

Method traceability together with man, material, and measurement traceability allows manufacturers to achieve full traceability thereby significantly reducing the scope of potential recalls while meeting nearly every possible traceability requirement.

Traceability – 4M Method

As the method is one of the key factor for any method traceability, we need to have -

- Supports free assembly by distinguishing between key and non key components.
- Assuring that the correct components are allocated to the correct process and by providing post-production traceability as demanded
- Manages and tracks material locations in the event of an alert, including material purging when appropriate
- Tracking changes on the shop floor, including introduction of BOM revisions, new parts

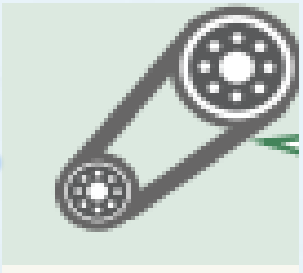
Traceability – 4M Method

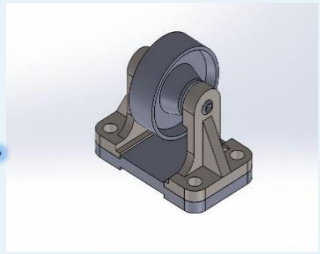
Continued…

- Events including capture of defects at the board level with repair routes undertaken such as rework or replaced components and operator activity
- Capturing machine events, (including machine/feeders used during mounting process), errors during mounting,
- Inspection and Verification that process is performed as planned and tracking components mounted to the reference assembly and tested

Traceability – 4M Method

Work Piece / Operator | Tools and Fixture | Machining / Assembly | Product Inspection





Serial No :
2021251821MAOM
Part 1 : 243
Part2 : 890
Part3 : 613

Part	Lot Code
243	SA1 - 5566
890	SA2 – 4444
613	SB1 - 3399

Serial No	2021251821MAOM
Operator	2021MAXOP
Inspector	2021RCINSP
Supervisor	2021MINSPV
Line no	01

Serial No	2021251821MAOM
Operator	2021MAXOP
Inspector	2021RCINSP
Supervisor	2021MINSPV
Line no	01
Tool	103725
Fixture	1821MA
Test Rig	MATR71

Serial No	2021251821MAOM
Operator	2021MAXOP
Inspector	2021RCINSP
Supervisor	2021MINSPV
Line no	01
Tool	103725
Fixture	1821MA
Test Rig	MATR71
Date/Time MFG	4/1/2021/ 12:24:56
Pressure	2 KPa
Tenp	27° C

Serial No	2021251821MAOM
Operator	2021MAXOP
Inspector	2021RCINSP
Supervisor	2021MINSPV
Line no	01
Tool	103725
Fixture	1821MA
Test Rig	MATR71
Date/Time MFG	4/1/2021/ 12:24:56
Pressure	2 KPa
Tenp	27° C
Date/Time INP	4/1/2021 12:27:12
Inspection result	125.5 mm
Pressure result	0.5 N/m
EOL	No wear and tear of belt and found ok
Status	OK

Note: Data and case study is only for training purpose

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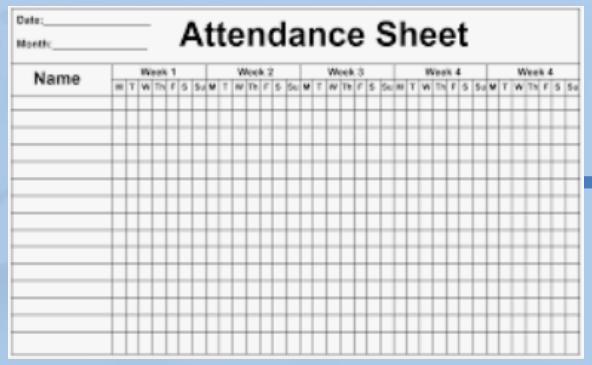
Traceability – 4M – Man

Why **Man** should be the first choice for your shop-floor execution system needs?

- The only manufacturing execution system designed with flexibility in mind
- Integrates with your ERP, MRP, and EDI systems
- Allows your organization to strategically implement and rapidly increase capabilities
- Can be fully integrated into your production environment in minimum days
- Most flexible solution for your production needs

But he also is the most volatile resource in a manufacturing industry

Evolution of Attendance



Register

Card punching

Card Scanning

Biometrics

Face
Reorganisation

Note: Data and case study is only for training purpose

Traceability – 4M – Man

As the man power is the most dependable service and support you expect the most in any manufacturing process, we need to have traceability to trace and track the activity performed.

- An automated / biometric data collection, lot traceability, and product & process sequencing followed.
- Integration to Manufacturing Information system to bridge the gap between the manufacturing shop floor and its ERP/IOT solution.
- The production information and product acceptance necessary to enable your management team to meet the customer demands.
- To adapt to customer driven changes in the manufacturing place.
- Understands training needs and skill mapping that provides successful opportunities to improve their internal manufacturing processes.

Traceability – 4M – Material

Ability to identify a materials used in a part assembly or in a product and throughout the life of the structure, When it come to material traceability is classify it self in to two levels -

- **Lot traceability**

Means that the materials used in a part can be traced to the set of MTR

- **Piece-mark traceability**

Means that the heat number can be correlated for each piece mark, of which there can be many individual pieces

Traceability – 4M – Material

Lot identification is most common type of traceability while Piece-mark traceability is often specified as main members in bridges gaps during traceability

traceability of material in manufacturing provides quality assurance, protect customer and end user from delivering defective products

By tracking each piece material, quality problems or product failures can be narrowed to a specific batch or production process. This will help isolate and reduce further issues with an individual heat (lot) or process, while improving performance evaluation and quality control measures.

Traceability – 4M – Material

Key benefits of Material traceability –

- Minimizes scope and size of product recalls
- Improves material management process
- Accurately tracks manufacturing events by capturing all assembly and inspection points
- Improves flexibility in issuing parts to the shop with the ability to track locations against specific work orders
- Automatically associates specific suppliers > lots > date codes to serial number thereby avoiding all guesswork
- Eliminates mounting errors associated with wrong part placements by verifying kitting and machine setup
- Gives instant visibility to material levels in WIP, allowing improved inventory planning
- Wins more business by complying with core traceability requirements

Traceability – 4M – Measurement

Measurement Traceability is important for providing assurance and accuracy to both customer and in-house manufacturer team for a given process.

Establishing a traceability in measurement that is accurately traceable to a higher standard gives credibility for manufacturers for their results to their customers.

One common misconception with measurement traceability is that the result of the measurement or the value of a standard is actually traceable which is not the only understanding it also provides measuring equipment is traceable and accuracy.

Measurement traceability ensures that a manufactured part dimensions, material or testing and even instrument calibration is accurate and will meet the desired specifications for the application.

Traceability – 4M – Measurement

Result records are documents that give an account of the results at manufacturing, testing and inspection.

Examples:

- Alterations in the manufacturing / measurement process.
- Results of tests and inspections
- Marking between parts and/or lots.
- Reports and investigations on nonconformities
- Certificate of parts / lot w.r.t SC and CC characteristics

Traceability – 4M – Measurement

Key benefits of Measurement traceability -

- Assure that correct components are allocated to the next processes or customer
- Improves & enables contaminated and noncompliant materials to be located and purged
- Provides comprehensive part inspection history including test results, repair and rework
- Improves product and process defects tracking including which repair activities were undertaken, such as replaced parts and operator activity.

Traceability – 4M – Measurement

Continued…..

- Normally trace possible root causes – particularly if the cause is a component failure from a specific vendor or production lot
- Tracks operator certification and skill confirming that only certified operators with the appropriate skill and training performed the necessary measurement
- Ensures calibrated equipment & instrument are used in production and track the best before date for calibration of equipment and instrument used for manufacturing and measurement.

Traceability – 4M – Documents

Bin card

Bin card is the record maintained under the inventory system by the stores department and shows the quantities of materials received, issued and balance in hand after each receipt and issue. It is also known as stock card or bin tag.

It is the statement of records only quantity of materials not the value. It is updated when receipts and issues are made in the store department.

Bin Card is maintained for each item in the stock, in this way it facilitates individual record keeping. It also provides information about the minimum level or maximum level of stock. Bin Card is flexible to use as its format is not standard or rigidly specified. Control over stock can be more effective due to continuous updating. It reduces counting errors.

Traceability – 4M – Documents

Bin Card

Material Code:
Material Description:
Location:
Unit of Measurement:

Maximum Level:
Minimum Level:
Reorder Level:

Date	Doc No.	Received from/Issued to	Receipt	Issue	Balance	Verification with SL Date & Verified by	

Real Time Data

Date	Raw Material Name	Particulars	Bin Card #	Quantity
1st Jan 2017	Air Mesh	Receipts		5,000
4th Jan 2017	C4 Cartons	Receipts		10,000
7th Jan 2017	C2 Cartons	Receipts		12,000
15th Jan 2017	C4 Cartons	Issues		4,000
20th Jan 2017	Air Mesh	Issues		1,000
23rd Jan 2017	C2 Cartons	Issues		8,000
27th Jan 2017	Air Mesh	Issues		2,100

Traceability – 4M – Documents

Route Card

Production route card is used for planning the material flow for the production with step by step process and sequence required for the product, this planning sheet is used in all the manufacturing industry that basic requirement for the process sequence and interaction between all the processes and product requirements. Production route card is information sheet for the order wise / customer wise product progress and route tracker and to monitor.

Process route card must have the all information that required to manufacturer the product as per customer requirement and also to consider the quality requirements for the product as per customer expectation.

Traceability – 4M – Documents

Some basic following fields are used for the production route card:

- Customer Name
- Product ID and Product Name and quantity to be produced
- Generate date – this production route card generated date
- Process sequences & production -
  - Process name
  - Start and end date
  - Production unit that is quantity
  - Reason form reject if any
  - Accepted unit
  - Remarks

Traceability – 4M – Documents

PRODUCTION ROUTE CARD

Customer Name

Product ID & Product Name

Quantity (Unit)

Generate Date

Customer Specific Requirement	Special Process / Characteristic

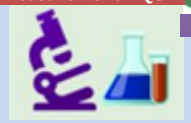
Process	Start Date	End Date	Production Unit	Rejected Unit	Reason For Rejection	Accepted Unit	Remarks

Traceability – 4M – Summary

Method : RM receipt

Supplier Lot Number
Date and Time
GRN
Internal numbering

Measurement : IQC



Man : IQC

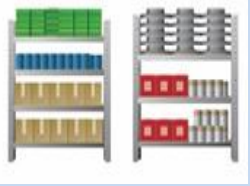
Employee number
Skill level
Authorization
Digital approval

Sampling and testing
Certification
Calibration
Sorting

Material and Method : Movement

Dock control
Batch tagging
Lot identification
Material identification

Method : Storage



Material Content
Vision control
Identification
FIFO / Shelf life

Method : Kitting

Identification of
Route History
Batch / Lot number
Station number

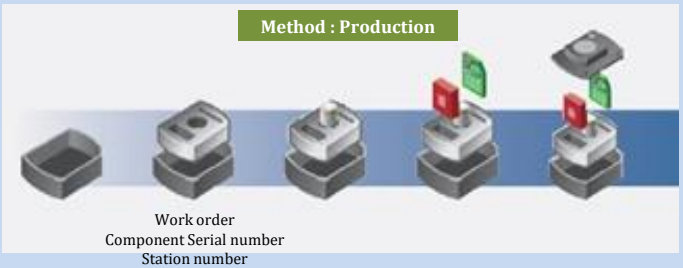
Man : Kitting

Employee number
Skill level
Authorization

Man : Production

Employee number
Skill level
Authorization

Method : Production



Work order
Component Serial number
Station number
Tools / Fixture number
Date and shift
Qty Ok vs. Not Ok
Rework / Repair records
Equipment certification
OEE / Time Management

Measurement : Final QC

Work order
Component Serial number
Station number
Sampling and testing
Date and shift
Measurement
Testing Equipment certification

Man : Final Insp

Employee number
Skill level
Authorization
Digital approval

Method : Packing

Work order
Qty and batch number
Date and shift
FIFO / Shelf life
Packing condition and reports

Method : Shipping

Vehicle number
Tracking system
Loading condition and Quantity

Data Reporting and traceability (ERP or other IT system)

Purchase Order
Production History
Productive Reports
Process Controls
Machine Events
Measurements
Change History
Deviation Records
Chemical Presence
Certification
Packing and Dispatch
Invoicing etc

Exercise – Backward Traceability

Backwards traceability

Select a finished product from the material ready to be dispatched. All team will collect record stored may be throughout the different process or department.

Team will present there finings along with photocopy of relevant records based on the data at receiving, at incoming inspection, manufacturing, packaging and shipping of the finished product. **Do not write on or use highlighters on original records.**

Complete a physical inspection and document the results based on the traceability completed. Add as much as photocopies of all related records used during the traceability exercise e.g., material description, lot numbers, quantities, production records, shipping records etc.

Based on the recovery or tracking done Identify areas of improvement to increase efficiency.

The team has to collect the documents from different department / process mentioned based on the exercise completed for markings

Exercise – Backward Traceability

Record	Relevant Information for Traceability (be sure the information can answer the question in parentheses)	Location
Receiving Log		
Incoming inspection records Instrument calibration records		
Product Storage Log Shelf life Storage Log Cold Storage Log etc.		

Exercise – Backward Traceability

Record	Relevant Information for Traceability (be sure the information can answer the question in parentheses)	Location
Production Record Packaging Material Usage Record		
Shipping Log		

Chapter 8

Traceability – Data elements linkage to ERP / Other IT systems

Traceability - ERP

ENTERPRISE RESOURCE PLANNING(ERP)

ERP is a cross- functional enterprise system driven by an integrated suite of software modules that supports the basic internal business processes of a company

A traditional company has many departments/ business units(BU), these departments/ BU continuously communicate and exchange data with each other when ever needed, but ERP combines all databases across departments into a single database that can be accessed by all employees

By combining all databases across departments into a single database that can be accessed by all employees and also automates the tasks involved in performing a business process interlink

The success of any organization lie's in effective communication and data exchange between the departments/ BU as well as associated third party such as suppliers, outsourcers and customers.

ERP – Individual / Decentralized System

Management

Isolated reports from department / BU

Order / PO

Parts Shipped

Marketing and Sales

Prod Order released

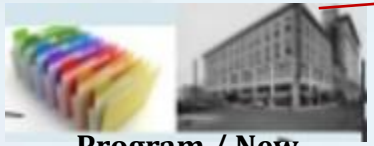
Parts not in stock
Less order time

Order / PO

Parts Shipped

Parts pickup request

SCM / Logistics / Store



Program / New Development

Assembly / parts ready for QC

Assembly / parts QC reports

Incoming and Final Quality

Assembly / parts are ready

Part and sub assy provided to line

Parts Shipped

We ordered part pl follow up

We need parts on time

Human Resource

Resource provided

Qualified Man Power Training

Production

Invoice with GRN number

Finance / Accounting

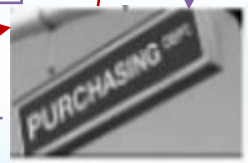
Payments pending

GRN + payment terms
Invoice of previous year

Suppliers

Less Lead time
Deviation

PO / Order placed
Acknowledge needed



Purchase and SQA

OMNEX

Note: Data and case study is only for training purpose

ERP – Individual / Decentralized System

Problems with ERP - Decentralized System -

- Numerous disparate information system are developed individually over the time.
- Integrating the data becomes time and money consuming.
- Inconsistences and duplication of data.
- High inventory, material and human resource cost.

ERP – Individual / Centralized System

(Portal)

Order / PO

Parts Shipped
Invoice

Marketing and Sales

Management

On Time data and reports

Order / PO

Parts shipped/ invoice

Incoming and Final Quality

Prod Order released

Assembly / parts ready for QC

Assembly /parts QC reports

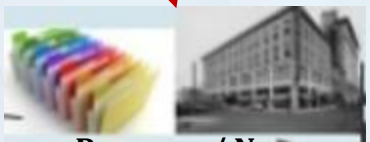
Invoice with GRN number

Lead time

Qty Received / lot Identified

We need parts on time

Part not in stock



Program / New Development

Parts pickup request

Development status

SCM / Logistics / Store

PO / Order placed
Acknowledge needed

Resource provided

Qualified Man Power
Training

Human Resource

Less Lead time, Deviation
Advance shipment notice

Suppliers

(Portal)

Dispatch readiness
Supplier Invoice

Customer invoice

Supplier payments

Part & sub assy provided

Assembly / parts are ready

New Parts request

Ordered Supplier parts

Finance / Accounting

Production

Purchase and SQA

OMNEX

Note: Data and case study is only for training purpose

Benefits of traceability with ERP Integration

Management

- Provides on time reports, spreadsheet and analysis on all BU processes including KPI
- Ability to modify, add and share new requirements and build plans for new models.
- Reduce the time taken and risk associated with managing issues, assets, non moving stock etc.
- Adapt quickly to changes in the business while continually improving operational effectiveness

Benefits of traceability with ERP Integration

Customer

- Facilitate on-time communication and ordering from customers through a portal and self-service ERP.
- Manage, Track and Trace all aspects of the product lifecycle, including quotes, orders, pricing, changes, validation and verification, requirement fulfillment, quality issues, returns, repairs, campaign and service
- Automatically turn a customer-specific feature requirement into a set of requirements to be validated as well as buildable manufacturing requirements to the shop floor.
- Streamline customer order which is faster, more accurate for make-to-order with fewer errors in manufacturing and shipping
- Provide visibility and tracking of product inventory and Improves equipment management and inventory of spare parts
- Manages and Tracks all modes of transportation w.r.t shipments control.

Benefits of traceability with ERP Integration

Manufacturing

- Digitalizes manufacturing by integrating planning, scheduling, quality, cost management, material movement and shop floor control

- Gains visibility across plans, accurately track manufacturing performance, tracks and provides information on waste.

- Capture material and production data w.r.t markings according to manufacturer, supplier and/or customer formats to improve effectiveness e.g. material transaction

- Optimize manufacturing performance, facilitate risk management analysis on planned and unplanned equipment and machine maintenance, including calibrations

Benefits of traceability with ERP Integration

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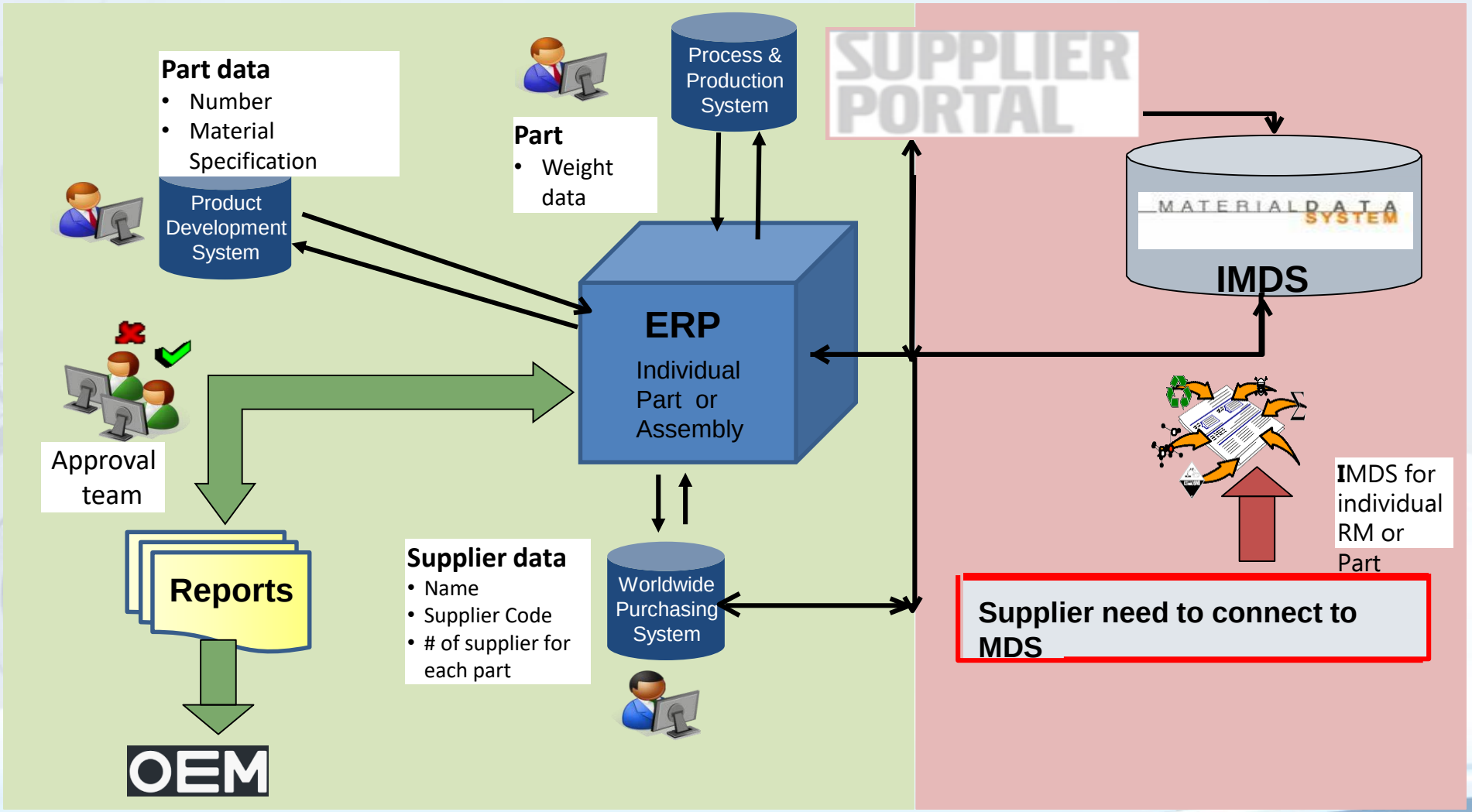
Benefits of traceability with ERP Integration

Supply Chain

- Facilitate real-time communication about RFQ and development including product and process requirement
- Synchronization operation and traceability between supplier and manufacturer
- Capture inbound receiving data w.r.t. supplier labeled markings
- Ensure quality standards compliance with suppliers
- Track corrective actions and support continuous quality improvement

ERP with Internal System and IMDS Linking Application



Chapter 9

Traceability – Industrial Internet of Things

Industrial Internet of Things (IIoT)

Stronger demand for customization, increasing customer expectations, the complexity of the global supply chain – these and many other challenges encourage manufacturers to find new, more innovative ways to remain competitive. In an attempt to gain productivity improvements and uncover new ways of enhancing manufacturing and supply chain operations, businesses resort to digital transformation.

Industrial Internet of Things (IIoT) is a way of digital transformation in manufacturing. Industrial IoT employs a network of sensors to collect critical production data and uses cloud software to turn this data into valuable insights about the efficiency of the manufacturing operations and services they provide.

Industrial Internet of Things (IIoT)

The Industrial IoT helps organization achieve and enhance customer experience by -

- Predicting product failures and service problems in after sales
- Evaluate product performance
- Maximize productivity through maintaining production uptime and efficiency
- Reducing costs and eliminating waste.
- Optimize supply chain processes, improve demand forecasting,

IIoT – After Market / Sales

Aftermarket service is the new focus to address the revenue, profitability in today companies as they are looking for new way to increase their revenue and customer loyalty along with increasing competition along with tougher and dynamic sales of new products, equipment and technology.

Profitability through services has always had a higher contribution to company's profit which further emphasizes the need for better service and a connected IIoT acts as a key enabler to monitor, control & optimize services throughout the life cycle of the product.

IIoT Enables -

- Remote service
- Analytics through systems
- Reduce Warranty costs / return

IIoT – After Market / Sales

Remote service - this provides a rapid ROI without immediately changing the entire value chain. Like -

- Monitor health & performance of product and provide much needed information to customer service agents and field technicians.
- Provide accurate solution at a faster rate and reducing the equipment downtime
- Tracks product and its performance against standard expected metrics.

IIoT – After Market / Sales

Analytics through systems - helps make informed data-driven decisions which includes -

- Predictive maintenance – including service visits, potential failure, alerts
- Real-time information on product usage
- Scope for business optimization – an opportunity to integrate business systems is made possible through IIoT and can help in automating processes like parts ordering, warranty claim management , customer support, asset tracking and fleet management.
- An ability to transform customer experience – additional product value can lower cost through software upgrade of the connected systems which can focus on the usability thereby increasing the life of the product.

IIoT – After Market / Sales

- Reduce Warranty costs
- Arrest false claims – the operating conditions can be monitored to help establish genuine warranty claims
- Improve design – Manufacturers can get better insight into the performance of the equipment thereby bringing in better features and functionalities with quicker and better design
- Reduce inventory costs – with insight into potential failures manufacturers can better plan their inventory levels and increase sales of their high margin parts
- Reduce service cost – by equipping the field technician with information on the equipment configuration, performance, usage, etc. he/she can provide better service enhancing
- Enable remote servicing – decreasing unplanned equipment downtime and reducing travel cost

Case Study : 2 Wheeler OEM

Built an intelligent electric scooter, featuring route optimization and predictive maintenance with Cloud IoT which enables instant data crunching for thousands of scooters.

Breakthrough of project

- A small engineering team to invent a unique IoT mobility system
- Facilitates platform updates every month
- Qualifies deployment of 43 IoT sensors on each vehicle for granular data on driver experience
- Delivers data insights that keep down costs for both the company and the consumer

They linked their big idea to Google Cloud, confident that Cloud IoT Core and Big Query

Case Study : 2 Wheeler OEM

The synergies between customer and Cloud IoT solutions resulted in a unique mobility platform and Google Maps Platform-enabled navigation as a core feature, 2 wheeler capabilities are amplified.

The 2 wheeler -

- Performs predictive maintenance to fix problems before they happen,
- Structures electricity use for big cost savings,
- Analyzes traffic and road conditions for optimal route options,
- Alerts riders to unoccupied electricity stations in the grid and many much more.

Case Study : 2 Wheeler OEM

The aggregated data from all scooters on the road is providing key intelligence to develop future models based on customer habits and requirements, for example,

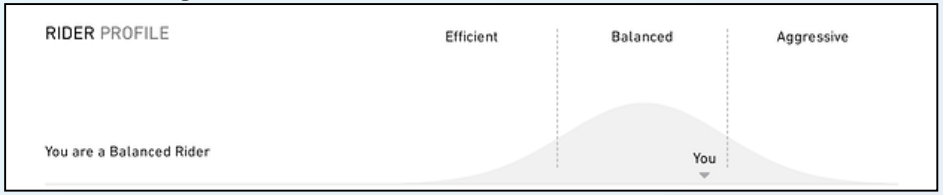
- Can read exactly how far customers are riding every day to inform decisions regarding driving range
- Innovative updates such as "guide-me-home" lights and real-time ride/energy efficient indicators help bolster Ather Energy’s competitive position
- Rolling out an update every month. And that means our focus has to be on application development too

With data insights the company makes a small tweak into some of the firmware and fix issues with no cost impact on the customer as well as for OEM

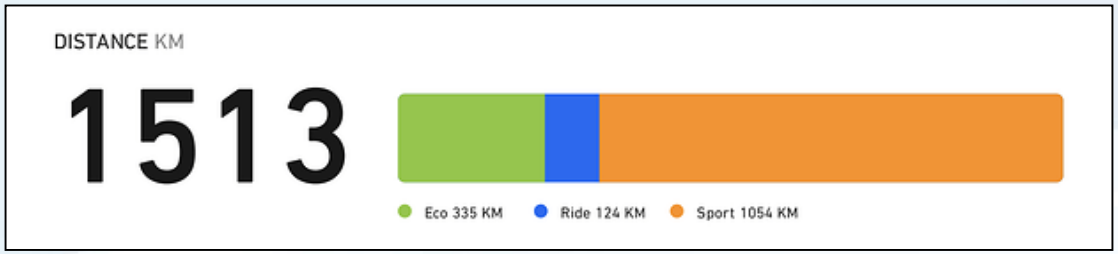
Case Study : 2 Wheeler OEM

Ride efficient

How did you ride?

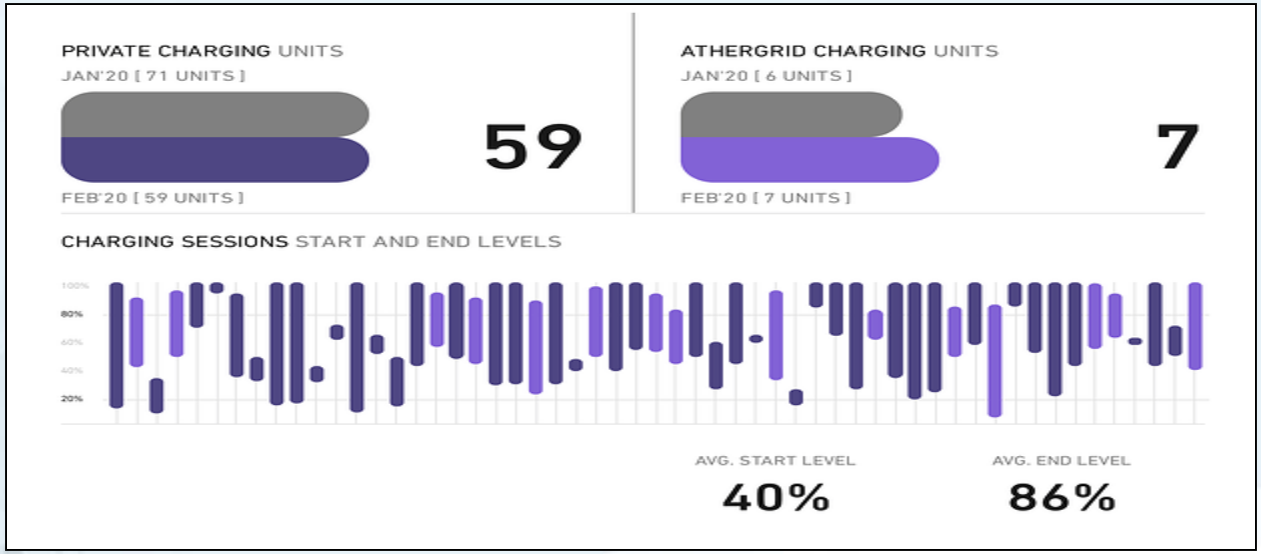


Mode of ride
Sport vs Ride vs Eco

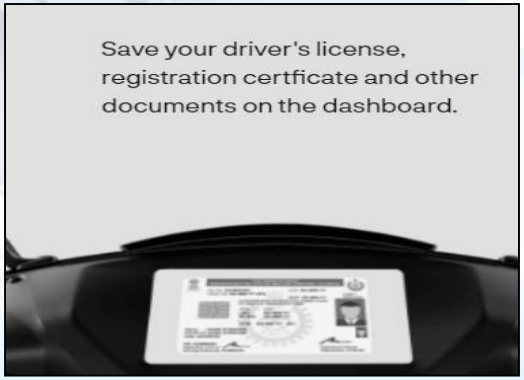


Case Study : 2 Wheeler OEM After Market

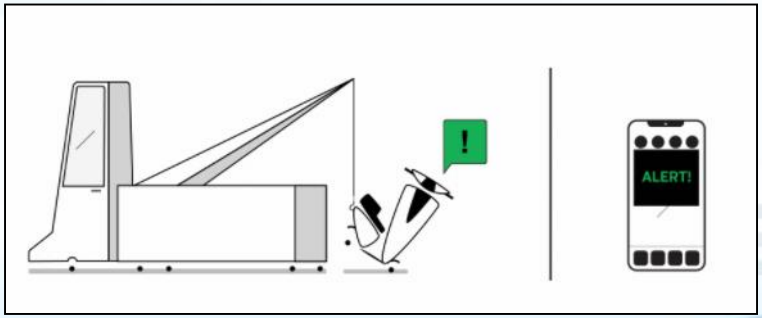
Charging behaviour



Personal and Vehicle documents



Towing Alert



IIoT Adoption in Manufacturing

The main adoption drivers for the Industrial IoT solutions include:

- **Cost reduction**. inventory management, reduced machine downtime, efficient energy use.
- **Shorter time-to-market**. Faster and more efficient manufacturing and supply chain operations, allow reducing product cycle time.
- **Mass customization**. A dramatic increase in the variety of produced increases manufacturing operations get more complex. Tracking the inventory and the manufacturing operations becomes burdensome and, in some cases, not feasible. IIoT facilitates mass customization by becoming a source of real-time data required for *thoughtful forecasting, shop floor scheduling and routing*.
- **Improved safety**. IIoT helps to ensure a safer workplace. Paired with wearable devices, IIoT allows *monitoring workers' health state and risky activities* that can lead to injuries. Along with ensuring workers' safety, IIoT addresses safety problems in potentially hazardous environments. For instance, in oil and gas industry, IIoT is applied to monitor gas leakages as it travels through the pipe network.

Three Visibility of IIoT's in Manufacturing

IIoT technologies are transforming the way production systems are built and run, driving improvements across manufacturing in digital transformation:

- Visibility into shop floor and field operations
- Visibility into the manufacturing supply chain
- Visibility into remote and outsourced operations.

Three Visibility of IIoT's in Manufacturing

Visibility into the shop floor and field operations

The Industrial IIoT offers the innovative level of visibility into the shop floor and operations, as well as the control over resources. IIoT technologies fill the gaps created by that lead systems like ERP which has their own limitations eg the dependence on manual data input or the inability to work with detailed information By providing manufacturers with second-by-second shop floor data, IIoT allows businesses to -

- Track real-time equipment status
- Manufacturing process productivity and records
- Inventory and its location

The IIoT applications allow manufacturers to gain a higher level of visibility in -

- Supporting manufacturing operations
- Facilitating industrial asset management.

Three Visibility of IIoT's in Manufacturing

Manufacturing Operations

IoT applications for manufacturing deal with operations as monitoring and optimizing equipment performance, production quality control, and human-to-machine interaction.

Monitoring equipment utilization

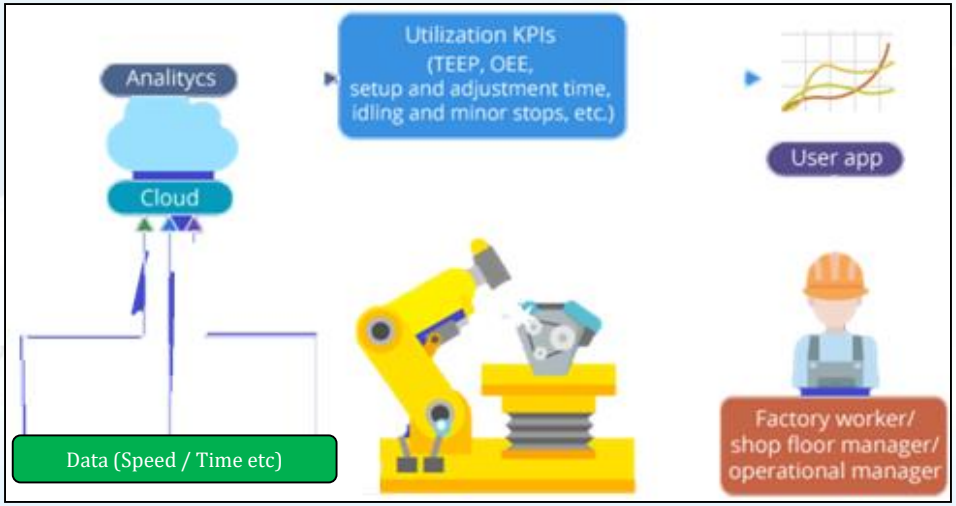
IoT applications for monitoring machine utilization can increase manufacturing productivity by up to 10% to 25%.

IoT solutions for monitoring machine utilization provide businesses with real-time equipment utilization metrics, eg. what is occurring at every point of the production process.

Three Visibility of IIoT's in Manufacturing

Monitoring machine utilization starts with pulling relevant data about machine operating parameters, e.g., run time, actual operating speed, product output, etc. IIoT gatherers data in real time and transmit it to the cloud for processing. The cloud aggregates the data and develops it into informative insights about equipment utilization KPIs.

Based on the data collected the results are visualized and displayed to user either web or mobile.



Three Visibility of IIoT's in Manufacturing

Manufacturing Operations

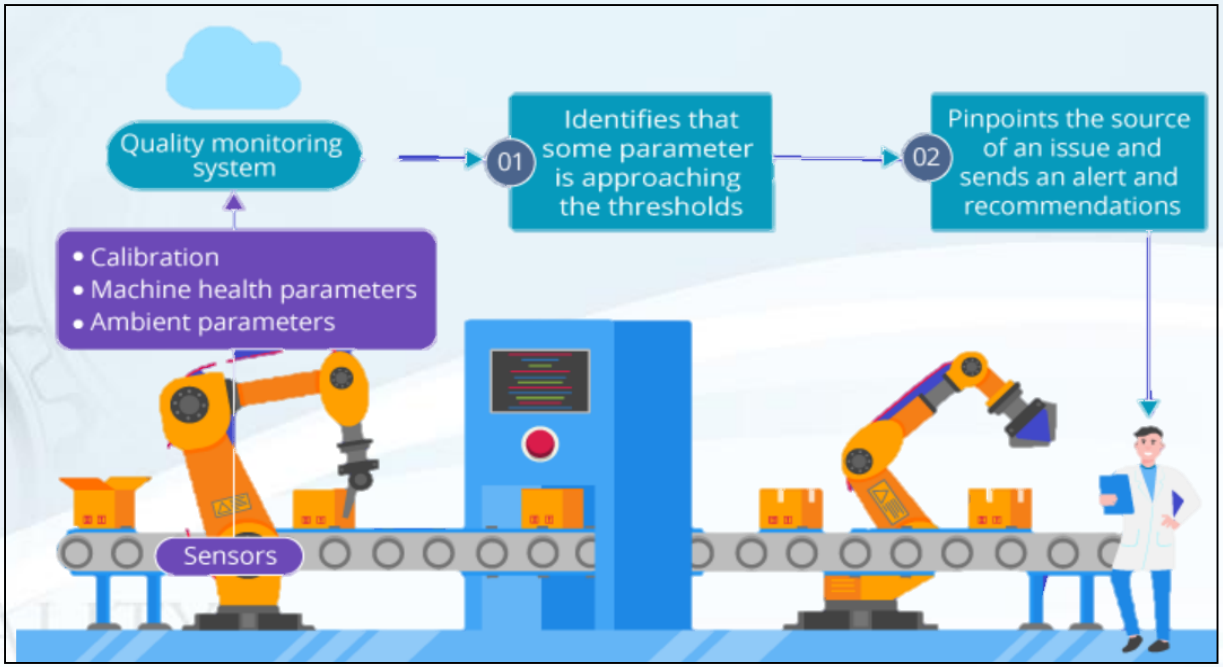
Quality monitoring

An IIoT Monitoring the quality is done jointly by capturing 3 activities and linking it to that individual product -

- Monitoring product quality like inspecting a WIP (work in progress) or produced goods as it moves through the production cycle. e.g. possibility to inspect every WIP, finish goods, statistical method etc.
- Monitoring the condition and calibration of machines/ equipment / instrument etc. on which a product is measured or manufactured. e.g. it helps to detect bottlenecks in the manufacturing operations, identify badly tuned and/or underperforming machines, timely prevent machine damages, and more.
- Monitoring the quality of the production process, such parameters as equipment, machine parameters (speed, vibration, etc.) and environmental conditions (temperature, humidity, etc.) are monitored to identify when they go beyond the normal thresholds and give trigger for correction.

Three Visibility of IIoT's in Manufacturing

A IIoT quality monitoring solution pinpoints the source of an issue, triggers an alert to take recommend action to fix or tune the machine and minimize the process of producing low-quality products.

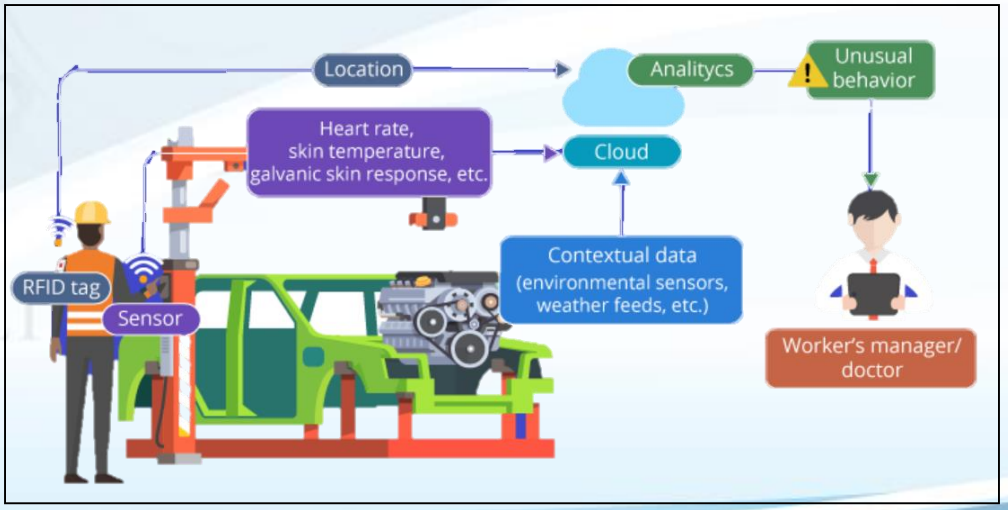


Three Visibility of IIoT's in Manufacturing

Manufacturing Operations

Monitoring safety

In various industrial sectors, including mining, oil & gas, transport, etc., workers receive RFID tags that gather data on their location and wearable sensors collecting data about their heart rate, blood pressure, skin temperature, and other parameters. The sensor data is relayed to the cloud where it is analyzed against data (e.g. from environmental sensors, legacy work planning systems, weather feeds, etc.) to detect unusual behavior patterns (say, sudden vertical movements, unusual heart rates, etc.), and prevent workers from falls, overexertion, and other injuries and timely report a safety threat.



Case Study : Tyre Industry (Manufacturing)

A Tyre Industries Ltd listed among the top 25 tire manufacturers in the world, with a wide range of products.

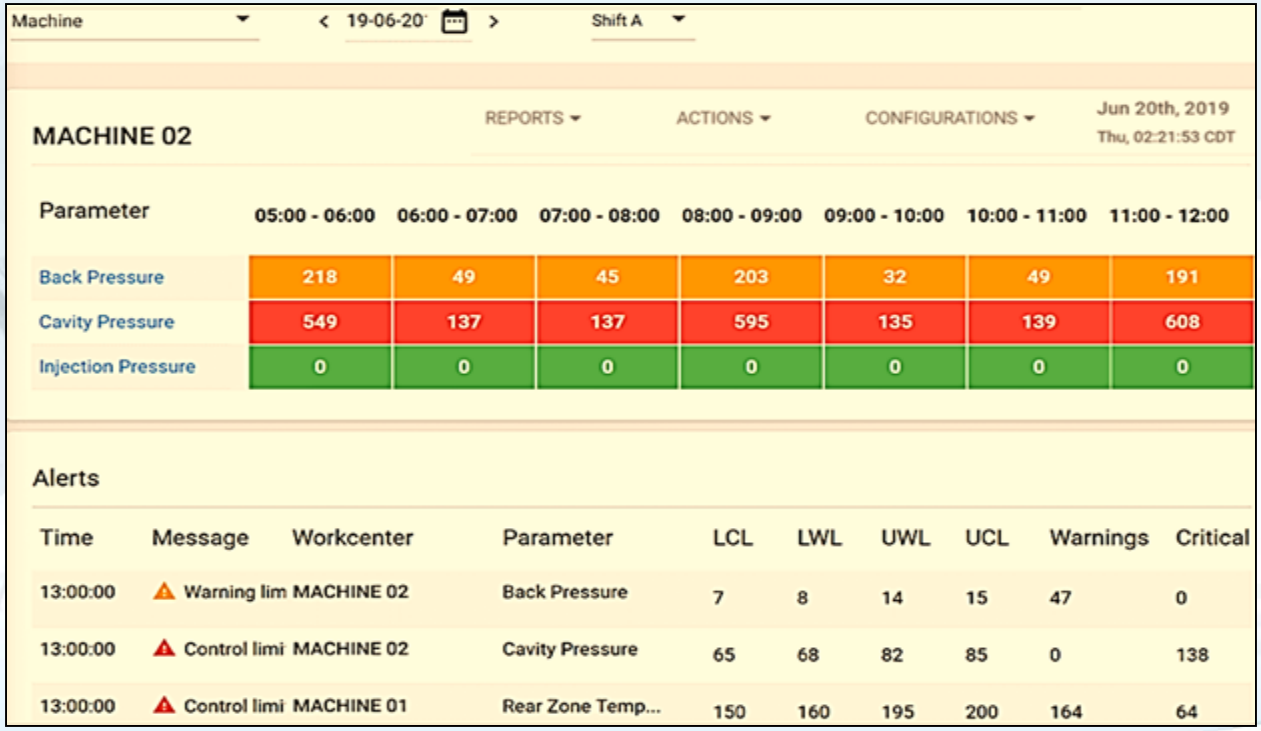
Caters to diverse different business segments in the automobile industry and with a global presence in 100 countries.
The companies has 12 manufacturing plants and produces over 35 million tires per year and they needed to check and drive all their performance.

The critical manufacturing processes included mixing, calendaring, extrusion, cutting, winding and curing and capturing the data and creating report manually was a challenging task.
To over come the constrain the company opted for drive IoT-enabled digital transformation by connecting critical processes in tyre manufacturing. Some challenges faced

- Integration with a fully-functional line and existing IT systems
- Support variety of machines with a variety of connectivity protocols
- Provided extreme accuracy and reliability so as to be used as point of reference

Case Study : Tyre Industry (Manufacturing)

The process and manufacturing data was integrated with ERP to bring visibility and predictability into the manufacturing value chain.
The resulting manufacturing process data was used for deeper analysis into improving process quality and predicting failure of product additional it was also used to monitor machine condition, and accuracy.



Case Study : Tyre Industry (Manufacturing)

Benefits

- **Traceability**: Mockup trail gave 98% accurate traceability through its manufacturing cycle and derive insights around critical quality, condition and production data at every stage.

- **Quality**: Reduced manufacturing rejection to only 0.05% as the data helped in performing root cause analysis of parameters that govern process quality using statistical and machine learning techniques.

- **Productivity Improvement**: Get an insight into parameters that impact line productivity, such as line rates, loss and quality analysis at multiple levels.

Case Study : Tyre Industry (Manufacturing)

Benefits

- **Machine Condition Monitoring**: improved machine availability unto 97% through monitor and analyze parameters that are critical to machine health. Optimize machine downtime by predicting failure before it occurs.

- **Automated Bookings**: with ITOT integration with ERP, automatically book production that helped in better visibility and unblocking the inventory.

- **Energy and Consumables**: Analyze energy and other consumables that are part of the production process and discover ways to optimize their utilization.

Look forward to scaling further as the single source of truth for monitoring our operational KPIs and continuous improvement initiatives : MD Tyre Limited

Three Visibility of IIoT's in Manufacturing

Industrial asset management

Along with improving the effectiveness of manufacturing operations, the IIoT is applied to ensure proper asset usage, extend equipment service life, improve reliability, and provide the best return on assets like.

- Industrial asset tracking
- Inventory management
- Predictive maintenance (based on condition monitoring)

Three Visibility of IIoT's in Manufacturing

Industrial asset tracking

IIoT provides -

- accurate real-time data about enterprise's assets,
- their statuses,
- locations and movements.

IoT-based asset management solutions remove the tracking burden and eliminate errors bound to the manual methods of data input.

Be it a mold, tool or fixture gets labeled with an tag, which serves as an asset identifier. Each tag has a unique ID, which is linked to the data about a particular asset. Both the ID and the corresponding asset data is stored in the cloud. The asset data may include the asset's physical parameters, cost, serial number, model, assigned line, area of use, etc.

Three Visibility of IIoT's in Manufacturing

Industrial asset tracking

Once an asset, say, a mold, leaves an equipment storage yard, an tag reader installed at the store entrance, scans the tag attached and saves the record about the asset leaving the store to an in-cloud database.

Similarly, when the mold enters, say, a molding machine, an tag reader at the machine scans the tag and updates the data in the database. Logging such data throughout the asset's journey allows all to see the movements of the assets.

A tag reader along with GPS tracking can be used to state the location of the movable assets out side you manufacturing location like supplier

Three Visibility of IIoT's in Manufacturing

Industrial asset management

Enterprise inventory management

IIoT-driven inventory management solutions help manufacturers

- Automate inventory tracking and reporting
- Ensure constant visibility into the statuses and
- locations of individual inventory items
- Optimize lead time (the time between an inventory order and its delivery).

Inventory management solutions applied in the manufacturing settings are based on IIoT and RFID technologies. Each inventory item gets labeled with a passive tag. Each tag has a unique ID that carries the data about the item the tag is attached to. To fetch the data from the tags, readers are used. A reader catches tags' IDs and relays them to the cloud for storing and processing. To establish the location and the movements of the scanned tags, along with the tags' IDs, the data about the location of the tag and the time of the reading are relayed to the cloud. The cloud pinpoints the location and the status of each item, visualizes the findings and displays them to the users.

Three Visibility of IIoT's in Manufacturing

Industrial asset management

Predictive maintenance, condition monitoring

Predictive maintenance relies on the insights gained with *continuous equipment condition monitoring*.

A equipment with sensors collect data on a wide range of parameters determining its health and performance, e.g. temperature, pressure, vibration frequency, etc.

Once collected, the real-time data from multiple sensors is transmitted to the cloud, where sensor readings are combined with data (equipment's model, configuration, operational settings, etc.), equipment usage history and maintenance data fetched from ERP, maintenance systems and other sources. The whole of data is analyzed, visualized, and presented to shop floor workers and management on a dashboard or in a mobile app.

Visibility across the manufacturing supply chain

Currently end-to-end supply chain visibility still seems far-off. However the adoption of IIoT-driven manufacturing supply chain management solutions are quite positive. Smart supply chain management solutions provide manufacturers with real-time insights into the location, status, and condition of every part (be it an individual inventory item on a warehouse shelve or a truck delivering supplies) at any segment of the manufacturing supply chain.

For instance, with the traditional supply chain management methods, the manufacturers could only get general data about the availability of an product.

Visibility across the manufacturing supply chain

With IIoT in the manufacturing supply chain, organization get the data about both the location and the properties (e.g. production date, shelf life, etc.) of each individual product.
Along with monitoring the location and the properties of the product, IIoT is applied to monitor the conditions, under which the objects are stored and delivered. Before IIoT came into play, the condition of goods could only be monitored once they arrived at the delivery point. Now, the condition of materials, components and goods can be monitored during transportation, which is especially relevant for the manufacturers of breakable and perishable items (e.g. adhesive, glassware, modern nanomaterial's, etc.).

Consider an example of a adhesive company shipping an order to a customer via a third-party logistics service provider. Sensors attached to the containers monitor the temperature inside the containers, suppose, because of a cooling system failure, the temperature inside the containers is starting to rise. A temperature sensor attached to the inner side of the container ‘detects’ the deviation from the recommended threshold and alerts both the supplier and customer. The IIoT solution notifies the driver too that the delivery conditions have been violated and immediate action have to be taken.

Visibility into remote and outsourced operations

When an enterprise builds or buys a manufacturing or storage facility in a different city, state or country it still has to maintain its manufacturing and production standards (material testing, industrial automation, predictive maintenance, and other) which is difficult with traditional methods of monitoring.

IoT-based system given timely prediction of potential failures, allows scheduling, maintenance activities in advance and eliminates the need to keep a local maintenance team. Similarly, IoT-driven utilization monitoring solutions help manufacturers keep an eye on the efficiency of manufacturing operations (by providing real-time equipment efficiency metrics) without direct access to the shop floor.

IIOT

The challenges of IIoT adoption

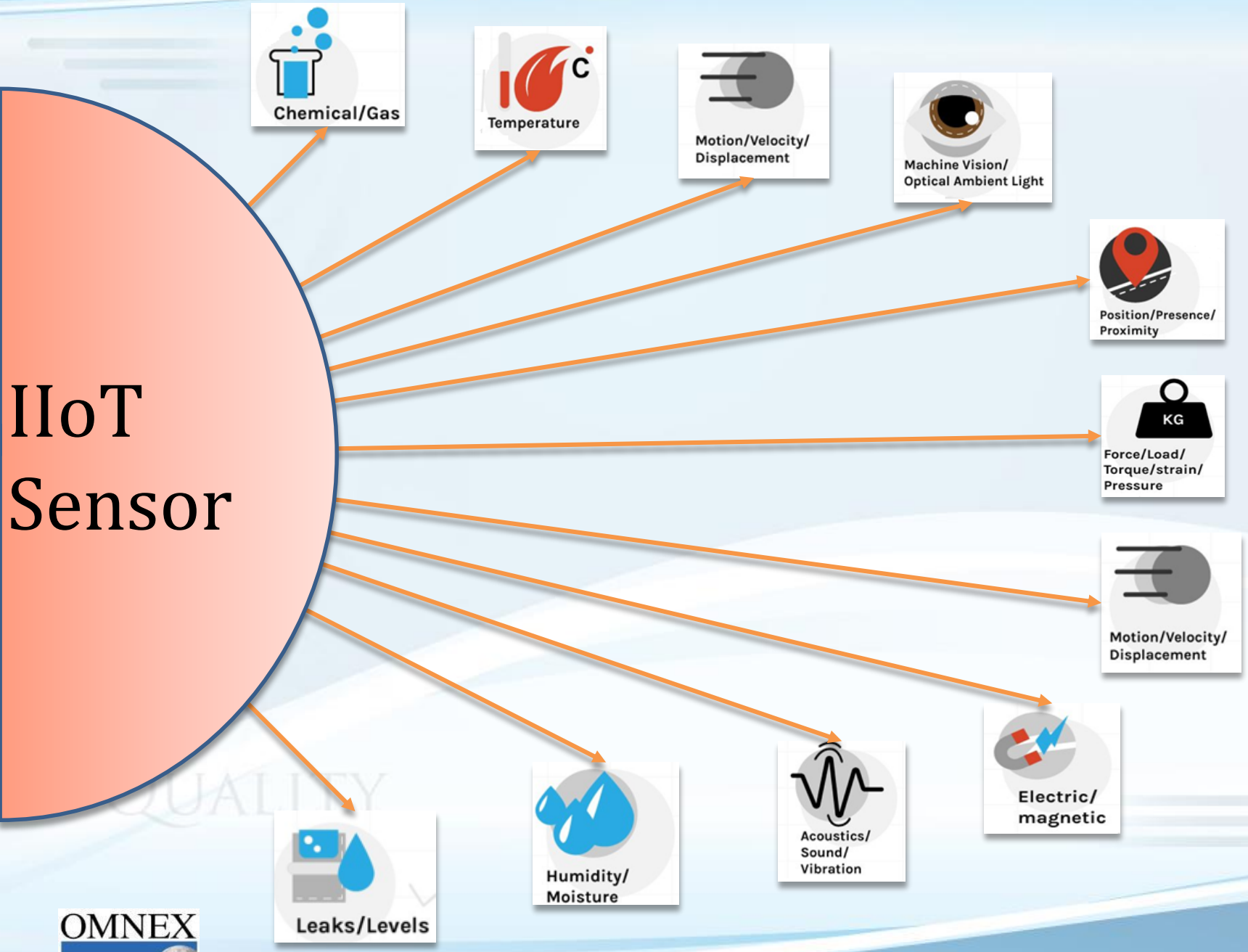
The toughest challenges faced for starting IIoT-enabled digital transformation initiatives include -

Investment needs and ROI - IIoT initiates spending on hardware (sensors, gateways), connectivity, cloud storage, administrative labor, and technical support. Businesses have to consider how quickly they can roll out new solutions and how fast it will take for a solution to start generating revenue.

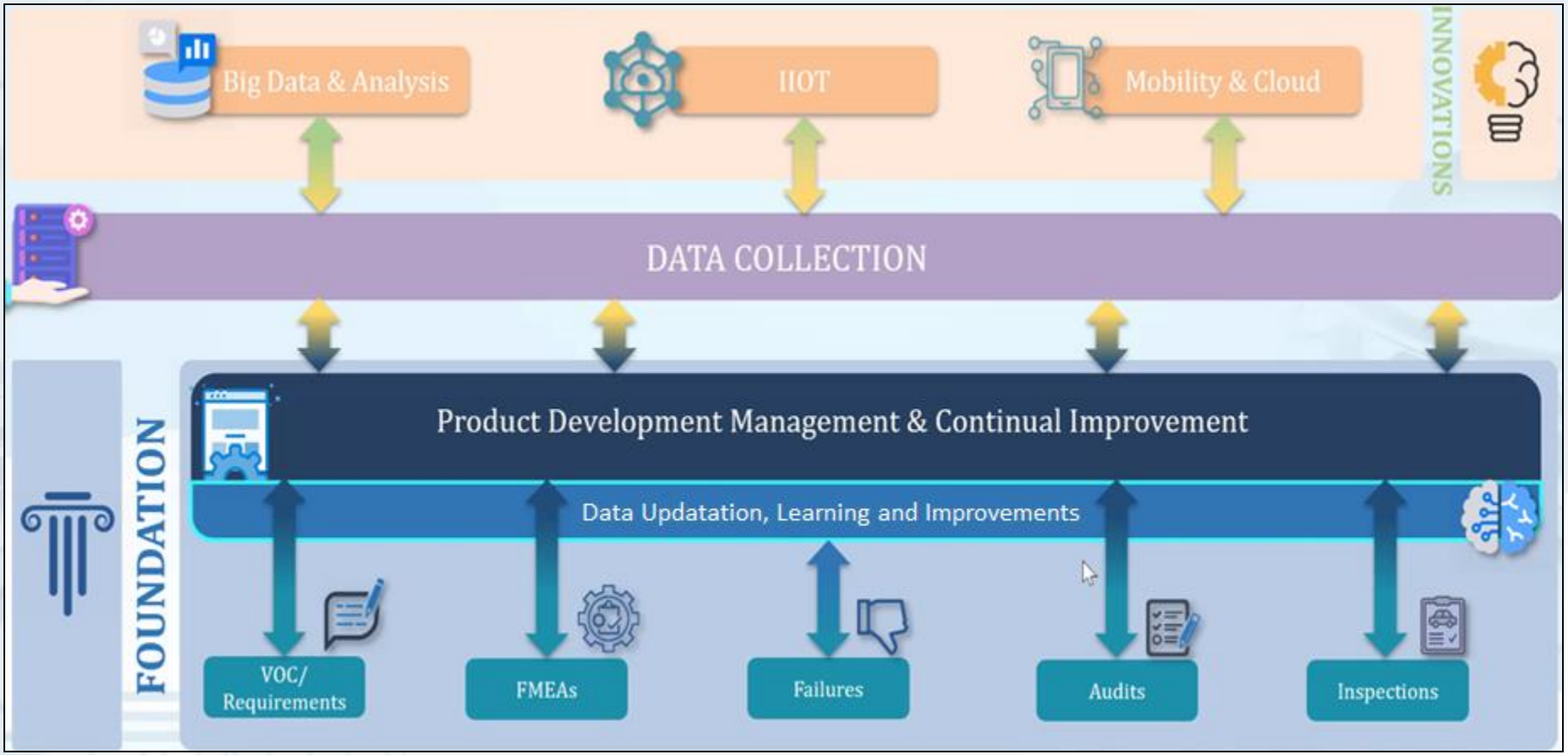
Data security issues - IIoT adopters believe IIoT is increasing the risk of cyber attacks as they do not have a plan to prevent losses from possible security threats. As most of IIoT system and sensor are driven through 3rd party

Lack of qualified employees - Have a shortage knowledge or trained people at the management and deployment level with experience in IIoT. Other specific skills that are lacking, which include analytics expertise and experience in big data, embedded software development, embedded electronics, IT security and artificial intelligence.

The integration with operational technologies and legacy systems - The difficulty of rolling out IIoT solutions in the existing manufacturing ecosystems and that to without data losses and security as they were based on different technologies and networks.



Overall Summary



Thank You!

Questions?

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