



Smart Manufacturing with 3D Printing

Rajiv Bajaj

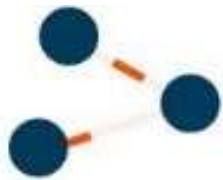
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TODAY'S MANUFACTURING SCENARIO



- Today's world of mass production is based on one simple rule: the *more* things you make, the *lower* the cost of each of those things
- This equation is literally pushed to its extreme limits
- Henry Ford Perfected the model of mass production and by 1915 he had reduced the time it took to build an automobile by 90%
- The Famous Statement !!!!
- Mass production is not the end of this story, but rather just a stop along the way to something completely different. What if a technology came along that could turn everything upside down all over again?

3D PRINTING ENABLES THE SHIFT OF DESIGN CONTEXT TO A HIGHER LEVEL – FROM SINGLE COMPONENTS TO SYSTEMS



Consolidation



Multi-functionality



Design Freedom



DFM to DFAM

Building a design environment that enforces shifting the context of design from the start.

Automotive - Manufacturing Tools

Volvo Trucks replacing metal
lift tool with thermoplastic tool

**From 28 Traditional to 6 FDM
Components**



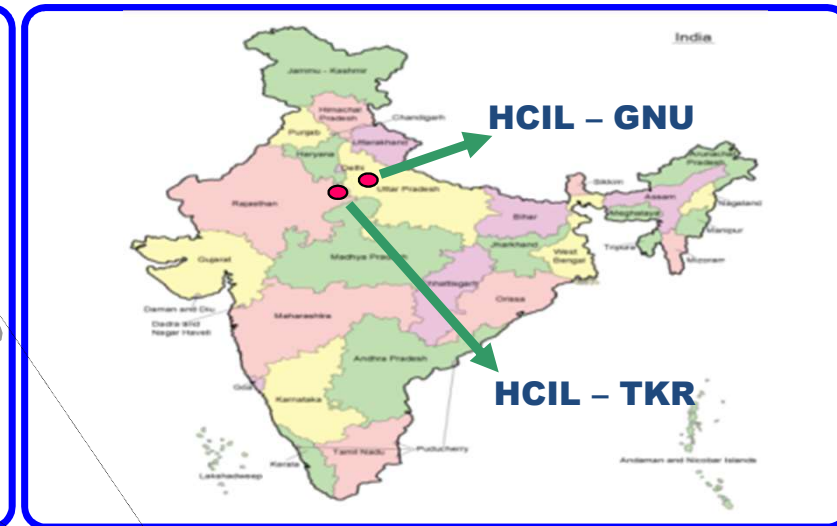
Smart Factory Solutions with 3D Printing



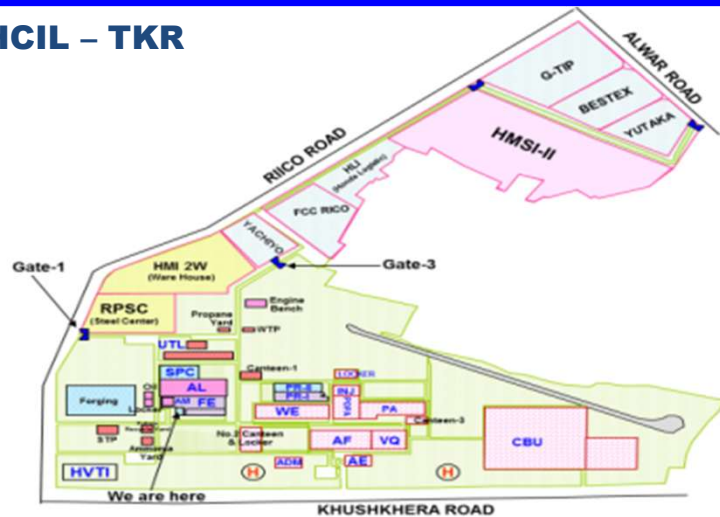
INNOVATION FOR THE DIGITAL FACTORY WITH HONDA CARS INDIA

Smart Manufacturing with 3D Printing





HCIL - TKR



LOCATION

ALWAR, RAJASTHAN
APPROX 67 KMS FROM
NEW DELHI

JOURNEY STARTED

3RD May 2007

AREA

TOTAL AREA - 611 ACRES
HCIL - 437 ACRES,
SUPPLIERS AREA - 174 AREA

PRODUCT

AMAZE,CITY,JAZZ,BRV,WRV,.

FRAME DIVISION



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WELDING IS PART OF FRAME DIVISION

- Innovation on Shop floor with 3D Printing
- Line Layout & Importance of Q checking assists
- Current SA & DA for 3D printing Introduction
- Methodology and Scope Fixation
- Project Execution & Implementation
- Learning's & Benefits of 3D printing
- Way Forward.....

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Conventional

(Made of Metal & Ciba)

3D Printed

(Made of Thermo-Plastics)

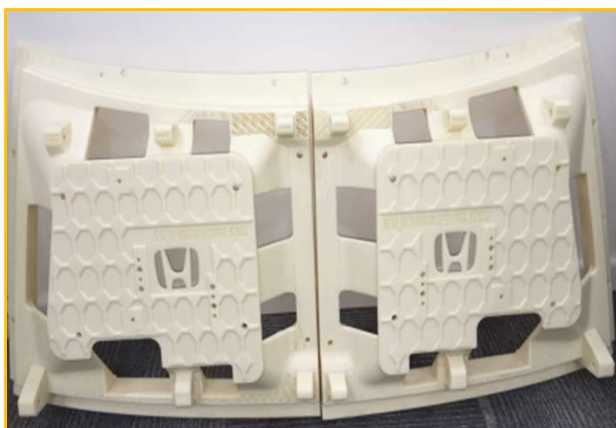
Car Windshield mounting dimension verification Jig



Car Headlights mounting dimension verification Jig



Trunk lid mounting dimension verification Jig



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INSPECTION JIGS CONVERTED TO 3D PRINTED JIGS

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Weld Shop- Line Layout

PROCESS FLOW:



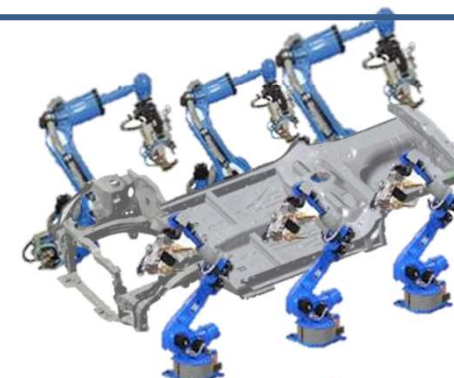
FRONT COMP



FRONT FLOOR



REAR FLOOR



FRONT WINDSHIELD INSPECTION



HEAD LIGHT INSPECTION



INSPECTION WITH CONVENTIONAL JIGS



TAIL GATE INSPECTION



TAIL LIGHT INSPECTION



welding shop

ADEQUATE CONTROLS IN PLACE TO ENSURE STANDARDISED OUTPUT

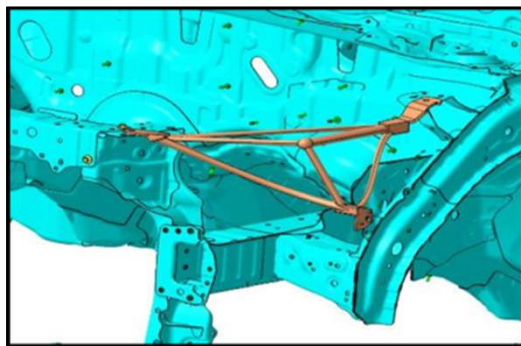
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VERIFICATION OF WINDSHIELD OPENING DIMENSIONS → SIMULATION @ ASSEMBLY



FRONT WINDSHIELD APERTURE

PILOT PROJECT FINALIZATION → HEAD LIGHT 3 D



HEADLIGHT GABARI

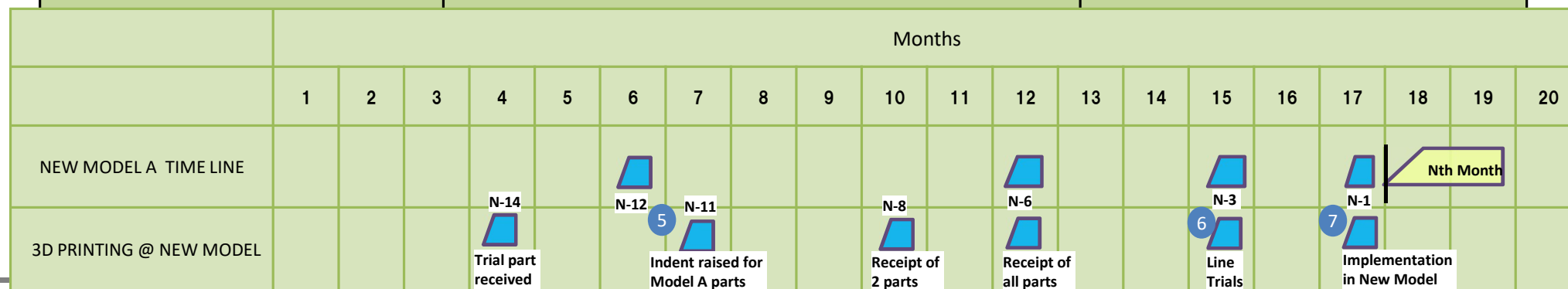
SA/DA - CONVENTIONAL Vs 3D PRINTING

Parameters		Conventional (SA)	3D Possible Benefits (DA)	Final Judgment
S Safety	ROBUST	<ul style="list-style-type: none"> Damage possibility → made of metal & ciba More Fatigue 	<ul style="list-style-type: none"> No Damage possibility → Robust Material Fatigue Reduced 	
	MOTIVATION	<ul style="list-style-type: none"> Low → Ergonomics issue Heavy weight 	<ul style="list-style-type: none"> High → ergonomics improvement Light weight → 60% Reduction 	
M Management	ACCURACY	<ul style="list-style-type: none"> Accuracy challenge due to Machining 	<ul style="list-style-type: none"> High accuracy → 3D Printing from 3D CAD data 	
Q Quality	COST	<ul style="list-style-type: none"> High cost 	<ul style="list-style-type: none"> Low cost → 40 ~ 50% Reduction 	
C Cost	LEAD TIME			<p>Technology change trial from Conventional to 3D</p>

PILOT PROJECT FINALISED & FORECAST BENEFITS EXPERIENCED OF 3D PRINTING

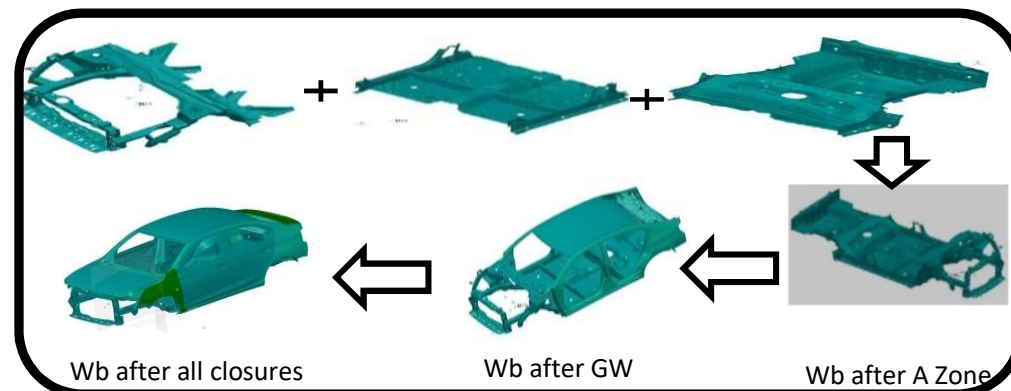
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1	Idea Generation	Seminar attended of 3D printing which gave the clue to use 3D printing for Ease of manufacturing	
2	Understanding the 3D Printing concept	Met M/S Stratasys India team- Understood the Application & scope of 3D printing	
3	Identification of Applicable area	Study of shop floor for identification of projects	1)Apertures 2) Gabaris 3) Fitment Jigs 4) Welding Jigs 5) Inspection Kengu
4	Concept Finalization	Finalized the concept and printed a sample jig of Head light CD checking for actual realization of the same	
5	Areas Identification for implementing in coming models	Areas identified in upcoming models for implementing this new technology	1)Apertures 2) Gabaris 3) Fitment Jigs 4) Welding Jigs 5) Inspection Kengu
6	Line Trial in simple and complex jig done	Trials done in both simple & complex types and got satisfactory results	
7	Implementation in New models	Implemented in two areas in new model	

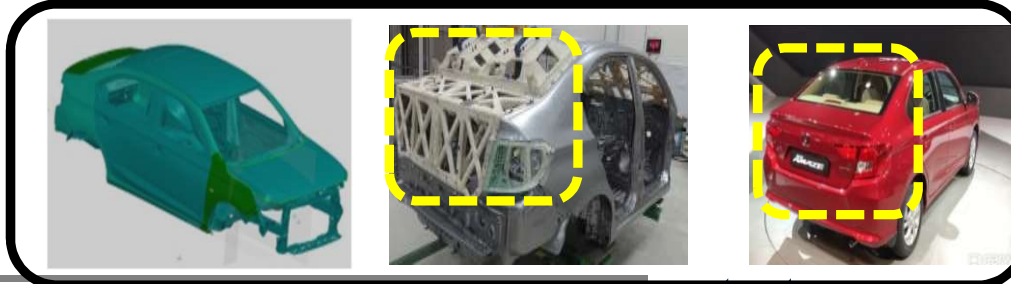


NEW MODEL TIMELINE MATCHED TO EXPERIENCE & HAVE REALIZATION OF THE NEW TECHNOLOGY

SR. NO.	NAME OF TOOL USED	DESCRIPTION	ILLUSTRATION
1	APERTURE S	APERTURES ARE USED TO SIMULATE ASSEMBLY CONDITION OF CRITICAL PARTS ON WHITE BODY	
2	GABARI	GABARI ARE USED TO ENSURE CRITICAL PITCH ACCURACY OF A SINGLE ASSEMBLY PART LIKE HEADLIGHT, TAIL LIGHT ETC.	
3	FITMENT JIGS	FITTING JIGS ARE USED FOR ACCURATELY GUIDING THE FASTENERS FOR FITMENT.	
4	WELDING JIGS	JIG IN WHICH TWO OR MORE PARTS ARE WELDED TOGETHER TO FORM A SUB ASSEMBLY COMPONENT.	
5	INSPECTION KENGU	THESE ARE THE MASTERS FOR VERIFYING THE CRITICAL COMPONENTS LIKE DOOR S, BONNETS, TRUNK ETC.	

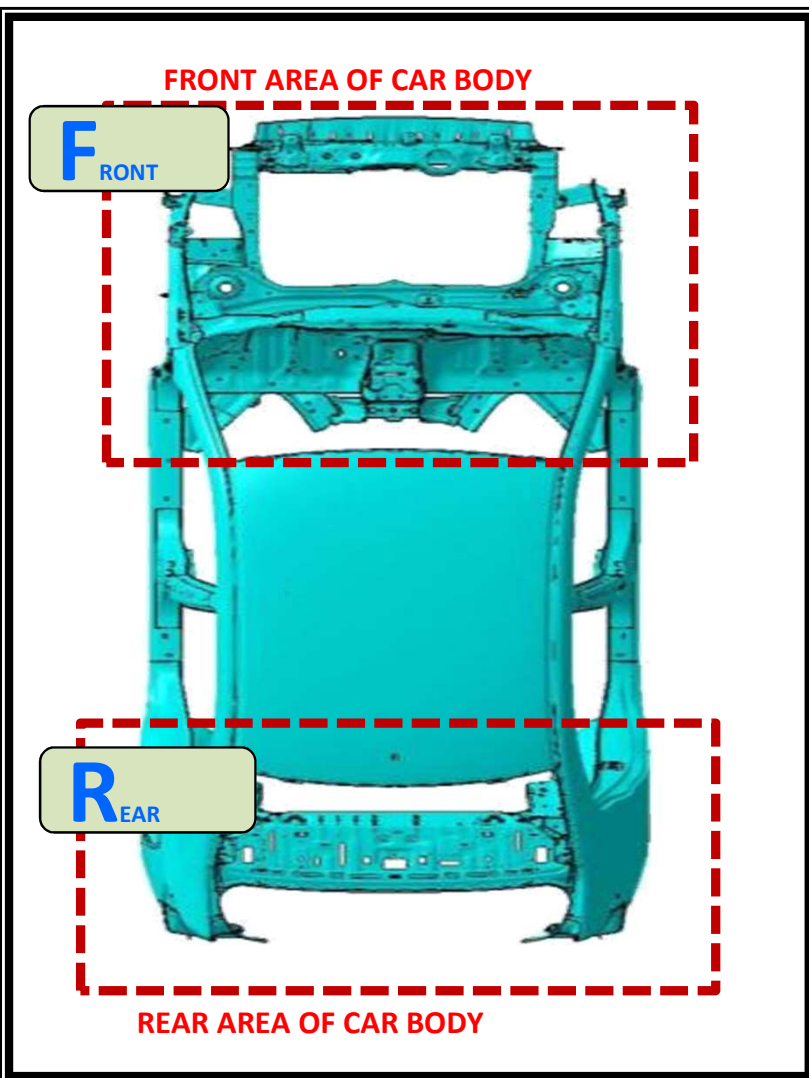
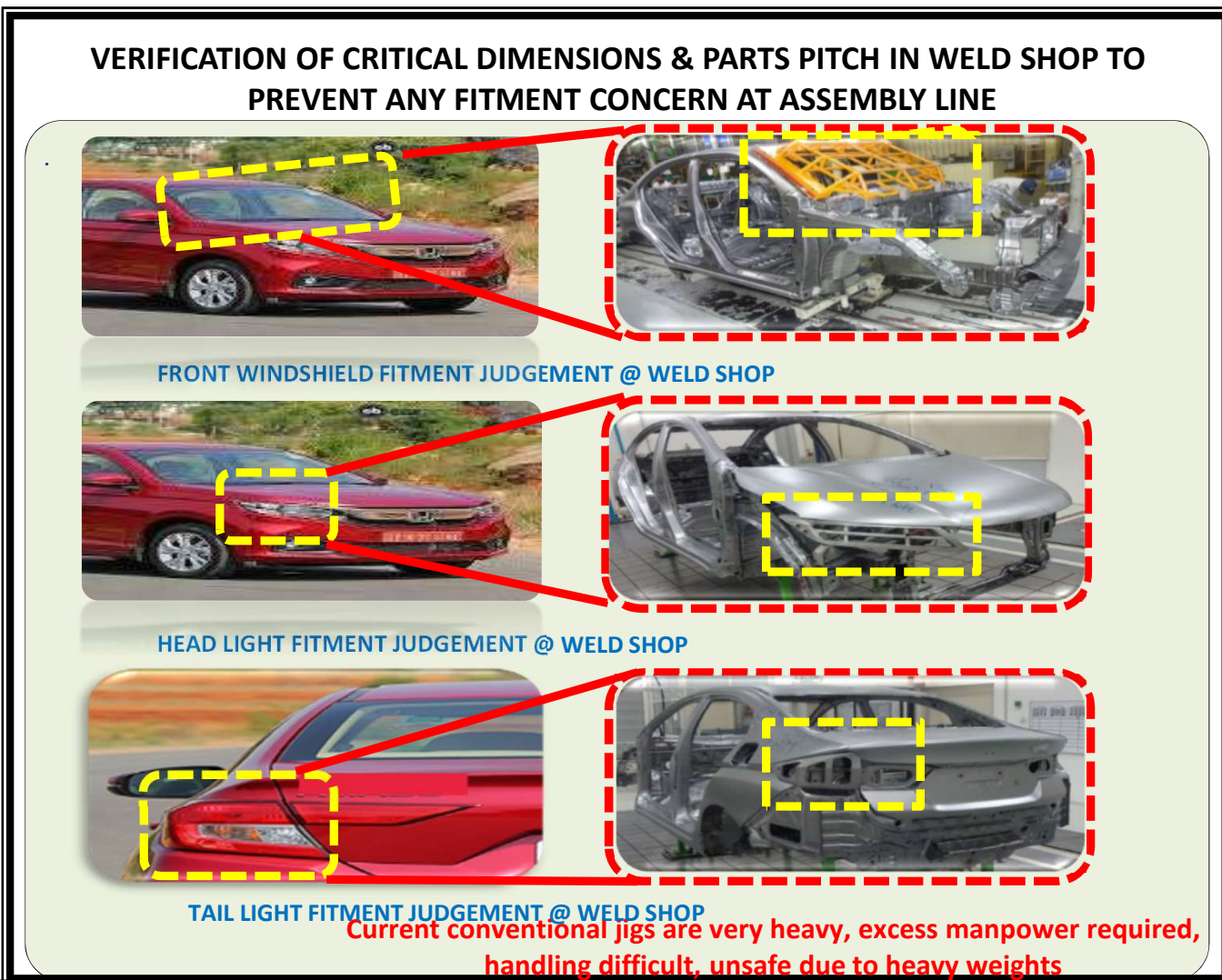


METHODOLOGY USED IN WELD SHOP FOR CRITICAL DIMENSION VERIFICATION



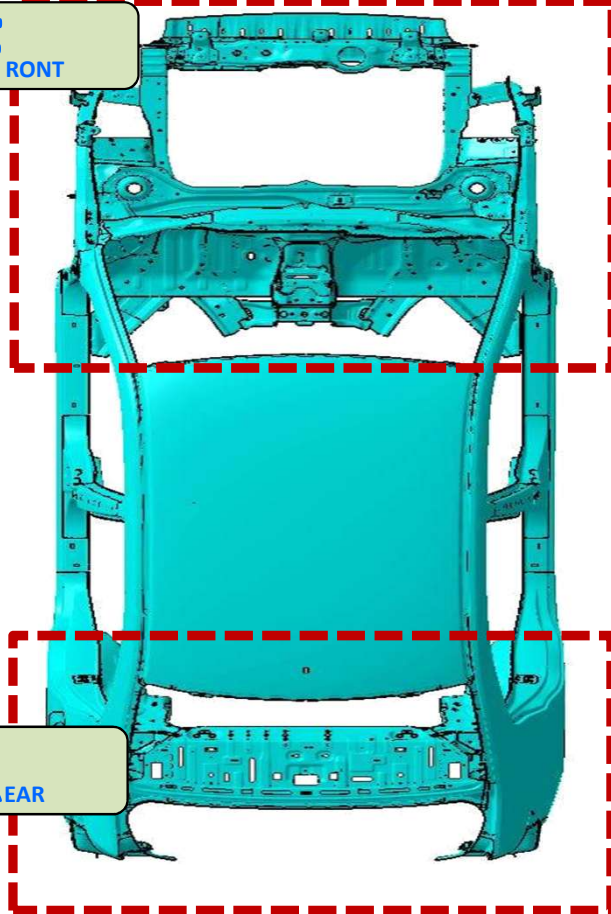
METHODOLOGY USED IN WELD SHOP FOR CRITICAL DIMENSION VERIFICATION

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FRONT AREA OF CAR BODY

F
FRONT



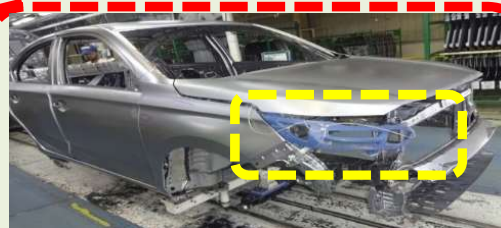
R
REAR

REAR AREA OF CAR BODY

VERIFICATION OF CRITICAL DIMENSIONS & PARTS PITCH IN WELD SHOP TO PREVENT ANY FITMENT CONCERN AT ASSEMBLY LINE



FRONT WINDSHIELD FITMENT JUDGEMENT @ WELD SHOP



HEAD LIGHT FITMENT JUDGEMENT @ WELD SHOP



TAIL LIGHT FITMENT JUDGEMENT @ WELD SHOP

Modified 3D printed Jigs are light in weight, only 1 manpower Required, easy handling and much safer

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IMPROVEMENT REALISATION IN 3D PRINTED JIGS



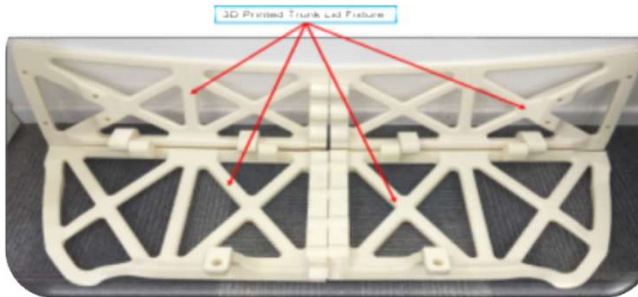
Head light LH



Front Windshield



Head light RH



Trunk Lid



Rear Windshield



Tail light LH



Tail light RH



Lid light
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SUCCESSFUL EXPERIENCE OF 3D PRINTED TECHNOLOGY

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AREA	FACTOR	ADVANTAGE	LEARNING	BENEFIT	OUTPUT
S	SAFETY WHILE USAGE & FATIGUE	<ul style="list-style-type: none"> Light weight Fixtures-Reduced to 7KG from 25 Kg 	<ul style="list-style-type: none"> Impact of weight reduction on shop floor safety 	<ul style="list-style-type: none"> Equipment (Jigs) Usage And Human Safety Improved Fatigue Reduced 	WEIGHT REDUCTION
Q	ACCURACY	<ul style="list-style-type: none"> Variation during Machining Operations minimised In 3D Printed Jigs 	<ul style="list-style-type: none"> Impact of manufacturing processes on accuracy of jigs 	<ul style="list-style-type: none"> Accurate Measurements as parts made as Per 3D Models 	ACCURACY IMPROVED
C	OVERALL COST	<ul style="list-style-type: none"> 40 ~ 50% Cost Reduced With 3d Printed Jigs 	<ul style="list-style-type: none"> Costing of different materials Direction for cost saving in future 	<ul style="list-style-type: none"> Cost Saving 	COST REDUCTION MANPOWER REDUCTION COST REDUCTION BY 50% & MANPOWER IN 1/3 RATIO
	MANPOWER COST	<ul style="list-style-type: none"> Low Weight Hence Manpower Reduced 		<ul style="list-style-type: none"> Manpower Cost Saved 	
D	LEAD TIME	<ul style="list-style-type: none"> Reduced Manufacturing Time Hence Shorter Lead Time Better Manageable, Digital Inventory 	<ul style="list-style-type: none"> Lead time difference with change of technology 	<ul style="list-style-type: none"> Project Timeline Reduced 	WIND SHIELD APERTURE DELIVERY TIME REDUCTION
	TACT TIME	<ul style="list-style-type: none"> Timely completion of work due to easy handling 	<ul style="list-style-type: none"> Impact of ergonomics on cycle time 	<ul style="list-style-type: none"> Line delay due to inspection reduced 	
M	OPERATOR MORALE	<ul style="list-style-type: none"> Easy Handling & Easy Movement Worker Comfort & Improved Ergonomics 	<ul style="list-style-type: none"> Awareness about Focus items of shop floor management 	<ul style="list-style-type: none"> High Motivation of Operators 	 High motivation Improved ergonomics

BENEFITS OF 3D PRINTING FOUND IN ALL VERTICALS OF SHOP FLOOR

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Assembly Frame:

- Emblem Placement
- Lock Fitting
- Wind Shield cantering Jig
- Body Protectors



EMBLEM PLACEMENT



BULK HEAD STOPPER



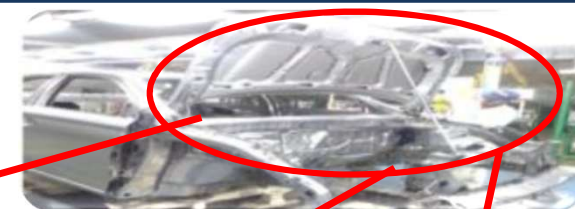
WIPER STOPPER



EMBLEM PLACEMENT

Paint:

- Stopper jigs
- Decal Aliment Jig



HOOD STOPPER



HOOD LATCH CD GABARI



BULK HEAD STOPPER

POPA:

- Bumper Prototype – for Robo Trial
- Bumper Carrying Jig to Paint shop- Before Production



WELD:

- Setting jig
- Gabari
- Aperture
- Kengu
- Welding jig



sirar@svs

HORIZONTAL DEPLOYMENT CAN BE DONE IN OTHER SHOPS ALSO

3D PRINTED JIGS AND FIXTURES

Optimizing manufacturing

COUNTERING MANUFACTURING CHALLENGES

- Decreasing cost
- Reducing cycle time
- Increases and maintains product quality and repeatability
- Increasing workforce safety
- Enabling a more nimble manufacturing process
- Minimize the possibility of human error
- Permit the use of medium-skilled labor
- Allow production of repeat orders without retooling

THANK YOU

