Innovations in Products for Strategic Sectors (Defence, Aerospace, Energy)

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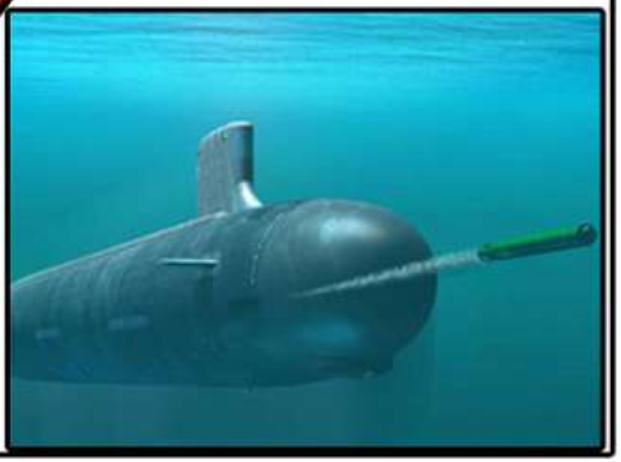
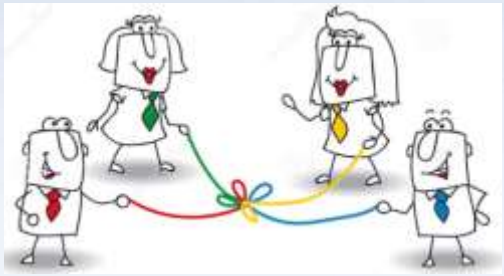
"WE ARE EVERYWHERE

FROM DEEP SEA TO SPACE"



A. Success factors in metallic materials product development

1. Customer specific product development / innovation



Co-development

Hand-holding

Launching

Maraging steel was co-developed by involvement of ISRO (Customer), DMRL (Research Organisation) and MIDHANI (Manufacturer).

During the initial stages hand-holding was done by placement of trial orders for various forms such as rings, plates and forgings.

After successful execution of trial orders meeting all the requirements of agreed specification, bulk orders were placed thus launching MIDHANI as a manufacturer of Maraging Steel.

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2. Role of Building blocks of acquired knowledge

New grade of precipitation hardening and maraging steel products developed and added into product basket

MDN350 for Energy sector
MDN17-4PH for Aerospace
MDN15-5PH for Aerospace
MDN11-10PH for Aerospace
MDN 15-5T for Defence
MDN13-8 PH for Energy and Aerospace
MDN12-10PH for Space
MDN 59 & MDN 60 for Defence
MDN465 for Aerospace

Acquired Knowledge

Successful manufacture of Maraging steel products

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3. Role of cross-functional team

Functional Area A

- **Melting**
- Choice of furnace, raw materials, procedure to be adopted and parameter to be adhered to during melting and remelting, etc to obtain a sound and segregation free ingot

Function Area B

- **Hot / Cold Working**
- Thermo-mechanical treatment to be adopted to ensure a fine grained, homogenous structure.

Functional Area B

- **Process**
- Melt route and hot /cold working process to be adopted, heat treatment cycles, etc to ensure the final material meets the specification and exceeds the customers expectation.

Area specific knowledge and skill set, recognition, team building, ...

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4. Product development/ Innovation is a Process

Incremental improvement in the existing products

1. Higher impact toughness in MDN13-8 PH for ball screw mechanism for nuclear fuel handling.
2. Ti31 dome forging for space
3. Increase in corrosion resistance in MDN 304L (NAG) for critical components in nuclear fuel reprocessing plants.
4. Improvement of fatigue properties in MDN 440 C for bearing in aerospace applications.
5. Triple melted quality feedstock for turbine rotor/disc forging of IN 718

...and many more

Breakthrough innovation / development

1. Supercast 713 C(IN 713C) thin section blade & impeller for turbocharger of 4400HP diesel locomotive
2. Superni 750MW various size ring/disc forging for semi-cryo engine.
3. Beta 21S/Titan 44 cold rolled sheet for engine shroud/missile application.
4. Supercast 55 for bushes of reactivity control mechanism of commercial / submarine nuclear application
5. Ti 10-2-3 forged and hot rolled bars for Class I component - landing gear of Tejas

... and more

Process innovation targets cost improvements

Product innovations target product improvement

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5. Bench marking of products for innovations

MIDHANI is a unique organisation and houses facilities for manufacture of alloy steels, nickel alloys, cobalt alloys, titanium alloys, etc and helps meet the critical requirements of aerospace, defence, nuclear, space and others.

The company can benchmark present performance against its own past performance.

Based on the above, there is quantum jump in the present performance (over a ten year period) over a similar period earlier. This is because in each of our customer in strategic sector is developing / innovating new technology which NEEDS NEW MATERIAL or product form.

Benchmarking help nurture and improve the **innovation** culture in any organization.

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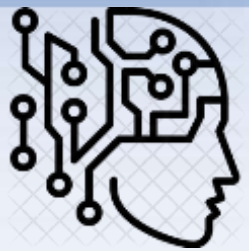
B. Future Directions for Innovations



1. Role of AI in Product Development

Offline and online data with respect to various parameters is being collected during the processing of the relevant grades.

The data is collated and analysed using AI tool to minimise the refining period and also the overall melt duration thereby improving the quality of steel.

Process optimization of (1) maraging steel such as MDN250 & MDN350 and (2) H13 tool steel.

Develop new alloy or improve the attainable strength, fracture toughness, etc of the present alloy.

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2. Role of 3D printing products

- **Additive Manufacturing** (AM) also known as 3D printing is a process that creates 3 dimensional objects from 3 dimensional information.
- 3D printing will drastically reduce the raw material requirements.
- Will replace all parts in future that are presently being investment cast or close die forged and machined.
- Prospective customers will be ISRO (semi-cryo and cryogenic engine components), HAL and medical hospitals (dental & other prosthetics)

Courtesy: Sciaky's

Finds applications in

- **Aerospace**
- **Aeronautical**
- **Automobile**
- **Artificial body implants**

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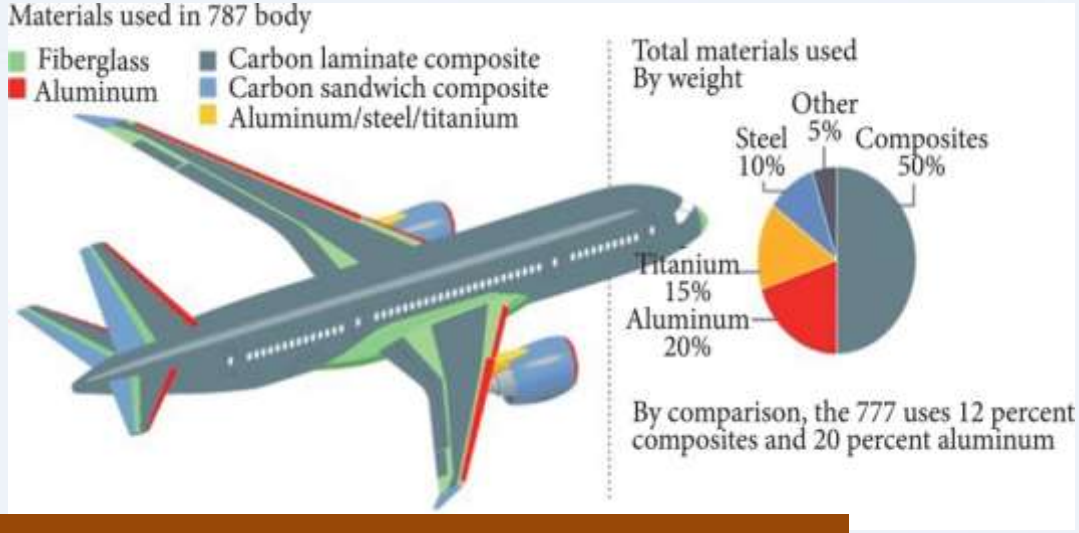
3. Role of non-metallic material products

Aerospace and aeronautical application are on constant look-out for materials that provide **high strength to weight ratio in the application environment**.

Common composite materials used on airplanes include fibreglass, carbon fibre, and fibre-reinforced matrix systems or any combination of these. The commercial aircraft / aerospace depends on the composite materials to decrease the weight and fuel consumption. **Carbon fibre is a material that offers stiffness and strength at low density.**

Ceramic Matrix Composites find use in aerospace and aviation engine because **they can withstand higher temperature, are non-corrosive and less dense**.



This allows for greater payloads on aircraft, faster speeds for military jets, and longer duration for space exploration.

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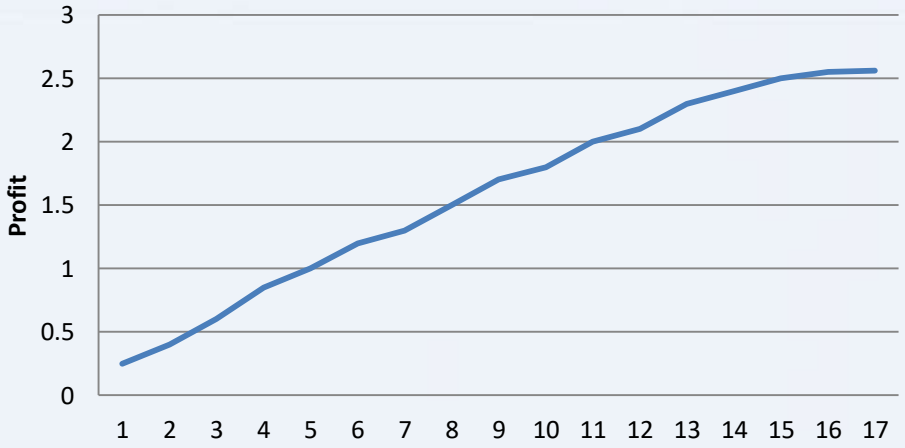
C. Payback of innovation in products

1. Economics of innovation / development

Normal Commercial Sector

Normally in any development / innovation , there is a period of investment in equipments and production trial runs before the product is released to market and the payback starts.

Strategic Sector



However, in case of strategic sectors payback starts with the production activity (as the material is developed with the available equipments) and this is because of the tight timelines of the projects. Subsequently suitable process developments are carried out to improve the cost margins.

2. EBDITA margins are always more, compared to normal product due to value proposition to customer (is high) & cost of raw materials (low)

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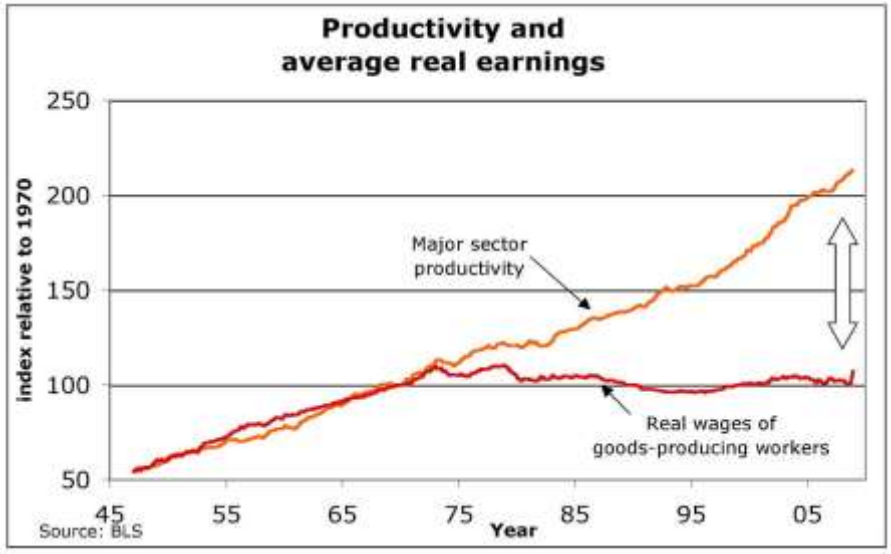
D. Appropriation of Innovation

1. Learning Curve

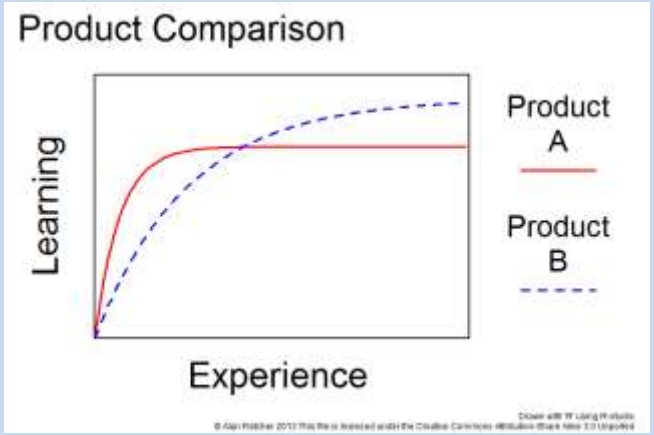
Effect of learning of productivity and efficiency for a individual or organisation is to bring down the cost of production.



U.S. productivity and average real earnings, 1947–2008

2. Complexity

The general pattern of learning team is of first speeding up and then slowing down, as the targeted level of improvement is reached.



Product A has lower functionality and a short learning curve.
Product B has greater functionality but takes longer to learn

3. Time dependence

The longer the time duration for gaining experience or longer the life of the innovation the better.

Conclusion

Strategic sectors are constantly are on look out for developing or manufacturing something new..... may be new higher protection armoured vehicle, higher temperature boiler for improving the efficiency of thermal power plant, lighter aeroplane, higher payload launch vehicles, smaller nuclear power plants, etc.

Such customer continuously throw challenges - either a new metallic material or a new form of earlier material to MIDHANI.

MIDHANI has steadfastly stood by its customer needs irrespective of the quantum of economic gain. The knowledge gained from one activity is applied to many other developments.

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Thank You

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