Digitization of Procurement in Supply Chain

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Abstract: This research is primarily focused on various methods of improving the agility of the supply chain and reducing inventory and processing costs while simultaneously improving their efficiency. Through remote tracking techniques and digital inventory records, it aims to identify and develop efficient ideas and models for transactions and interfaces between consumers and suppliers. This paper shall initially provide an overview of the forms of research and the applicability of digitization techniques in different industrial in a Tier 1 automotive industry.

1. INTRODUCTION

The rapid growth in technology coupled with a digitally focused world has opened the door for a new wave of automation in the work force across industries. In the past 5 years, there has been a 37% rise in automation in industries across the world *(Dautovic)*. The dynamic of digitization is shifting, from being a driver of marginal efficiency to an enabler of fundamental innovation. It is playing a pivotal role in the transformation of industries by providing unparalleled opportunities for value creation and capture. The pre-emptive hope for the Industry 4.0 revolution is a new era of digitization and automation. In keeping with this, a project, namely Digital Transformation of Industries (DTI), was launched by the World Economic Forum in 2015 to promote the movement of businesses towards automation and technology ("Digital Transformation of Industries", *3*).

Digitization is essential in Supply Chain Management (SCM), which requires constant research and development in all strata to compete in global markets. Supply Chain refers to a network between a company and its supplier to produce and distribute a specific product to the final buyer. The network, typically including individuals across different parts of the industry, also represents the steps taken to take the service or product from its original state and deliver it to its customer *(Kenton)*.

The primary objective for the existence of any supply chain is being satisfactory to customer needs by maximizing overall performance with more efficient design processes, improved quality or reduced costs as well as faster delivery. It functions to achieve a cohesive and high performing business design structure by integrating with primary responsibility for linking major business functions and processes across companies.

The main steps involved in a supply chain include:
- Sourcing of raw materials
- Acquisition and storage of materials
- Manufacturing
- Distribution of Products
- Selling finished products to customer

A common area of concern in the supply chain remains the functionality and lack of visibility due to conflicting priorities of individuals. However, new technologies and applications such as Internet of Things (IoT), the advent of artificial intelligence as well as block chain can all be applied in the improvement of supply chain to improve efficiency and reduce costs, while proving a high degree of transparency and traceability to ensure consumer satisfaction.Further, they are able to counteract issues of functionality by providing an efficient and smooth functioning for they log all actions and interactions between customers properly.

2. RESEARCH METHODOLOGY

Automotive Original Equipment Manufacturers (OEMs) have a drastically different supply chain as opposed to other industries for their customers are typically other manufacturing industries as opposed to general consumers.

They typically transport goods and services that are more fragile, valuable and usually rather large. However, strategies used by different companies across the world to digitize their supply chain are yet applicable in their general sense and only require changes made to improve their applicability in to the automotive industry.

- **Fast Moving Consumer Goods(FMCG)** – These goods have taken to the forefront in recent scenarios with companies such as Walmart acquiring large firms to improve their supply chain. Walmart recently acquired Jet.com, a large industrial company, and IBM for 3.3 billion dollars which has greatly enhanced their revenue *(Nanda)*. They have employed several technologically based approaches as well, using block chain in the transfer of goods, investing in Internet of Things (IoT) and using machine learning to reduce human dependency

in the supply chain. A large number of these companies have started using different types of trackers to have an innate understanding of the location of their products at all times, as well as digitized warehouse systems which can be accessed to view the availability of different products.

- **Online Retailers** – There has been a dynamic rise in the number of online services across the world from Amazon delivery services to Uber car rides. Companies such as FlipKart and Grophers have also managed to capture the Indian market. A key feature in such retailers is the efficiency of their supply chain, which is almost completely digitized. Companies such as these, as well as Swiggy and Scootzi, use online GPS Trackers at all times to keep track of their products. Further, they provide this service to their consumers to allow them to keep track of their orders. For this, they use many services, typically RFIDs which help improve the visibility and transparency of the supply chain.

- **Automotive Industries** – A large number of automotive companies require supply chains in different forms. From companies such as Audi and Volkswagen using automotive parts to make various vehicles to General Motors creating various parts of larger appliances and vehicles, all use their supply chain effectively to maximize profits. Randy Mott, the CEO of General Motors claimed that by digitizing the supply chain and increasing automation within the company, he has managed to increase profitability by 9.3% in 3 years *(High).*Typically, the automotive industry uses smart warehousing techniques to effectively manage its products and

3. AREAS OF DIGITAL IMPROVEMENT

1. *Sensors and Product Tracking*

Privatization and consumer sensitivity towards their own data seems to have overshadowed their requirements in various products. With new tracking systems being created, consumers now expect the reliability of their suppliers, and believe it essential to track their products across the supply chain.

Different techniques, including Global Positioning System (GPS) Tracking and other sensors, however, have now outdated and consumers require a higher level of encryption and security for their products.

Modern Technologies that have sparked attention include:

- **Sensor Tip Technology** – Initially used by Bosch, this sensor is based on Internet of Things (IoT) Technology. Aiming to reduce cost and promote transparency and security, this is a diminutive in-built chip placed inside every product. It is directly linked to the metallic box covering the product. It is capable of providing pin-point GPS location at any given duration as well as setting off an alarm if the metal box is opened without authentication (which can be given to the consumer on arrival of their package). This sensor can be linked directly to a database, accessed by the relevant individuals. This database can at all times track the product via and the sensor and provide authentication to remove the product from the metallic box.

- **Radio Frequency Identification (RFID)** – RFID works on a system whereby digital data encoded RFID tags or smart labels are captured by a ready via radio waves. These provide explicit security for they can read directly outside the line of sight whereas barcodes are required to be aligned with the optical scanner. These RFIDs can be placed either on the employees delivering products or the products themselves to keep track on location and usage of product at all times.

- **Beacons Bluetooth Low Energy (BLE) –** It is a form of wireless communication over Bluetooth, which allows for employees in the supply chain to communicate directly with their supervisor. Beacons are low energy radio transmitters that are strategically mounted throughout locations to transfer data via Bluetooth. This is the most modern and cost effective method of communication and tracking. However, it only consists of 40 frequency channels separated by 2 MHz, resulting in it only being effective over short distances *(Adarsh).*

The requirements for implementing each of the above technologies vary drastically.

1. Beacons BLE can be directly purchased through an external source such as Eddystone. These can be provided to employees on the supply chain and used to communicate directly.

2. The RFID system can also similarly be purchased from an external source. However, in this case, the RFID needs to be coded to create unique identification for different employees. For this an Information Technology team shall have to duly monitor the employees with RFID.

3. The sensor tip technology would have to be developed in-house for which a team would be required with experience in such products. This will also be slightly costly for it will have to be added to every product.

   The Beacons BLE can be directly implemented and switched between employees for they are improved communication devices.

   The RFID tags shall be created for every individual separately and these unique IDs cannot be transferred among individuals.

Therefore short trial runs to ensure correct implementation would be vital in ensuring its productivity.

The sensor-tip technology could be activated at any point. However, since the technology is being self-developed, the accuracy and precision of the sensor can be tested properly prior to mass implementation.

2. *Inventory and Warehouse Management*

The heart of any supply chain lies in its inventory. To create a successful supply chain, it is important for the product manufacturer to have an efficient inventory or warehouse and keep track of all products within them. As applied by Siemens, firms could use automated inventories to negate all human error and keep a check on the products and other materials present in the warehouse.

This could be applied by having a scanner at the entrance and exit of the warehouse/inventory. This scanner has to be internally programmed using artificial intelligence to recognize every product placed in the inventory. Alternatively, an RFID or digital code could be placed on each product that can be scanned using the aforementioned scanner. As individuals walk in and out of the warehouse, the scanner should scan their products automatically and log them into an electronic database or send them back to the main server. This main server can keep a digital directory of every product inside the warehouse that can be cross-referenced by users. By using such a system, firms could keep track of each item within their warehouse. Simultaneously, this would reduce costs and improve efficiency within the firm.

However, here the usage of automated scanning is optional. Alternatively, all employees can be asked to log the products incoming and outgoing at all periods, which can be added to the digital warehouse. This smart warehouse can be additionally programmed to understand the location of products in the warehouse and the ideal location for new products on the warehouse, based on their category, size and type.

Requirements:
1. A member of the IT team to monitor the warehouse at times and keep track of the incoming and outgoing products. This individual can also ensure smooth functioning of the digital system. Errors must be logged immediately to prevent negative effects on functionality

2. A Digital Warehouse Software is to be created for such usage. However, this is not costly or time consuming and can be created by any individual with basic coding knowledge as well. This software

shall require a large number of servers and good backup for it stores essential information. A good web firewall shall be useful to protect data as well.

3. The scanner can be created using RFID coding or artificial intelligence to scan barcodes on products incoming or outgoing.

For the beginning of this implementation, perhaps the first 2 months, the digital warehouse should be manned by 2 or 3 individuals to ensure smooth functionality. Further, manual records should also be made during this period to ensure no loss of data in the case of a crash.

Additionally, in the beginning all the products currently in the warehouse will need to be properly logged into the system, along with their location, ensuring that no products are left out.

3. *Predictive Maintenance*

Firms typically believe in the idea of correcting errors in their products. However, 'Prevention is better than cure'; Firms should apply basic precautions for every product and have a predictive maintenance in-built to easily identify errors in the supply chain of a product.

Initially used by Audi, this system is based on the idea of early repair. Designed based on a system of Internet of Things(IoT), a small chip needs to be implanted in every unit of product at the supply chain. This chip must be fitted with baseline parameters required for the basic functioning of the system. If the product or good is functioning outside these objective parameters, the chip must provide some form of digital signal directly to the main server. This chip can be programmed such, using artificial intelligence, to predict the probability of the product functioning outside the scope of the parameters. This probability can be mapped out based on previous records and data and can be fitted using different probability curves based on the applicability and likelihood of the specific instance.

Requirements:
1. Team to develop IoT device that checks and tracks predictive maintenance of a product

2. Monitoring team to check when maintenance is required

3. Basic materials for the IoT device such as Arduino, connection wires etc.

To make such a device, a team will have to qualitatively and quantitative specify the requirements that deem a product necessary for maintenance. Further, such a device shall have to tested several times prior to implementation for false

alarms could lead to loss of efficiency and increased costs, opposing the initial goal.

4. Cockpit Interface

Saving time and maximizing the utility of every worker in monumentally significant in a supply chain, typically for firms shipping hundreds of different products to various locations across the country.

Having staff and employees adhering to a strict set of guidelines is therefore important in ensuring the correct transfer of goods and products to the consumers. To amplify this system, Proctor and Gamble created a Cockpit Interface. This has greatly reduced long term costs and maximized revenue and efficiency of employees.

Here employees and distributors act within a certain metric based on what are considered 'value adding services' i.e. services a consumer is willing to pay for to improve cycle time efficiency.

- A team has to design parameters for every employee, either as a class or individually, that the employee(s) adheres to

- Employees carry RFID and GPS tracking devices as well as a sensor of every product they are delivering

- If they act against these metrics and deviate from the supply chain, knowingly or unknowingly, an alarm system activates or a digital response it to indicate the same to the relevant management

- This ensures no/few employee defaulters and provides essential data for customers and management regarding their product.

- This method can be done in conjunction with the 'Sensor and Product Tracking' technologies as they serve a similar purpose and use several similar products.

- No new technologies are required for this since they use the same technologies as 'Sensor and Product Tracking'

5. Performance and Quality Detectors

The part of a product most valued by customers is the quality. It differentiates companies from one another and is the single most important thing in a competitive industry. This system is applicable and essential to the procurement function while obtaining raw material from suppliers. It aims to detect the quality of a product and accordingly procure more products or raw materials from the supplier of the highest quality product.

- Create an elaborate metric based on the important parts of the raw material or product. This metric should include all the key components that consumers find essential while judging the quality of the part in question.

- Design an automated 'Quality Checker' using artificial intelligence. For this an OLED chip/sensor containing information regarding the quality metrics designated by the administrator.

- Based on the predefined parameters, the checker shall provide a quality score to each of the products. To ensure reliability, do two rounds of testing. The OLED chip shall track the functionality of the device in detail and accordingly assign a quality rating score to it, out of 5. Based on the different metrics mentioned, a summative quality score can be given to the product.

- For a comparison of the scores, conduct a Chi-Square Test (a typical test for proportionality based on the discrete value scores of 2 or more products)

Requirements:
1. Team of minimum 3 individuals to create a standard OLED chip for such testing. This OLED chip will need to be flexible and have adjustable parameters, so that it is capable of taking qualitative commands and converting it quantitative data. Therefore, the individuals should be part of the Information Technology Industry and have experience with artificial intelligence.
2. 1 individual to assign and input parameters for each product, on the basis of which the quality score shall be given
3. Material for the creation of the OLED chip, typically an Arduino Uno board, connection wires and other items deemed essential

To promote the effectiveness and utility of such a device, the device should go through Alpha and Beta tests during its implementation. The first test should compare scores assigned by product experts based on their understanding of the product. It is important that the manually assigned scores are done so with care for they determine the functionality of the OLED chip. The second test can be done similarly with the changes made to account for differences between manual and assigned scores. These tests can be repeated and done for different products to ensure correct scoring by the OLED chip prior to implementation.

6. Block Chain Supply Chain

With advancement of the world of technology, there have been several innovations, especially with regard to the use of block chain in different sectors of technology.

Using supply chain improves the following features:

- **Traceability** – Operational efficiency is improved by mapping and visualizing enterprise supply chains. Block Chain helps organizations understand their supply chain and provide consumers verifiable and immutable data.

- **Transparency** – Captures key data points such as claims and certifications which is then made publicly available. After being registered on the Ethereum Block Chain, third party attesters can verify a product's authenticity.

- **Tradability** – Using Block Chain, one may redefine the market for goods. In the concept used by crypto-currencies such as Bitcoin, the firm could 'tokenize' the product as a digitally tradable item. An entire shareholder market could be created under this guise, by dividing the assets of the product or enterprise properly.

- **Availability** – Recalls are much easier and cheaper using Block Chain for it reduces the amount of time taken for a firm to trace the location of a product.

For a detailed understanding of how the block chain system would be applied effectively to reduce costing and promote efficiency, look at the diagram below, indicating the new supply chain model.

SUPPLY CHAIN MODEL

Based on available data and improvements listed above, a model has been created for the supply chain of ABC. This model is primarily based on the idea of Block Chain and its applicability in the supply chain. Here, the vendor updates the master data (digital inventory) every time a new product is added to the warehouse or purchased i.e. removed from the warehouse. By allowing the vendor to upload e-invoices and contracts created from the additions or deletions to the warehouse, the firm can keep track of the new locations of each of its products. By keeping electronic copies of receipts, it reduces the cost and time take to scan the receipts after a purchase order is complete. This also keeps track of the raw materials available in the warehouse.
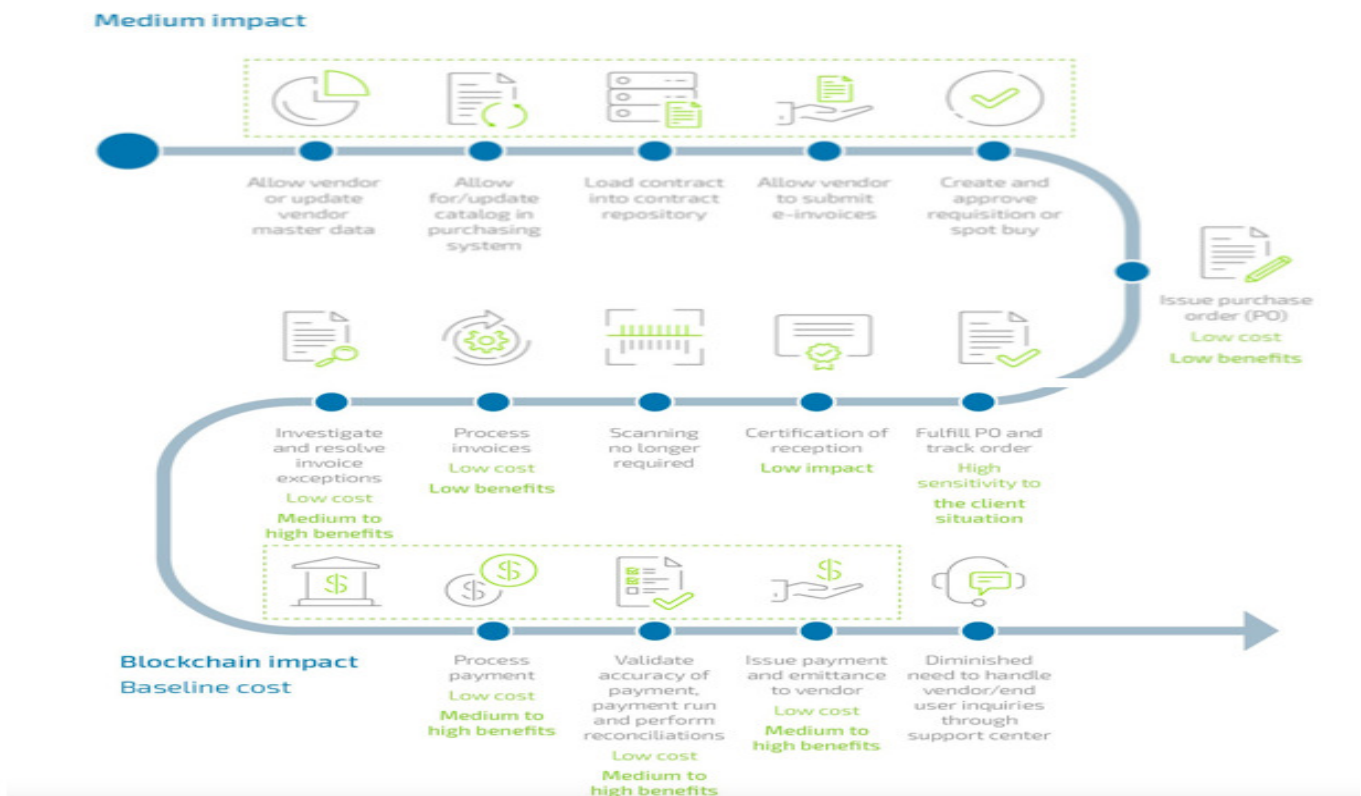
4. CONCLUSION

The idea of digitization and automation has become synonymous with the likelihood of success in all fields, especially industries. Different firms within different markets are adopting new styles and strategies to promote the sales and maximize profits.

From smart warehouses to logistics visibility, firms within this industry have adapted new approaches to reduce costs and possibility of human error.

The above ideas are largely based upon the transformation of ABC as a leading Automotive OEM firm in the market. They mainly touch upon different ways in which technology and

artificial intelligence are capable of digitizing ABC's supply chain. The model created is a summation of these ideas, while considering their baseline costs, their feasibility and effectiveness in the short as well as long run. These ideas, in spite of many being long term in their benefit, touch upon key characteristics that are required to promote efficiency in the supply chain.

There are several benefits of switching to automation and digitization in the supply chain: reduced cost, increased efficiency and increased productivity. Further, the traceability of items is greatly improved for each item is logged, with its location, onto a virtual database. This ensures that items are easy to track and that they are never lost.

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5. QUESTIONNAIRE

1. What changes have you made to your supply chain to improve visibility and tracking of your products?

2. What new technology or features has your company adopted to improve the procurement function of your supply chain?

3. How has the digitization of the supply chain contributed to the overall efficiency and profitability in the short and long run?

4. What manual processes as part of your traditional supply chain practices have been automated or digitised in last few years?

5. What kind of Customer supplier online interface do you use with your supplier partners and what benefits did you reap because of it?

6. Are your suppliers using any smart practices in their ware houses and for their logistics visibility?

7. How effectively do you use the advance shipment notice concept with your suppliers?

8. What kind of interface for monitoring & measurement of the critical parameters and process capability is being used along with the suppliers?

9. What kind of digitisation have you done for identification & traceability of the products from shipment to receipt of goods to the customer?

10. Are you using any online interface for early involvement & effective communication with suppliers in the new product development process?

11. Are your suppliers using the rapid prototyping methods for reducing the development time?

SURVEY – RESPONSE I

1. What changes have you made to your supply chain to improve visibility and tracking of your products?
   - We plan our manufacturing as per customer forecast, available capacity and ensuring the material availability thru high-end planning systems i.e. Advance Supply chain planning.
   - Procurement as per manufacturing plan and need of material.
   - Sales, Purchase & logistic agreement with vendors, customers & service providers.
   - Automatic generation of Purchase order as per agreed terms and conditions. '
   - Generating the invoices as customer orders (Sales order)
   - Ordering /dispatch communication thru EDI or Portal

2. What new technology or features has your company adopted to improve the procurement function of your supply chain?
   Global ERP IT applications like Oracle, SAP & custom solutions.
   - Using supply chain planning tools i.e. ASCP (Advances supply chain planning)
   - Using decision support system using Data warehousing and Qlikview

3. How has the digitization of the supply chain contributed to the overall efficiency and profitability in the short and long run?
   - Forward visibility and past trend analysis
   - Increased efficiency from automation.
   - Mistake proofing and ensuring doer and checker.
   - Reducing overhead by optimizing the inventory.

4. What manual processes as part of your traditional supply chain practices have been automated or digitised in last few years?
   Utilizing improved and latest world class technologies are strategically remained a priority work culture in our organization from the beginning. That has helped in eliminating lot many manual processes like
   - Raising manual order,
   - Tracking shipments on phone etc

5. What kind of Customer supplier online interface do you use with your supplier partners and what benefits did you reap because of it?
   Our company uses following tools.
   1. Web portals for seamless vendor integration starting from quote management, Order confirmation, forecast sharing, ASN and delivery confirmation.
   2. Direct EDI interface through EDI tools.

6. Are your suppliers using any smart practices in their ware houses and for their logistics visibility?
   Yes, Suppliers are using smart devises like hand held devises. These helps in reading bar codes stickers to receive and dispatch shipments to avoid mistakes and improve efficiencies. Logistics providers are using latest world class shipment tracking software/applications to support their customers for online shipment tracking

7. How effectively do you use the advance shipment notice (ASN) concept with your suppliers?
   As explained in above said questions, ASN being used extensively through Web Portals, EDI interfaces and in few cases thru emails automation.

8. What kind of interface for monitoring & measurement of the critical parameters and process capability is being used along with the suppliers?
   - Process capability Index (Cpk), Critical Process Parameters (CPP) and Management System Audits etc proven processes/practices being used extensively.
   - Vendors are being rated regularly based on delivery, quality & cost parameters and shared with them.

9. What kind of digitization have you done for identification & traceability of the products from shipment to receipt of goods to the customer?
   Barcode Technologies extensively during manufacturing to shipment to customers at multiple level each SKU level.

10. Are you using any online interface for early involvement & effective communication with suppliers in the new product development process?
    Yes Combination of technologies like online RFQ modules/application ERP Systems, Web Portals etc being used for early Involvement and effective communications
    Are your suppliers using the rapid prototyping methods for reducing the development time?Yes

SURVEY-RESPONSE 2

1. What changes have you made to your supply chain to improve visibility and tracking of your products?
   - Electronic extranet communication system
   - Vendor inventory visibility system -certain details vendors have to input at all times, quantum available with which vendor, which vendor is likely to run out of parts

2. What new technology or features has your company adopted to improve the procurement function of your supply chain? (answered with 3)

3. How has the digitization of the supply chain contributed to the overall efficiency and profitability in the short and long run?
   - Developed a business analytical tool that consolidates the report from different vendors from their own turnovers and part wise price, receipts for that vendor-further segmented for different production parts
   - Makes relevant queries on change in turnovers and price of parts- cause of price variation, good received, (statistical analysis), quality
   - Dashboard- BCG- supply chain risk chain management – captures dependence on vendors, issues of supply, less inputs/raw materials

4. What manual processes as part of your traditional supply chain practices have been automated or digitised in last few years?

   - BA system-business analytical tool
   - Purchase order(quantity, price)- amended periodically based on price- initially done manually, now a specific system is implemented that is linked to other sub-systems that now allows PO function to occur online- reduces human intervention and error

5. What kind of Customer supplier online interface do you use with your supplier partners and what benefits did you reap because of it?

   - Same as previous
   - Vendor ranking system is created –different set of parameters for timely delivery- quality issues etc. –vendors are aware of ranking to try and make them improve

6. Are your suppliers using any smart practices in their ware houses and for their logistics visibility?

   - RFID tag based model is under implementation
   - Truck movement tracking GPS linked system – mainly for larger vendors

7. How effectively do you use the advance shipment notice (ASN) concept with your suppliers?

   - Electronic extranet- send things divided in 1st, 2nd and third forntight

8. What kind of interface for monitoring & measurement of the critical parameters and process capability is being used along with the suppliers?

   - Vendor ranking system (refer to 5)

9. What kind of digitisation have you done for identification & traceability of the products from shipment to receipt of goods to the customer?Same as 6

10. Are you using any online interface for early involvement & effective communication with suppliers in the new product development process?

   - Extranet-production on fortnight basis

11. Are your suppliers using the rapid prototyping methods for reducing the development time?Yes

SURVEY- RESPONSE 3

1. What changes have you made to your supply chain to improve visibility and tracking of your products?

   There are many initiatives being undertaken by various plants for visibility and product tracing. Example: For our ECUs, we have QR coding done on the product right at the first stage of production and that is traceable at each station during production until dispatch.

2. What new technology or features has your company adopted to improve the procurement function of your supply chain?

   Various supplier interaction tools. Most of them developed inhouse.
   We work towards automation, catalogues, long term contracting in order to simplify and accelerate the procurement process for our employees.

3. How has the digitization of the supply chain contributed to the overall efficiency and profitability in the short and long run?

   It has definitely contributed significantly and digitization will continue to be our focus (we will not be able to share any numbers)

4. What manual processes as part of your traditional supply chain practices have been automated or digitised in last few years?

   Many processes from start to end. RFQ management, negotiations, market intelligence, order processing and response, schedules management, transport management, warehouse management, quality management

5. What kind of Customer supplier online interface do you use with your supplier partners and what benefits did you reap because of it?

   With suppliers – we do RFQs, e-negotiations, purchase order and response, e-catalogues, schedules, ASN, e-invoicing etc. Benefits in terms of efficiency, speed, transparency and cost.

6. Are your suppliers using any smart practices in their ware houses and for their logistics visibility?

   Yes. Many suppliers have their own solutions. (no further details available)

7. How effectively do you use the advance shipment notice (ASN) concept with your suppliers?

   It is used for majority of direct material suppliers.

8. What kind of interface for monitoring & measurement of the critical parameters and process capability is being used along with the suppliers?

9. What kind of digitisation have you done for identification & traceability of the products from shipment to receipt of goods to the customer?

   As explained above, RFID / GPS. Since we are tier 1 suppliers to our customers (OEMs), sometimes we need to adapt the customer's solutions

10. Are you using any online interface for early involvement & effective communication with suppliers in the new product development process? *No*

11. Are your suppliers using the rapid prototyping methods for reducing the development time?*Yes.*