Internship Project Title	Design an innovative framework for vehicular mass customization
Project Title	Mass Customization in automotive Industries.
Name of the Company	Tata Consultancy services (TCS iON)
Name of the Industry Mentor	Mr Raj Shah
Name of the Institute	S.B. Jain Institute of Technology, Management & Research

PROJECT SUMMARY:

Start Date	End Date	Total Effort (hrs.)	Project Environment	Tools used
17/Aug/2021	13/Nov/2021	210	Online and Software based.	Microsoft Word Paint, CAD,CAM,AutoCad , Fusion 360, Inventor, Ansys,Solidworks

Project Synopsis: Is Below
Title:-Mass Customization in automotive Industries.
Objective: - design an innovative framework Technology for vehicle of mass customizations for utilizing and developing the various methodology.
Keywords: - Mass Customization, Automotive industry, Industry 4.0.

Solution Approach: A theoretical and analyses views of mass customization in automotive industry.
Various graph and diagram is use to analysis the project Domain.

Assumptions: This Project report is made upon the study of various research paper and case studies

Project Diagrams: The Diagram shows the workflow and the Procedure of report to making the Individual phenomenon in Mass customization .

Outcome: It can be concluded that the new Industry Revolution both requires and provides the personalization movement in the automotive industry. In the study, the Industry 4.0 phenomenon is discussed with a focus on the themes of customization and personalization. Technological developments have transforming effects on manufacturing and marketing vision in the automotive industry. Mass customization reflects the alignment of manufacturing environment into a more customer-oriented stance in the last decades. The manufacturers offer more and more options for customization; however, the rapid transformation along with Industry 4.0.

Exceptions considered:NA

Enhancement Scope: The portion is detailed described in the current scenarios portion of the report.

TCS iON Remote Internship Project Report

On

Mass Customization in automotive industries

Design an innovative framework for vehicular mass customization

By

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Year 2021

ABSTRACT

Mass customization is the method of effectively postponing the task of differentiating product for a specific customer until the latest possible point in the supply network. This report is represent a theoretical and analyses views of mass customization in automotive industry. The main goal and objective of this paper is to design an innovative framework Technology for vehicle of mass customizations for utilizing and developing the various methodology. Use of various software like AutoCAD , Inventor fusion 360 , Ansys and solidwork are used. This report is made upon the various case studies of automotive industries. The Report is approach towards the solution mass customization caused and cased studies problem statements. within the help of various software and introduced the Computer aided manufacturing (CAM) and Computer aided Design frameworks(CAD).

Keywords:- - Mass Customization, Automotive industry, Industry 4.0 .

ACKNOWLEDGEMENT

I would like to express my gratitude towards my parents and Organization of **TCS iON** for their kind cooperation and encouragement which help me in completion of this project. I would like to express my special thanks to the industry Mentor **Mr. Raj Shah** for giving me such attention and time. My thanks and appreciation also goes to my institution professor **Mr. Vikrant Katekar** and all the members in the digital discussion room to have willingly help me out with this the project activities. I thank all my friend families who helped to declare for me I am grateful to thank my I their industry mental Raj shah which accompanies my schedule during the time of internship in particular to my the the assumptions tcs-ion for all the support attention and dedicating to guide me in the focus of writing this project.

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CHAPTER 1

INTRODUCTION

Fig01:- What is Mass Customization

Mass customizations is the marketing ,manufacturing ,call centers and management is the use of flexible computer aided manufacturing (CAM) system to produce a custom output such a system combines the low unit cost of mass production process with the flexibility of indigenous customizations.

1.1 DEFINATION OF MASS CUSTOMIZATION

Duray, Ward, Milligan and Berry (2000) stated that “the practice of mass customization does not fit with the conventional paradigm of the manufacturing management”. In the past, production companies chose processes that supported the production of either customized produced products or standardized mass produced products. This means that customized products with high variety and a high degree of customer involvement are made using low volume production processes. This is the opposite with mass production processes for making standardized products where the focus is on efficiency and scale economies. In contrast to this traditional paradigm, mass customization has appeared.

The definition of mass customization was first described by Davis (1987) in his book Future Perfect. Davis described mass customization as “the ability to provide individually designed products and services to every customer through high process agility, flexibility and integration without sacrificing scale economies”. This definition is confirmed by Kotha (1995) who described mass customization as a system by which companies apply technology and management methods to provide product variety and customization through flexibility and quick responsiveness. In addition to Davis and Kotha, Broekhuizen and Alsem (2002) defined mass customization as the ability to provide customized products and services to individual customers using technology at optimal production efficiency and cost levels.

Customization is a mainly four type of customizations collaborative mass customizations, adaptive customizations, transparent customizations, cosmetic customizations.

Fig 02:- Types of Mass Custamization

1. **Collabrative Customization:-** Firms talk to individual customers to determine the precise product offering that best serves the customer's needs . This information is then used to specify and manufacture a product that suits that specific customer. For example, some clothing companies will manufacture pants or jackets to fit an individual customer. This is also being taken into deeper customization via 3D printing with companies like Shape ways Examples: Tailored Conver lets consumers chose the color or pattern of every element of certain types of shoes, either in-store or online.

2. **Adaptive customization** – Firms produce a standardized product, but this product is customizable in the hands of the end-user (the customers alter the product themselves). Example: Lutron lights, which are programmable so that customers can easily customize the aesthetic effect

3. **Transparent customization** – Firms provide individual customers with unique products, without explicitly telling them that the products are customized. In this case there is a need to accurately assess customer needs. Example: Google Adwards and Adsense.
4. **Cosmetic customization** – Firms produce a standardized physical product, but market it to different customers in unique ways. Example: Soft Drink served.

1.2 INTRODUCTION OF MASS CUSTOMIZATION IN AUTOMOTIVE INDUSTRIES

Mass customization, on the other hand, requires a *dynamic network* of relatively autonomous operating units. Each *module* is typically a specific process or task, like making a given component, a distinctive welding method, or performing a credit check. The modules, which may include outside suppliers and vendors, typically do not interact or come together in the same sequence every time. Rather, the combination of how and when they interact to make a product or provide a service is constantly changing in response to what each customer wants and needs.

From continually trying to meet these demands, the mass-customization organization learns what new capabilities it requires. Its employees are on a quest to increase their own skills, as well as those of the unit and the network, in a never-ending campaign to expand the number of ways the company can satisfy customers.

The mass customization model presents a challenge to the production planning process in the automobile industry. Mass customization implies that the customers can select order and receive a specially configured product to satisfy their specific requirements.

1.3 LEVELS OF MASS CUSATAMIZATION

There are many ways to achieve mass customization (Broekhuizen and Alsem, 2002). Each level of mass customization can be categorized by:

• The degree of organizational transformation that is required: this refers to the initial point in the manufacturing process where customers can alter their products, also known as the point of customer involvement or decoupling point (Duray et al., 2000, Lampel and Mintzberg, 1996).

• The mass customization approach: this is related to the nature of the customization.

The initial point of customer involvement relates to the internal transformation required and the mass customization approaches are related to how customer value can be created. First the degree of organizational transformation that is required will be described. Lampel and Mintzberg (1996) developed the idea that the level of customer involvement in the production cycle can play a critical role in determining the degree of customization. Also McCutcheon, Raturi and Meredith (1994) argued that the production stage where a product is differentiated is a key variable in process choice decisions. This means that the point of customer involvement in specifying the product is related to choices about the customization process (Duray et al., 2000). Duray et al. stated that "the point of customer involvement is a key indicator of the degree or type of customization provided". Lampel and Mintzberg view customization as taking one of three forms:

1. Pure: customers are involved in the entire production cycle, from design through fabrication, assembly **and delivery and it provides a highly customized product.**

2. Tailored: the customer enters the production cycle at the point of fabrication where standard products are modified.

3. Standardized: the customer enters the assembly and delivery processes through selection of the desired features form a list of standard options

CHAPTER 2

OBJECTIVES

The various objectives is as follows:-

1. The objective of this project is to propose a details framework for vehicle I'm asking atomization based on latest technology for automobile industry the various methodology.
2. Which one would be the best scaling of the scales impact of efficiency guidelines and policies implementations in the same without violating the environmental norms.
3. Design the methodology of reducing mass customization causing effect of the work process and production.

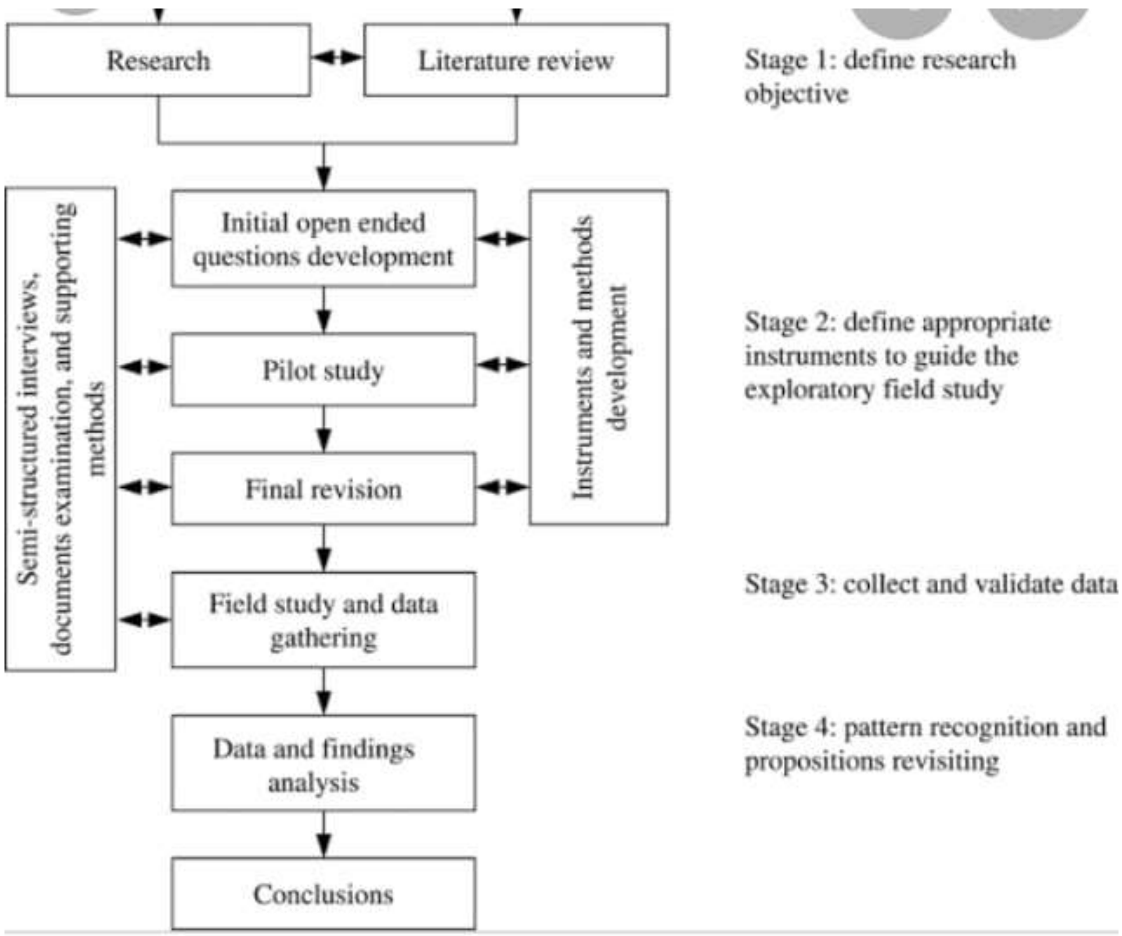

Fig 03 :- Flowchart of Objective procedure

CHAPTER 3

PROBLEM STATEMENT

Markets have moved from a business environment where the supplier held the power to a situation where the customer is in charge. This situation forces organizations to be more flexible to changing customer requirements (Christopher, 2005). Related to this development concepts like agile manufacturing, focused factories, customer relationship management and mass customization have enjoyed increasing attention in the literature during the last decade (Piller, Moeslein and Stotko, 2004). These new concepts of industrial value creation share a common objective; to provide ways of enabling companies to increase cost efficiency while simultaneously increasing the ability to react to changing customers' needs. For companies it becomes more and more important to develop customer value into their products. Therefore companies should listen more carefully to their customers (Fournier, Dobscha and Mick, 1998). This study will focus on the strategy of mass customization. Mass customization is becoming an important topic in industry and academia (Tseng and Jiao, 1998). Despite of the increased attention mass customization has received in the literature; it is still a novel concept lacking more extensive development (Silveira, Borenstein and Fogliatto, 2001). This statement is confirmed by Duray, Ward, Milligan and Berry (2000) by saying that mass customization is known to exist in practice, but academic research has not adequately investigated this new form of competition. In the literature is little contention on theoretical aspects such as the mass customization concept, objectives and justification, the debate over more specific and often practical questions remains somewhat inconclusive (Silveira et al., 2001). Also McCarthy (2004) states that there is a relative shortage of research on how to design and operate a manufacturing system capable of mass customizing. According to Silveira et al. (2001) the implementation part of mass customization is in the literature still at a starting point. The problem of how to implement and operate new manufacturing strategies like mass customization is a recurring and important theme in operations management (McCarthy, 2004). Despite of this importance, the adoption rate of mass customization in practice is low. The reason for this is the need for significant change to existing business models (Broekhuizen and Alsem, 2002). For achieving a mass customization strategy standardized methods and modularized product structure must be utilized. This requires changes inside of the company (Partanen and Haapasalo, 2004). The problem of the implementation part is not about understanding what constitutes the strategy, but determining how to design and transform an organizational system from its current form into one capable of achieving its new goals. This is certainly the case for mass customization.

From the problem indication, the following problem statement is formulated:

- **What are the requirements to product and process design related to the implementation of a mass customization strategy?**

CHAPTER 4

SOLUTION APPROCHED

In the future, many companies will go from a make-to-stock to a mass customization business model. For instance, General Motors plans to transform from a make-to –stock company to a mass customization company to reduce the costs of parts and unsold cars.

Some of the important strategies required for mass customization are:

•Supply chain management

•Internet Supply chain management

A typical supply chain management in the automobile industry is formed by thousands of companies related with the raw materials supply, the part of production, the sub-assembly, the final assembly and the distribution. For example, the Hyundai supply chain has approximately 400 first tire suppliers, 2,500 second tier suppliers and an unknown number of third or superior tier suppliers.

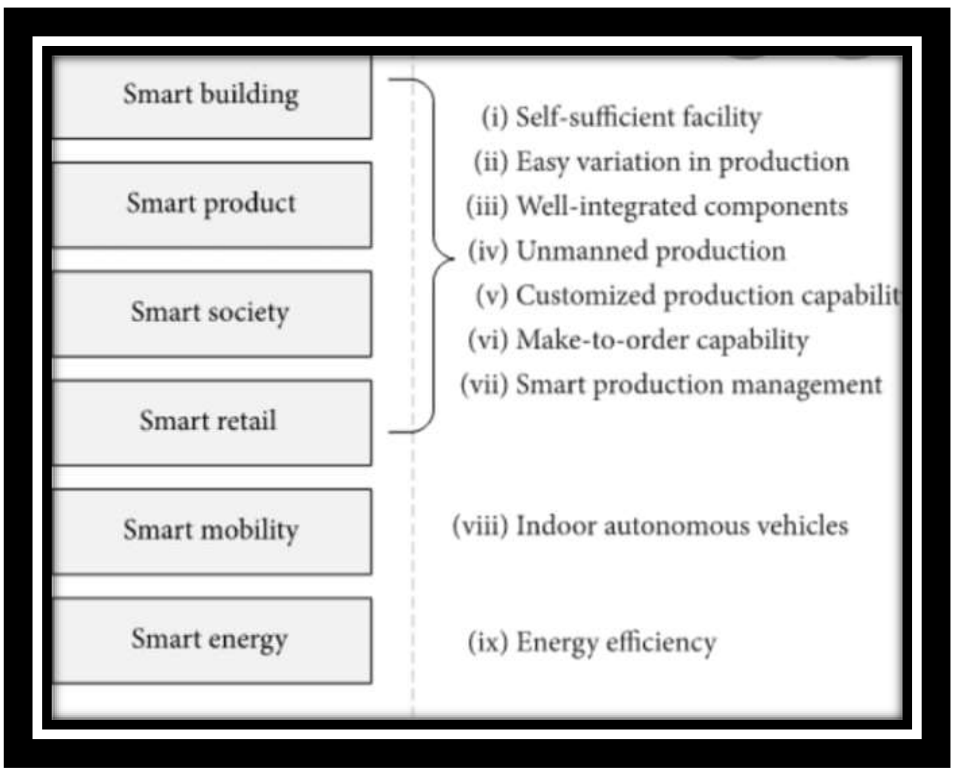

Fig 04:- Solution Approached procedure

Internet:

As in other industries, the internet revolution has had different impacts on the automobile industry. Four primary areas where automobile manufacturers are applying internet technologies

The internet facilitates e-procurement across the auto industry. The low cost and high speed of this communication method is necessary for the mass customization strategy to be economically feasible and to tell the automakers what you want them to build. The advent of electronic commerce over the internet has facilitated new relationships for connecting with new supply chain partners, thereby significantly increasing the quantity and quality of inter-organizational information flows.

The direct channel between manufacturers and consumers is enabling mass customization, and is influencing the production planning process. As a consequence, producers get better signals regarding the customers' preferences and demand levels, which in turn lead to better inventory management and production planning.

CHAPTER 5

METHODOLOGIES

5.1 REQUIREMENTS TO PRODUCT DESIGN

Product design is one of the critical points in developing a mass customization strategy (Feitzinger and Lee, 1997). The aim of this chapter is to investigate the requirements to product design in order to achieve mass customization. According to Duray, Ward, Milligan and Berry (2000) mass customization requires that unique products must be provided in a cost-effective way by achieving volume-related economies. They suggest that modularity is the key to achieve customization at or near mass production costs. Also Piller, Moeslein and Stotko (2004) argued that mass customization is only possible due to the capabilities of flexible manufacturing systems and modular product structures. Therefore, this chapter will focus on modular product design. The role of flexible manufacturing systems will be investigated in chapter four.

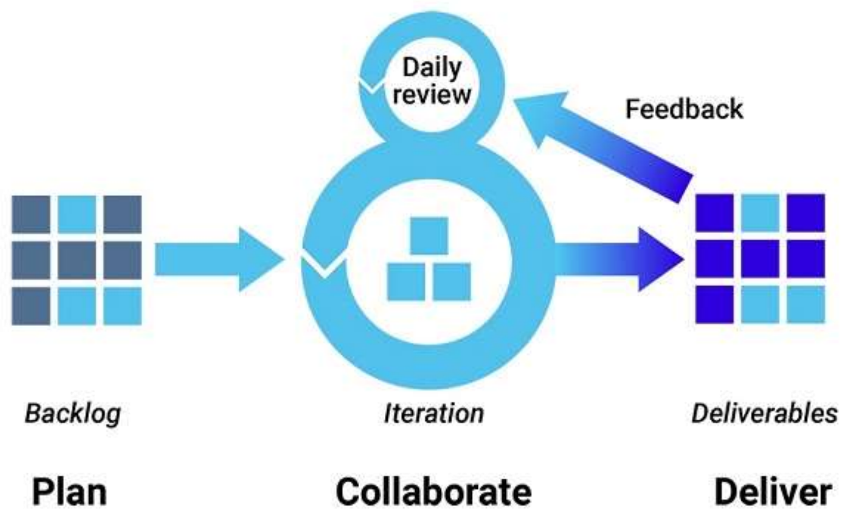

Fig 05:- Methodology Overview

5.2 MODULAR PRODUCT DESIGN

some methods for achieving mass customization. Two of these methods are related to product design. Firstly, a company must create products that are customizable by customers and secondly, companies must design modularize components to customize end-products. To investigate the aspects of modular product design it is important to know more about the boundaries of mass customization. These boundaries can be more clearly established by delineating two issues (Duray et al., 2000):

1. The basic nature of customization: this part is related to the distinction between customization and variety. Ulrich (1995) argued that product variety has emerged as an important element of manufacturing competitiveness. He added that variety is only meaningful to customers if the functionality of the product varies in some way. Durey et al. (2000) pointed out that variety provides choice for customers, but not the ability to specify the product. To improve variety a company must design their products specifically to

meet the needs of a customer. He described further that customization and variety are distinct. This distinction is important because it implies that customers must be involved in specifying the product.

2. Achieving customization at or near mass production costs: this part addresses the mass in mass customization. Pine (1993) argues that for developing and manufacturing unique products in a mass production way, modularity is a key to achieve mass customization. Through modularity a part of the product can be made in volume as standard modules, while Bachelor Thesis Edwin Heuvelmans, 2010 14 product distinctiveness will be achieved through the combination or modification of modules. Duray et al. (2000) concluded that modularity can be viewed as the critical aspect of gaining scale in mass customization. Pine (1993) argued that mass customization requires product modularity. Through utilizing modularity a firm can also provide variety and speed (McCutcheon, Raturi and Meredith, 1994). This is confirmed by Ulrich (1995) who stated that “modularity can provide an increase in product variety, shorten delivery lead times and economies of scope”. Durey et al. (2000) concluded in their research that “the literature suggests that modularity can facilitate an increasing number of product features available while also decreasing costs. Therefore, it follows that the successful implementation of mass customization is enhanced by effective use of modular product designs”. This statement is confirmed by Feitzinger and Lee (1997) by arguing that to achieve an effective mass customization program, “a product should be designed so it consists of independent modules that can be assembled into different forms of the product easily and inexpensively”.

CHAPTER 6

PRACTICAL INVESTIGATION OF MASS CUSTMOZATION

Duray et al. (2000) defined four mass customization configurations. These configurations are determined by the point of customer involvement in de production cycle and the type of modularity. can be seen that within the first group both customer involvement and modularity taking place during the design and fabrication stages. Duray et al. named this group the fabricators. This group involves the customers early in the process when unique designs can be produced or major transformations can be made in the products. Duray et al. stated that "the fabricators closely. Bachelor Thesis Edwin Heuvelmans, 2010 26 resemble a pure customization strategy, but employs modularity to gain standardization of the components". The second group integrates customer involvement during the design and fabrication stages but modularity is used during the assembly and use stages. This group is named by Duray et al. as involvers, because customer involvement precedes the use of modularity. This means that customers are involved early in the process but no new modules are produced for this customer. In this case customization will be achieved by combining standard modules to meet the specific requirement of the customer. Comparing this group of mass customizers with the first group (fabricators), Duray et al. determined that involvers capture greater economies of scale than the fabricators while maintaining a high level of customer involvement. The third group creates a modular approach in the design and fabrication stages, but the customer can just specify their unique requirements in the assembly or use stages. Duray et al. named this group the modularizers.

This configuration of mass customization does not gain maximum customization advantages from modularity (Duray et al.). In the fourth group customer involvement and modularity take place at the assembly and use stages. Duray et al. called this group the assemblers. Assemblers offer mass customization by using modular components to present a wide range of choices to the customer. Comparing this group with the other groups, the assemblers are the most related to mass production. However, this group differs from mass producers in the way that the customer is involved in specifying the product and the range of choice that assemblers made possible is large related to mass producers. Duray et al. tested their theoretical classification of mass customizers in practice. They carried out an empirical analysis and classification of 126 mass customizers for exploring manufacturing systems and performance implications of the various mass customization configurations. The mass customization configurations use different processes to achieve their mass customization capabilities. Duray et al. investigated the usage of line manufacturing processes and flexible manufacturing processes in order to achieve mass customization. The outcome of their research, related to the process choice of companies, can be summarized as follows. The fabricators are most closely related to pure customization. Therefore, the limited use of line processes for component manufacturing is not surprising. If a company qualifies itself as a fabricator, the company needs more flexible manufacturing methods to be able to produce products given specific customer requirements. The opposite of the fabricators are the assemblers. This group of mass customizers is most closely related to mass producers.

This means that assemblers have the highest usage of line processes. Bachelor Thesis Edwin Heuvelmans, 2010 27 Modularizers utilize modularity in the early stages of the production cycle. Duray et al. stated that "Modularizers may use modules to provide component standardization without providing customization until the customer is involved in the later stages”. This means that a part of the production processes exist of line processes and that the flexible manufacturing processes are necessary for achieving customization in the assembly part. Involvers have the customer involvement early in the production cycle and modularity later in the production cycle. For this group no new modules will be produced, so the standard modules can be produced with the use of line processes. After the customer specification is known more flexible manufacturing processes are necessary to combine these standard modules to the customer specification. Combining these outcomes of the practical investigation of Duray et al. with the process design approaches defined by Christopher (2000), Christopher and Towill (2001) and Naylor, Mason-Jones and Towill (2000) the following can be concluded:

- All the four mass customization groups have a leagility process design.

- The point of customer involvement determines the intensity of lean and agile in the processes. If the point of customer involvement is in the design or fabrication stages the main focus is on flexible production processes. If the point of customer involvement is in the assembly or use stages the focus is in the beginning more on efficiency and after the decoupling point agility is needed.

- For the design of the processes the focus must be on designing flexible processes to provide customization and responsiveness. Efficiency must be achieved through the production of standard modular components. Also Feitzinger and Lee (1997) investigated mass customization in practice by the Hewlett-Packard Company. They proved that it is possible for companies to deliver customized products quickly and at a low cost. Feitzinger and Lee defined three organizational-design principles that form together the basic building blocks of an effective mass customization strategy:

- A product should be designed so it consists of independent modules. This makes it possible for a companies to assemble their products into different forms easily and inexpensively.

- Also the manufacturing processes should be designed that it consist of independent modules to provide flexibility. Bachelor Thesis Edwin Heuvelmans, 2010 28

- The positioning of inventory and the location, number and structure of manufacturing and distribution facilities in the supply network, should be designed to provide two capabilities:

1. Supply the basic product to the facilities providing the customization in a costeffective way.

2. It must have the flexibility and responsiveness to take individual customers’ orders and deliver the finished, customized products quickly. Finally, Feitzinger and Lee stated that “the key to mass customization is postponing the task of differentiating a product for a specific customer until the latest possible point in the supply network”.

CHAPTER 7

DESIGN FRAMEWORKS FOR MASS CUSTMISAZATION

To design of various frameworks for mass customization is using the various mechanical simulating and design software's like AutoCAD, fusion 360 ,Inventor Autodesk , AutoCad , Ansys and solidworks. In the term of mechanical engineering on mass customization product design Deployment and forecasting is another with the use of this software design is made as with same of real industrial world life project with give all experimental theoretical and practical analysis and overview of the model.

7.1 COMPUTER AIDED DESIGN

CAD or computer-aided design and drafting (CADD), is technology for design and technical documentation, which replaces manual drafting with an automated process. If you are a designer, drafter, architect or engineer, you have probably used 2D or 3D CAD programs such as AutoCAD or AutoCAD LT software. These widely used software programs can help you draft construction documentation, explore design ideas, visualise concepts through photorealistic renderings and simulate how a design performs in the real world.

Fig 06 :- User Interface of CAD in Mass Customization

7.2 COMPUTER AIDED MANUFACTURING

Without CAM, there is no CAD. CAD focuses on the design of a product or part. How it looks, how it functions. CAM focuses on how to make it. You can design the most elegant part in your CAD tool, but if you can't efficiently make it with a CAM system, then you're better off kicking rocks.

The start of every engineering process begins in the world of CAD. Engineers will make either a 2D or 3D drawing, whether that's a crankshaft for an automobile, the inner skeleton of a kitchen faucet, or the hidden electronics in a circuit board. In CAD, any design is called a model and contains a set of physical properties that will be used by a CAM system.

When a design is complete in CAD, it can then be loaded into CAM. This is traditionally done by exporting a CAD file and then importing it into CAM software. If you're using a tool like Fusion 360, both CAD and CAM exist in the same world, so there's no import/export required.

Once your CAD model is imported into CAM, the software starts preparing the model for machining. Machining is the controlled process of transforming raw material into a defined shape through actions like cutting, drilling, or boring.

Computer Aided Manfacturing software prepares a model for machining by working through several actions, including:

- Checking if the model has any geometry errors that will impact the manufacturing process.
- Creating a toolpath for the model, a set of coordinates the machine will follow during the machining process.
- Setting any required machine parameters, including cutting speed, voltage, cut/pierce height, etc.
- Configuring nesting where the CAM system will decide the best orientation for a part to maximize machining efficiency.

Running a Contour toolpath in Fusion 360. Image courtesy of Kansas City Kit Company

Once the model is prepared for machining, all information gets sent to a machine to produce the part physically. However, we can't just give a machine a bunch of instructions in English. We need to speak the machine's language. To do this, we convert all of our machining information to a language called G-code. This is the set of instructions that controls a machine's actions, including speed, feed rate, coolants, etc.

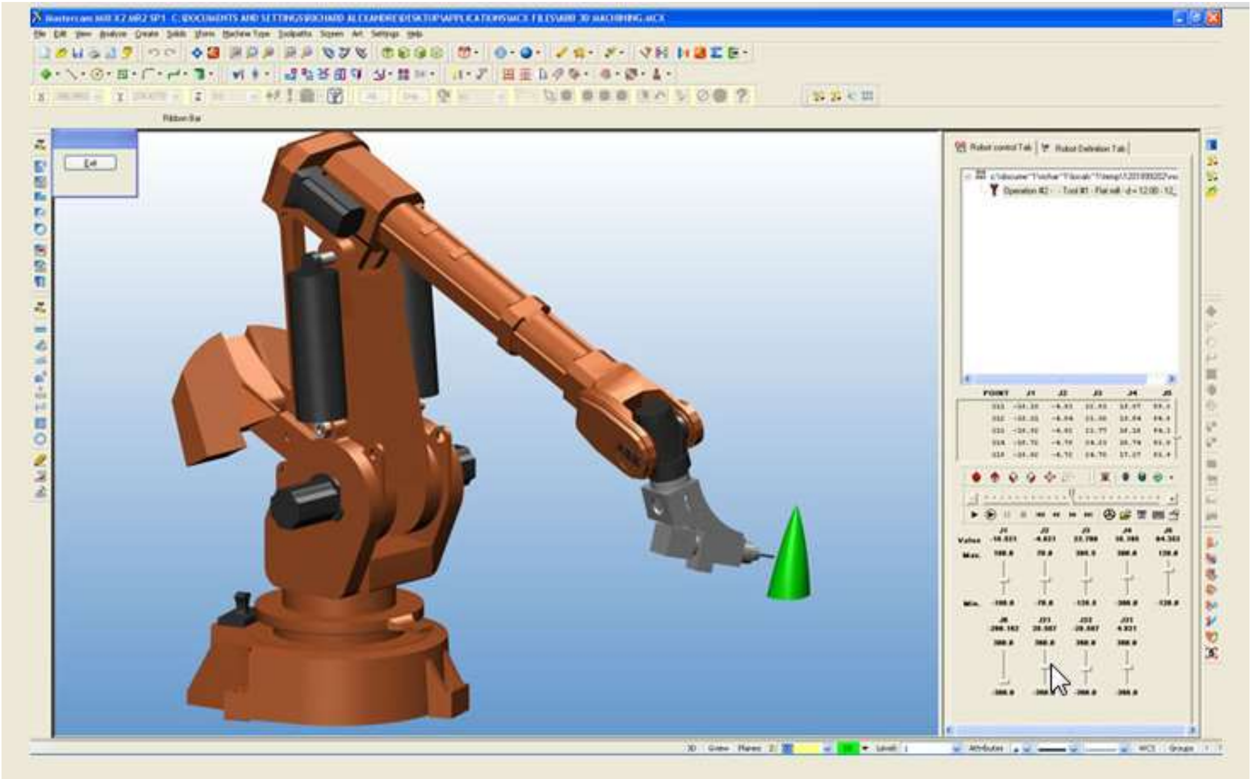

Fig 07:- Computer aided Manufacturing using Softwares

7.3 COMPUTER NUMERICAL CONTROL

G-code is easy to read once you understand the format. An example looks like this:
G01 X1 Y1 F20 T01 S500

This breaks down from left to right as:

- G01 indicates a linear move based on coordinates X1 and Y1.
- F20 sets a feed rate, which is the distance the machine travels in one spindle revolution.
- T01 tells the machine to use Tool 1, and S500 sets the spindle speed.

Fig 08 :- Mass customization using CNC

CHAPTER 8

CASE STUDIES OF AUTOMOTIVE INDUSTRY

8.1 CASE STUDY OF TOYOTA .LTD

Continuous improvement at Toyota Motor Company is now a business legend. For three decades, Toyota enlisted its employees in a relentless drive to find faster, more efficient methods to develop and make low-cost, defect-free cars. The results were stupendous. Toyota became the benchmark in the automobile industry for quality and low cost.

The same, however, cannot be said for mass customization, Toyota’s latest pioneering effort. With U.S. companies finally catching up, Toyota’s top managers set out in the late 1980s to use their highly skilled, flexible work force to make varied and often individually customized products at the low cost of standardized, mass-produced goods. They saw this approach as a more advanced stage of continuous improvement.

As recently as early 1992, Toyota seemed to be well on its way to achieving its goals of lowering its new-product-development time to 18 months, offering customers a wide range of options for each model, and manufacturing and delivering a made-to-order car within three days.

In the last 18 months, however, Toyota has run into trouble and has had to retreat, at least temporarily, from its goal of becoming a mass customizer. As production costs soared, top managers widened product-development and model life cycles and asked dealers to carry more inventory. After Toyota’s investigations revealed that 20% of the product varieties accounted for 80% of the sales, it reduced its range of offerings by one-fifth.

What happened? Was Toyota’s new goal off-base in the first place, or was the mass-customization program a victim of troublesome economic times? Many analysts believe that Japan’s recession and the devaluation of the dollar against the yen were the culprits that forced Toyota’s pullback. These factors had undermined the company’s competitive position and were causing its profits to slide. But, according to Toyota top managers, these weren’t the only reasons for the company’s retrenchment. They acknowledged that they had learned the hard way that mass customization is not simply continuous improvement plus.

All too often, executives at manufacturing as well as service companies that have been pursuing continuous improvement do not realize that mass customization is a distinct and, generally, a very unfamiliar way of doing business. This mistake is understandable. The frequent process enhancements generated by continuous improvement can increase the inherent flexibility of those processes. And, as a work force gets better and better, expanding its range of skills, it can handle an increasingly complex set of tasks, such as assembling a variety of products or delivering tailored services.

While executives are correct in thinking that continuous improvement is a prerequisite for mass customization, one thing is becoming clear from the experiences of companies such as Toyota, Amdahl, and Dow Jones. Continuous improvement and mass customization require very different organizational structures, values, management roles and systems, learning methods, and ways of relating to customers.

In continuous-improvement systems, tightly linked teams bridge disparate functions that typically interact with each other in a predictable, sequential manner. A hallmark is the conviction that every process must contribute to satisfying the customer by constantly and incrementally achieving higher quality. But a big difference from mass-customizing systems is that workers do not question the basic design of the product that they are assigned to build; they assume it to be what customers want.

Continuous-improvement organizations school workers in tools and techniques to help them improve the tasks they must perform. The fundamental precept is to learn by doing a task and then do it better. Managers of such organizations lead everyone on a relentless mission to eliminate waste and enhance quality through a vision of “being the best,” while still ensuring reliable outcomes from routine tasks. These managers are eternally striving to tighten the links between processes so that every team and individual worker knows how its function affects others and ultimately the quality of the product or service. They must be coaches who constantly urge employees to interact, converse, improve, and do what is right for the team. They try to foster values that create a sense of community because the interests of the individual are subsumed within the interests of the team, the company, and the customer.

Mass customization, on the other hand, requires a *dynamic network* of relatively autonomous operating units. Each *module* is typically a specific process or task, like making a given component, a distinctive welding method, or performing a credit check. The modules, which may include outside suppliers and vendors, typically do not interact or come together in the same sequence every time. Rather, the combination of how and when they interact to make a product or provide a service is constantly changing in response to what each customer wants and needs. From continually trying to meet these demands, the mass-customization organization learns what new capabilities it requires. Its employees are on a quest to increase their own skills, as well as those of the unit and the network, in a never-ending campaign to expand the number of ways the company can satisfy customers.

Managers in these ever-changing settings are coordinators whose success depends on how well they perfect the links that make up the dynamic network. They strive to make it ever easier and less costly for the process modules to come together to satisfy unique customer requests. And they lead the effort to increase the range of things that the organization can do. They must create a culture that places a high value on the diversity of employees’ capabilities because the greater the diversity of the modules, the greater the range of customization the organization can offer.

What all this boils down to is that mass customization is a totally different world from continuous improvement. It is a world in which the unpredictable nature of each customer’s demands is considered an opportunity. To exploit that opportunity, the organization must perpetually generate new product teams. The key to success is designing a linkage system that can bring together whatever modules are necessary—instantly, costlessly, seamlessly, and frictionlessly.

Vehical production in the year 2021 is,

Rank	Group	Country	Vehicles
1	Toyota	Japan	10,466,051
2	Volkswagen Group	Germany	10,382,334
3	Hyundai	South Korea	7,218,391
4	General Motors	United States	6,856,880
5	Ford	United States	6,386,818
6	Nissan	Japan	5,769,277
7	Honda	Japan	5,236,842
8	Fiat Chrysler Automobiles[a]	Italy/United States	4,600,847
9	Renault	France	4,153,589
10	Groupe PSA[a]	France	3,649,742
11	Suzuki	Japan	3,302,336
12	SAIC	China	2,866,913
13	Daimler	Germany	2,549,142
14	BMW	Germany	2,505,741
15	Geely	China	1,950,382

Fig 09:- Case studies of Vehicles Production in across world.

Chapter 9

CURRENT SENARIO

9.1 Introduction

In 2020, India was the fifth-largest auto market, with ~3.49 million units combined sold in the passenger and commercial vehicles categories. It was the seventh-largest manufacturer of commercial vehicles in 2019. The two wheelers segment dominates the market in terms of volume owing to a growing middle class and a young population. Moreover, the growing interest of the companies in exploring the rural markets further aided the growth of the sector.

India is also a prominent auto exporter and has strong export growth expectations for the near future. In addition, several initiatives by the Government of India and major automobile players in the Indian market is expected to make India a leader in the two-wheeler and four-wheeler market in the world by 2020.

Fig 10:- Future scope of Mass Custamisation

9.2 Market Size

Domestic automobiles production increased at 2.36% CAGR between FY16-20 with 26.36 million vehicles being manufactured in the country in FY20. Overall, domestic automobiles sales increased at 1.29% CAGR between FY16-FY20 with 21.55 million vehicles being sold in FY20.

In FY21, the total passenger vehicles production reached 22,652,108. In June 2021, total volume of passenger vehicles, three wheelers, two wheelers and quadricycle production reached 1,693,639 units. Two wheelers and passenger vehicles dominate the domestic Indian auto market. Passenger car sales are dominated by small and mid-sized cars. Two wheelers and passenger cars accounted for 80.8% and 12.9% market share, respectively, accounting for a combined sale of over 20.1 million vehicles in FY20. Two-wheeler sales stood at 995,097 units, while passenger vehicle sales stood at 261,633 units in April 2021.

Overall, automobile export reached 4.77 million vehicles in FY20, growing at a CAGR of 6.94% during FY16-FY20. Two wheelers made up 73.9% of the vehicles exported, followed by passenger vehicles at 14.2%, three wheelers at 10.5% and commercial vehicles at 1.3%.

Indian automobile exports stood at 1,419,430 units from April 2021 to June 2021 as compared to 436,500 units in April 2020 to June 2020.EV sales, excluding E-rickshaws, in India witnessed a growth of 20% and reached 1.56 lakh units in FY20 driven by two wheelers.

According to NITI Aayog and Rocky Mountain Institute (RMI) India's EV finance industry is likely to reach Rs. 3.7 lakh crore (US$ 50 billion) in 2030. A report by India Energy Storage Alliance estimated that EV market in India is likely to increase at a CAGR of 36% until 2026. In addition, projection for EV battery market is forecast to expand at a CAGR of 30% during the same period.

- Premium motorbike sales in India recorded seven-fold jump in domestic sales, reaching 13,982 units during April-September 2019. The luxury car market is expected to register sales of 28,000-33,000 units in 2021, up from 20,000-21,000 units sold in 2020. The entry of new manufacturers and new launches is likely to propel this market in 2021.

9.3 Investments

To keep up with the growing demand, several auto makers have started investing heavily in various segments of the industry during the last few months. The industry has attracted Foreign Direct Investment (FDI) worth US$ 25.85 billion between April 2000 and March 2020, according to the data released by Department for Promotion of Industry and Internal Trade (DPIIT).
Some of the recent/planned investments and developments in the automobile sector in India are as follows:

- In August 2021, Hindustan Zinc Ltd. announced a US$ 1 billion investment across its eight mines to replace diesel-powered trucks and equipment with battery EVs.
- In July 2021, Maruti Suzuki India announced a Rs. 18,000 crore (US$ 2.42 billion) investment in a new manufacturing facility in Haryana, with an installed capacity of 7.5-10 lakh units per annum. As it prepares to protect its market dominance, the company aims to increase capital spending by 67% to Rs. 4,500 (US$ 605 million) crore in FY22.
- In July 2021, Hyundai Motor India opened its new corporate headquarters in Gurgaon, backed by a Rs. 2,000 crore (US$ 269 million) investment.
- In April 2021, Mahindra & Mahindra announced a three-year investment plan in the electric vehicles segment of Rs. 3,000 crore (US$ 403 million).
- Between January and July 2021, EV component makers, electric commercial vehicles and last-mile delivery companies invested a total of Rs. 25,045 crore (US$ 3.67 billion) on electric vehicles.
- In FY21, passenger vehicles sales reached 27.11 lakhs units, two-wheelers reached 151.19 lakhs units, commercial vehicles sales reached 5.69 lakhs units and for three-wheelers it was 2.16 lakhs units.
- In 2019-20, the total passenger vehicles sales reached ~2.8 million, while ~2.7 million units were sold in FY21.
- In February 2021, the Delhi government started the process to set up 100 vehicle battery charging points across the state to push adoption of electric vehicles.
- In January 2021, Fiat Chrysler Automobiles (FCA) announced an investment of US$ 250 million to expand its local product line-up in India.
- A cumulative investment of ~Rs. 12.5 trillion (US$180 billion) in vehicle production and charging infrastructure would be required until 2030 to meet India’s electric vehicle (EV) ambitions.
- In January 2021, Lamborghini announced it is aiming to achieve sales in India higher than the 2019-levels, after recovering from pandemic-induced disruptions.

- In January 2021, Tesla, the electric car maker, set up a R&D centre in Bengaluru and registered its subsidiary as Tesla India Motors and Energy Private Limited.
- In November 2020, Mercedes Benz partnered with the State Bank of India to provide attractive interest rates, while expanding customer base by reaching out to potential HNI customers of the bank.
- Hyundai Motor India invested ~Rs. 3,500 crore (US$ 500 million) in FY20, with an eye to gain the market share. This investment is a part of Rs. 7,000 crore (US$ 993 million) commitment made by the company to the Tamil Nadu government in 2019.
- In October 2020, Kinetic Green, an electric vehicles manufacturer, announced plan to set up a manufacturing facility for electric golf carts besides a battery swapping unit in Andhra Pradesh. The two projects involving setting up a manufacturing facility for electric golf carts and a battery swapping unit will entail an investment of Rs. 1,750 crore (US$ 236.27 million).
- In October 2020, Japan Bank for International Cooperation (JBIC) agreed to provide US$ 1 billion (Rs. 7,400 crore) to SBI (State Bank of India) for funding the manufacturing and sales business of suppliers and dealers of Japanese automobile manufacturers and providing auto loans for the purchase of Japanese automobiles in India.
- In October 2020, MG Motors announced its interest in investing Rs. 1,000 crore (US$ 135.3 million) to launch new models and expand operations in spite of the anti-China sentiments.
- In October 2020, Ultraviolette Automotive, a manufacturer of electric motorcycle in India, raised a disclosed amount in a series B investment from GoFrugal Technologies, a software company.
- In September 2020, Toyota Kirloskar Motors announced investments of more than Rs 2,000 crore (US$ 272.81 million) in India directed towards electric components and technology for domestic customers and exports.
- During early September 2020, Mahindra & Mahindra singed a MoU with Israel-based REE Automotive to collaborate and develop commercial electric vehicles.
- In April 2020, TVS Motor Company bought UK’s iconic sporting motorcycle brand, Norton, for a sum of about Rs. 153 crore (US$ 21.89 million), making its entry into the top end (above 850cc) segment of the superbike market.
- In March 2020, Lithium Urban Technologies partnered with renewable energy solutions provider, Fourth Partner Energy, to build charging infrastructure across the country.
- In January 2020, Tata AutoComp Systems, the auto-components arm of Tata Group entered a joint venture with Beijing-based Prestolite Electric to enter the electric vehicle (EV) components market.

9.4 Government Initiatives

The Government of India encourages foreign investment in the automobile sector and has allowed 100% foreign direct investment (FDI) under the automatic route.
Some of the recent initiatives taken by the Government of India are -

- As of June 2021, Rs. 871 crore (US$ 117 million) has been spent under the FAME-II scheme, 87,659 electric vehicles have been supported through incentives and 6,265 electric buses have been sanctioned to various state/city transportation undertakings.
- In July 2021, India inaugurated the national automotive test tracks (NATRAX), which is Asia's longest high-speed track to facilitate automotive testing.
- In Union Budget 2021-22, the government introduced the voluntary vehicle scrappage policy, which is likely to boost demand for new vehicles after removing old unfit vehicles currently plying on the Indian roads.
- In February 2021, the Delhi government started the process to set up 100 vehicle battery charging points across the state to push adoption of electric vehicles.
- The Union Cabinet outlaid Rs. 57,042 crore (US$ 7.81 billion) for automobiles & auto components sector in production-linked incentive (PLI) scheme under the Department of Heavy Industries.
- The Government aims to develop India as a global manufacturing centre and a Research and Development (R&D) hub.
- Under NATRiP, the Government of India is planning to set up R&D centres at a total cost of US$ 388.5 million to enable the industry to be on par with global standards.
- The Ministry of Heavy Industries, Government of India has shortlisted 11 cities in the country for introduction of EVs in their public transport systems under the FAME (Faster Adoption and Manufacturing of (Hybrid) and Electric Vehicles in India) scheme. The Government will also set up incubation centre for start-ups working in the EVs space.
- In February 2019, the Government of India approved FAME-II scheme with a fund requirement of Rs. 10,000 crore (US$ 1.39 billion) for FY20-22.

9.5 Achievements

Following are the achievements of the Indian automotive sector:

- In H12019, automobile manufacturers invested US$ 501 million in India's auto-tech start-ups according to Venture intelligence.
- Investment flow into EV start-ups in 2019 (till end of November) increased nearly 170% to reach US$ 397 million.
- On 29th July 2019, Inter-ministerial panel sanctioned 5,645 electric buses for 65 cities.
- NATRiP's proposal for "Grant-In-Aid for test facility infrastructure for EV performance Certification from NATRIP Implementation Society" under the FAME Scheme was approved by Project Implementation and Sanctioning Committee (PISC) on 3rd January 2019.
- Under NATRiP, following testing and research centres have been established in the country since 2015.
    - International Centre for Automotive Technology (ICAT), Manesar
    - National Institute for Automotive Inspection, Maintenance & Training (NIAIMT), Silchar
    - National Automotive Testing Tracks (NATRAX), Indore
    - Automotive Research Association of India (ARAI), Pune

    - Global Automotive Research Centre (GARC), Chennai
- SAMARTH Udyog - Industry 4.0 centres: ‘Demo cum experience’ centres are being set up in the country for promoting smart and advanced manufacturing helping SMEs to implement Industry 4.0 (automation and data exchange in manufacturing technology).

CHAPTER 10

PROS AND CONS OF MASS CUSTUMAZATIUON

10.1 PROS OF MASS CUSTUMAZATION

- Higher customer retention since products have options and are tailored to personal tastes
- Fewer unfinished goods need to be stored, reducing overhead costs
- Quick, efficient production process from start to finish
- A higher price point for customized products, which means higher profits
- More flexible software and systems to handle highly customized orders

10.2 CONS OF MASS CUSTAMAZATION

- Impossible to build up stock ahead of time
- Forecasting trends/spikes in sales more difficult due to wide range of options
- Difficult to plan for surge in product demands
- Affects the flow of supply chains with 3rd party business partners
- Wait time from order placement to shipment to in-hand increases
- Increased costs to maintain a variety of machinery that can produce different product colors, shapes, etc.

CHAPTER 11

CONCLUSION

In conclusion, the findings of the case study suggest that automotive industry effectively employs mass customization. However, personalization represents a higher degree of one-to-one marketing vision. In particular, the firm examined in our case prioritizes personalization activities to create more customer value and develop a more customer-oriented product design approach. Besides, the disruptive progress along with Industry 4.0 comes up with various opportunities to facilitate the mass-personalization strategy. It can be concluded that the new Industry Revolution both requires and provides the personalization movement in the automotive industry. In the study, the Industry 4.0 phenomenon is discussed with a focus on the themes of customization and personalization. Technological developments have transforming effects on manufacturing and marketing vision in the automotive industry. Mass customization reflects the alignment of manufacturing environment into a more customer-oriented stance in the last decades. The manufacturers offer more and more options for customization; however, the rapid transformation along with Industry 4.0.

CHAPTER 12

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13. Industry Webinar

Thank You
