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# Commercialisation - A Strategic cost management mechanism, Patented, Manufactured In India

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## Abstract:
We had envisaged rapid manufacturing activity in terms of scale and quality, in the emerging markets like India as long term perspective when we had begun to architecture our business goals in TMS, founded in 1997.

The main objectives were, to innovate strategic cost management mechanisms for the manufacturing sector, affordable, application specific, addressing to the micro functions of manufacturing activity with capability to mass customize the technological solution for various processes. The implemented technology shall have an impact on the overall cost of production through improvement in the efficiency of the utilities used in the manufacturing process.

## Introduction:
We focused on the choice of technology as a need based solution. Our choice was building a business driven field research, that involves identifying the need, implementing the technological solution, evaluation of the implemented technology, establishing the performance improvement of the utility using data driven analytics and replicating it to several other similar systems thus maximizing the learning curve benefit. We planned to build a sustainable business model. We obtained the patents for the technologies and used the referential campaign strategy by institutionalizing both the technology and the business.

## The novelty of the value proposition:
We configured the business driven research model by innovating technology to micro-improvise the efficiency of the existing systems, without any modification, thus evaluating the percentage of improvement in specific energy consumption, after implementation. The pay back was within 90 days.

Our unique proposition against competing technologies was providing combustion improvement of both Gaseous and liquid hydro carbon fuel, which technologies like additives and others do not provide. The patent no's are 253287,250627,250491.

Improvisation of combustion process of the utilities forms the basis of the application of generic technology- Application of magnetic resonance for dynamic polarization of hydro carbon fuel that will readily react with air, thus for same mass flow we have increased reaction rate. The magnetic material is a Nano- crystalline cluster of amorphous Neodymium ferrous alloys having high coercive strength.

Numerous field experiments in manufacturing plants were carried out to correlate the effect of Magnetic resonance and its correlation with flow velocity of Hydrocarbon fuels in the fuel pipelines, in proximity to burners/injectors were undertaken. Computing the fluid dynamics of the fluid in the conduit, the configuration of Magnetic Resonators was finalised. Mass customization was achieved by using the standard units of Magnetic resonators and number of units were varied to suit the requirements of Gas turbines, Boilers and Furnaces of varying capacities.

Collaboration was at its best when our clients like L&T, Hyundai, made presentations of our technology in CII. IOCL, HPCL, made presentations in the RTM. Our current portfolio of clients include HPCL, Hyundai, IPGCL, IOCL, L&T LTD,

## The process of implementation:

1. **Predictive analytic:** We study the utility and its contribution for the total process. The base data of the utility is analysed, such as, type of fuel, its flow rate, Load pattern, capacity utilization, diameter of fuel line leading to the burner/injector etc

2. **Configuring the Magnetic resonators:** Magnetic resonators are compact magnetic material having very high Gauss value and weighing less than 300 grams. There are two types of magnetic materials one Neodymium NDFe37B and the other strontium ferrite. Viscosity, specific gravity of the fuel and kinetic velocity of the fuel inside the fuel line, are significant drivers for choosing, configuring and positioning magnetic material, supported by the computational fluid dynamic algorithm.

The basic aim of this procedure is to tune the magnetic resonators to the frequency spectrum of fuel in the fuel conduit closer to the point of combustion. The fuel in motion when resonated with Magnetic field gets polarized in phase perpendicular to the magnetic field. The polarized fuel readily reacts with air, enhancing the Air: Fuel ratio, thus improving the combustion.

## Case Study 1:

**Magnetic Resonators for 20MW Gas Turbine, completed in HPCL VIZAG REFINERY (4 NOS)**

## Predictive analytic:

An uninterrupted captive power generation from the gas power plant is vital for petroleum refining process. The efficiency of generation is calculated in terms of the specific fuel consumption.

The feasibility study of the implementation of fuel management by installation of Magnetic resonators for GT (GE Make) Frame V, base load (21.3 MW) using the Naphtha as fuel was studied. The magnetic resonators were to be located on the fuel line closer to the burners of the combustor. There are 10 combustors and the outside diameter of fuel line 20 MM.

## Schematics for installation:

Fig 1 A and Fig 1 B shows the placement of Magnetic resonators. The Magnetic resonators (M) is installed on the fuel with help of safety device. There are 2 Nos of Double resonance type 2 Nos of Magnetic memory type clamped using safety devices (**Q**) on the fuel line (**F**). There are 10 such fuel lines (F) supplying the liquid Naphtha to the each of combustors in the combustion chamber (**C**). The Fuel lines (Naphtha) originate from the flow divider (**E**) that belongs to Frame V G.E gas turbine (**A**).The Magnetic resonators are two type. 1 Double resonance 2. Magnetic Memory type. They are placed alternatively one after another, with Magnetic memory type closer to the burner.

## Evaluation:

The table 1 shows SFC for different loads. The loads are chosen as those that match it with post installation load. The sampled savings is compared with larger data and the plant technical services department gives the final report as that around 1.65 MT of Naphtha consumption is saved per GT.

The Figure 2 shows the plot of SFC versus designated loads that are almost equal during the pre-installation and Post-installation.

## Economics:

Initially we installed for 1 no Gas turbine and later extended to other GTS. 1st Gas turbine: Project completion – 6 Months. After the successful and sustainable results in the first Gas turbine, we replicated for 3 more Gas turbines. Project Duration: 11Months, Quantum of Naphtha saved: 1.65 MT/Day/GT, Total Investment for 4 gas Turbines= Rs.15, 90,400, Payback = 8 Days

## Case Study 2:

**Furnaces (Heat treatment) 10 no's completed in L&T Powai & L&T Hazira works, L&T(MHPS),L&T(SSHF). After successful implementation for 1 no, we extended it to other furnaces with similar operating characteristics in L&T Hazira.**

The case study focuses on L&T Heavy Engineering Division (Powai Works), that has Natural Gas fired furnaces for heating the Specimen Job of Weighing 559 Kgs to the desired Temperature.

The TABLE 2 represents the technical details of the burner relevant to the experiment. Initially the data has been collected before the installation of Magnetic Resonators for the above mentioned three different fuel flow inlet pressure, namely 0.37 bar, 1 bar & 2 bar, of Natural Gas by L&T Powai. After installation of Magnetic Resonators on the NG Fuel line, the performance data was monitored, for same Fuel inlet pressures.

## Evaluation:

The Field tests were conducted in controlled conditions and 3 key observations were planned. All the observations were tailored to monitor the results before the installation of Magnetic resonators and after the installation of Magnetic resonators for all three conditions, namely condition -1 (0.37 bar), condition-2 1 bar, condition-3 ( 2 bar).

TABLE 3 represents the Observation 1 that depicts the % improvement in the temperature rise in during the 240 minutes, after installing the Magnetic resonators. 0.37 bar and 2 bar, are two extremes fuel inlet pressure that designates the scope for improvement being the lowest, supported by data in the fact sheet in table 2 (S No 5) giving the details of % heating efficiency at different fuel inlet pressures. The fact sheet Table2 indicates, % heating efficiency of burner ST-80 is highest at 1 bar, say 24.4%. TABLE 3 shows the % improvement in the temperature rise in 240 mins is the highest at 1 bar fuel inlet pressure after installation of Magnetic resonators, it has improved by 20 degrees Celsius.

Figure 3 shows the installation of Magnetic resonators for each of the burners of the furnace.

## Economics:

The FIGURE 4 shows the improvement data such as improvement in cycle time by 5 Hours, improvement in fuel consumed and Fuel saved.Quantum of NG saved: 292 SCM/Cycle, Total investment Rs.60Lacs approximately, for 10 such furnaces Payback 68 Days

The case studies depict the mass customisation of technology for implementing it to different categories of utility, GT and Furnaces, commonality amongst them being combustion process.

## Business Plan:

As evinced through our case studies we balanced our model between Current Need, Challenges, opportunities and Value Proposition.

**The current need:** The current need is to provide a unique micro-improvisation mechanism to improve the efficiency of a process or total processes. The improvisation by improving the combustion efficiency by providing magnetic resonators solution results into tangible results such as lowering specific fuel consumption of any utility, in addition to reduced emissions.

The systematic approach enabled us to formulate the Technology-Market grid. We segmented the market based on type of Processes, Type of Fuel and Type of Equipment/Utility defines the market size. For Example, in refinery we have Natural gas fired Gas turbines or Naphtha fired Gas turbines, Fuel gas fired Furnaces and RFO fired Boiler.

**Challenges:** After identifying the need, the major challenge is to tailor the technology to obtain the optimum results. It is technically intensive activity. It demands that we have engineers who are trained in the soft skills, along with technical acumen. The predictive analytics and our experimentation gives the edge towards accurate prediction.

**Opportunity:** The need to manage costs and control emissions is the cause for implementing the fuel management by installation of Magnetic resonators. However, referencing is the force multiplier for sustained existence of opportunities and to maintain the sustainability we deliberate utmost focus on analysis of the performance of the utility after installation.

**Business Value:** The value of the deliverable is critical, as depicted in the case studies it leverages on ease of installation, affordability, quicker payback and higher profitability index.

For all our projects completed, we have maintained the same format such as Predictive analytic, configuration of Magnetic resonators, submission of proposal and conducting the performance evaluation study after implementation of Fuel Management by installation of Magnetic resonators. This has enabled us to institutionalise the brand “Magnetic resonators” that most of manufacturing companies are aware of. It has enabled us to successfully commercialise the technology and its methodology for implementation.

We believed commercialisation of the technology should be associated with sustainability of the business. The business driven field research, formed the basis of our technology implementation and was replicated for decade and half for various utilities that include Boilers, GTS, DG sets and Furnaces. Manufacturing sector demands repeated performance characteristic of the technology. Thus repeated implementation, characterised the commercialisation. Revenue model coupled with gaining the market simultaneously enabled us to bootstrap the funds required for our further research in the technology. We developed our market carefully based on Build up and break through strategy.

## Conclusion:

The patented technology, indigenously manufactured in India, by us, MSME, is affordable for all sectors. It improvises the performance efficiency of utilities that gets converted into revenue, increasing overall operational efficiency, controlling social costs, saving the scarce hydrocarbon resources, helping to mitigate the climate change.

*Figure 1*

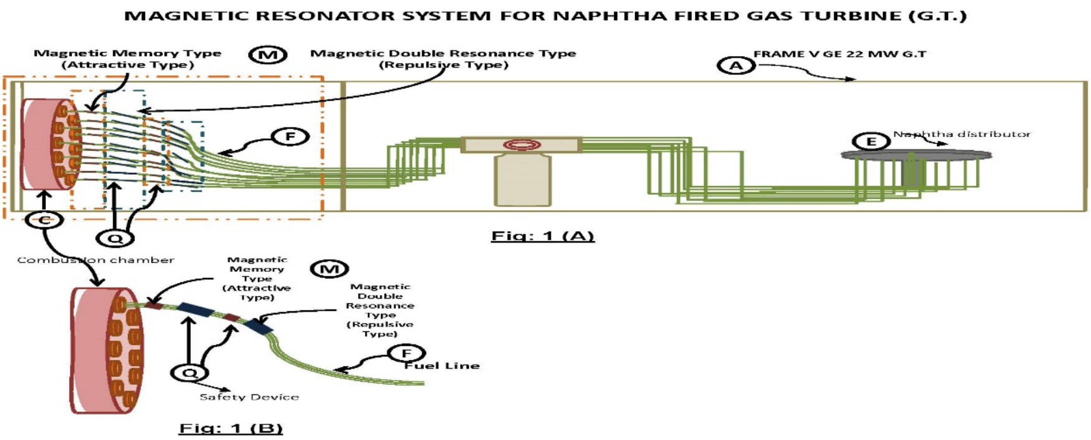
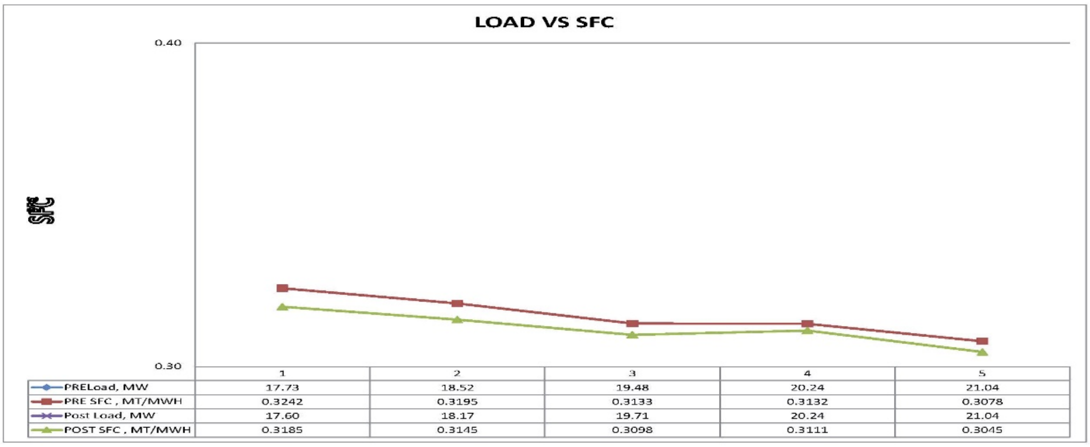



**TABLE 1: Data For avg SFC and the Corresponding avg Loads in MW for Naphtha Fired GT**

| | | | | | | |
|---|---|---|---|---|---|---|
| PRE | PRE LOAD , MW | 17.73 | 18.52 | 19.48 | 20.24 | 21.04 |
| | PRE SFC, MT/MWH | 0.3242 | 0.3195 | 0.3133 | 0.3132 | 0.3078 |
| POST | POST LOAD , MW | 17.60 | 18.17 | 19.71 | 20.24 | 21.04 |
| | POST SFC, MT/MWH | 0.3185 | 0.3145 | 0.3098 | 0.3111 | 0.3045 |

*Figure 2*




The above Figure "LOAD vs SFC" shows SFC plotted for Pre-installation and Post installation. The Pre-installation plot and Post installation plot shows a gap and the Gap indicates savings achieved after installation of Magnetic resonators.

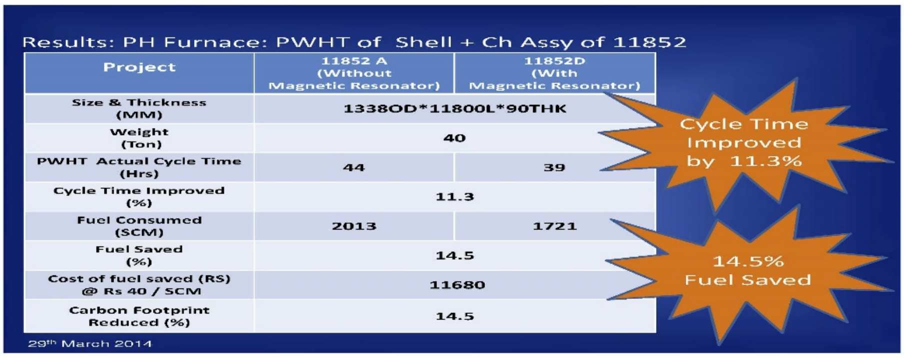
**TABLE 2 ; The technical details about the burner integrated in the Furnace :**

| Sno | Particulars | Condition1 | Condition -2 | Condition-3 |
|---|---|---|---|---|
| 1 | Name of the Burner | ST-80 | ST-80 | ST-80 |
| 2 | Fuel used | Natural Gas | Natural Gas | Natural Gas |
| 3 | Fuel Calorific Value Kcal/Sm$^3$ | 9130 | 9130 | 9130 |
| 4 | Fuel Inlet Pressure, Bar | 0.345 | 1.034 | 2.068 |
| 5 | Heating efficiency of burner | 16.2% | 24.4% | 17.7% |

**TABLE 3**: **OBSERVATION-: Improvement in the temperature rise in 240 min**

| OBSERVATION | UNITS | Condition-1 0.37 BAR | Condition-2 1 BAR | Condition-3 (2 BAR) |
|---|---|---|---|---|
| Max. average temperature reached in 240 min**. (without Resonator)** | °C | 150 | 228 | 235 |
| Max. average temperature reached in 240 min**. (with Resonator)** | °C | 153 | 248 | 238 |

*Figure 3* *Installation of Magnetic resonators*



Results: PH Furnace: PWHT of Shell + Ch Assy of 11852

| Project | 11852 A (Without Magnetic Resonator) | 11852D (With Magnetic Resonator) |
|---|---|---|
| Size & Thickness (MM) | 1338OD*11800L*90THK | |
| Weight (Ton) | 40 | |
| PWHT Actual Cycle Time (Hrs) | 44 | 39 |
| Cycle Time Improved (%) | 11.3 | |
| Fuel Consumed (SCM) | 2013 | 1721 |
| Fuel Saved (%) | 14.5 | |
| Cost of fuel saved (RS) @ Rs 40 / SCM | 11680 | |
| Carbon Footprint Reduced (%) | 14.5 | |



*Figure4: Cost Benefit analysis on installation on installation of Magnetic resonators for L&T (Heavy Industries)*