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Arus MR Tech
A case of Product Innovation

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ACKNOWLEDGEMENT

This report entails my journey as an innovator and the entrepreneurial activities in Arus MR Tech, Headquartered in Sharjah, United Arab Emirates and having its regional office Falcon MR Tech, India. This work summarizes my learning experience as an entrepreneur, leading from the front and how the coursework Management Engineering at Politecnico Di Milano helped me shape my mind in understanding the essential engineering concepts and built my confidence in approaching the real business challenges with the right strategic tools and concepts learnt from the classroom and applying it in real world application mainly with how to manage product innovation and the startup firm.

My Academic tutor Stefano Magistretti showed remarkable support in giving me the right insight and direction in completion of this work. I would like to appreciate Claudio Dell 'Era for being kind in accepting to be my supervisor and took time to help me in providing relevant and informative case studies, suggestions and Encouragement to further bolster my understanding all along the process and coordinated in writing this report. Last but not least, as a master student who is expecting to graduate in July'18, I would like to thank Politecnico di Milano, Management Engineering Department for giving me this rewarding education which strengthened my knowledge, skills and competences, made me a better entrepreneur and set me up for a bright and exciting career with unlimited opportunities.

I would also like to express my deepest appreciation to all those associated with Arus & Falcon MR Tech, who provided me the possibility to complete this report with immense support and contribution by taking extra time out to make up for my absence, encouraged and coordinated in completion of my report work.

A special thanks to my mother, who played the wind beneath my wings, stood by me at all times. She is the source of inspiration, unconditional love and always encouraged me to set the benchmark higher and work towards it by staying laser focused. Without her indispensable support, I could not have reached where I am today.

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EXECUTIVE SUMMARY

Arus MR Tech specializes in the production of top of the line Magnetorheological (MR) fluid solutions, an extensive line of controllable smart fluids deployed for advanced Vibration/Motion control devices in the tradename AMT-DAMPRO, AMT-MAGNAFLO, AMT-SMARTEC and the development of MR based smart devices. Established in late 2015 as a culmination of years of rich and vast experience in Research & Development of Smart Fluids and with comprehensive commercial assessment of innovation. Operating in Sharjah, U.A.E and Chennai, India. Since its launch in 2015, Arus MR Tech has offered and continues to offer innovative MR solutions to cater the needs of Industrial Clients, Top Automotive research institutes & Emerging OEM manufacturers.

This report focuses on the main challenges faced by Arus MR Tech in the management of product innovation, with the successful development of MR fluids better in technical and functional characteristics over the commercially available product in the market. This further led to the commercialization with the formation of a startup. However the startup management in the light of growing market expansion and with new scope of product application presents greater challenges and opportunities to AMT that requires tailor make solutions to create niche market and the strategy to take on big firms who are already in the market with great commercial force.

This report involves the analysis behind the market expansion, Technology development, future trend and the formulation of strategy to tackle the challenges at AMT with the objective to stay ahead in the market and also an approach to planning and execution involved in leveraging the overall company's capabilities and offerings to the market with technology innovation management.

At Arus MR Tech, I look forward to build and grow the team backed with right competences ,Skills and expertise to keep the ongoing R&D and go big in the future with Product line expansion and new technological breakthrough using MR fluids. This means that AMT would embrace the strategy of create/co create to keep up with the development of new magnetorheological fluid based devices for smarter, better and safer mobility.

PROFILE: MY – BACKGROUND

Designation: Founder, Arus MR Tech / Falcon MR Tech

Coming from an Automobile background, I enjoyed the comprehensive exposure to the areas and function of vehicle engineering, automotive components and technology, and a strong conceptual understanding of the same. Vehicle Dynamics and control has always been a fascinating subject to me, as the Ride & Handling aspect of a vehicle is rarely thought and less focused while it remains the most vital aspect to the overall vehicle engineering for the Safety, comfort and Performance.

Areas of Expertise/Passion Vehicle Dynamics (Ride & Handling) Semi Active Suspension system Smart fluids & Smart devices Magnetorheological (MR) fluids ,Automotive-Technology, Automotive-R&D.

I pursued MSc Engineering in Industrial Management to consolidate my management skills. It's been a rewarding learning experience thus far and has helped me shape my mind, built my confidence to approach with right problem solving techniques and sharpened my skills to understand the business from close quarters.

Areas of Expertise/Passion: Entrepreneurship & leadership Product Innovation Management New Product Development Business intelligence Marketing & Sales Strategy Supply Chain Management

This combination of engineering & Management has equipped me with the Hands on learnt experience, Knowledge, Skills and ability to contribute towards an organization's desired goals and objectives. Furthermore, I am a team player, having effective communication skills and leadership abilities.

Achievements & Honors:

Innovator: Incremental Innovation with the formulation of highly stable and efficient MR fluid with functional and Technical specs better than the commercially available. Carried out extensive line of testing and commercial assessment of innovation on proving ground with MR fluids and being the scientific and entrepreneurial mind behind AMT.

Launched three top of the line MR variants in the name AMT-DAMPRO, AMT-MAGNAFLO, AMT-SMARTEC for wide range of applications meeting heavy demands

of Vibration/Motion control needs. AMT has been into market actively since 2016 and we are pleased with our Clients/Customer's product experience and testimonials.

Managing to grow the Client base, with Industrial consumers (B2B Target) – Automotive OEM's and Individual Consumers (B2C).

Managing multiple roles from Supplier management to Product Research, Business Development with Marketing & sales planning & execution to customer technical assistance and stakeholder management. Challenging yet Rewarding & Learning experience.

Development of new line of Monotube MR Dampers at its Design & Validation phase.

First ever to be brought and presented to Indian Automotive Market packed with unbeatable performance features and superior quality all at competitive price. Product launch is expected in the Q4 2018.

Currently in Collaboration with Politecnico Di Milano, for Joint development of new MR based applications.

Patent formality to be soon initiated and executed.

Been selected for "Young Entrepreneur Award", in the Innovative start up category recognized and issued by Indian Achievers Forum.

COMPANY PROFILE

Company: Arus MR Tech

Products: Magnetorheological (MR) Fluids

Category: Smart Fluid (Controllable fluid)

Tradename: AMT - Dampro

AMT - Magnaflo

AMT - Smartec

Vision: To become a global Leader in MR smart Fluids and Smart devices by 2020.

"With ever changing consumers needs and market evolution, to accomplish our vision in three years and beyond we must look ahead to adapt and prepare ourselves to the future trends, creating competitive edge with MR technology and product innovation

that will scale our business in the future and AMT must get ready for tomorrow today. The values and ethics inbred in AMT will be the key to translate its vision into reality"

Our Mission: To redefine smart mobility for a safer, smoother and better world

The path of roadmap

*Premium Quality and Technically Superior Magnetorheological fluids

*Excellent service to our customers & clients

*Improve the customer experience by delivering world-class products, technologies and services.

*Foster relationship with our valuable customers. Enhance the customer experience by delivering world-class products, technologies and services

* Strive to build our customer base and Market share

Fig 1 Business Operations – Location

1.1 Incremental Innovation – Smart Fluid (Magnetorheological Fluid)

"Breakthroughs are unexpected they come out from random combinations of things that nobody has combined before this means that it is very much like composing a music unexpected and surprising"

According to Business Dictionary, A series of small improvements to an existing product or product line that usually helps maintain or improve its competitive position over time. Incremental innovation is regularly used within the high technology business by companies that need to continue to improve their products to include new features increasingly desired by consumers to meet the technical needs of the application. [2]

Incremental Innovation – AMT line of MR solutions	**Benefits**
Higher Yield Strength achieved at low magnetic field. **Broad range of Yield stress**	What it Means? Yield strength characteristic determines the damping capability of MR solution as it takes up heavy shock energy for dissipation – Higher Damping capability
Low Electrical Consumption	Lasting performance
Low Heating up of device	Higher reliability ,Safer operation and ensures longer life of the device
High Settling Resistant with proven Stabilizers	High Durability & Reliability
Wide range of Compatibility with Sealing materials	Flexibility in the material selection for sealing.

Table 1 Incremental Innovation of AMT Line of Magnetorheological Solutions

let's begin with the description of Magnetorheological (MR) fluids. It is classified as a smart fluid, so called controllable fluid as their rheological properties (elasticity, plasticity, and viscosity) respond rapidly to any source of external magnetic field .Thus its ability to switch from free flowing liquid state to Semi-solid state and vice versa unleashes its potential for wide range of vibration/Motion control based applications and its common application in large volume is in automotive suspension (Shocks/Dampers).

Fig: 2 Sample AMT MR Fluid in Active State

MR fluid composition: The basic composition of such smart fluid consist of three to four components namely tiny microscopic Ferromagnetic particles with base oil , thixotropic agents acting as stabilizers to keep the Ferro particles suspended in the base oil and additives to act as a coating material to ferromagnetic particles enhancing the fluid characteristics from abrasivity and Magnetic remanence. However, It is not as simple as it sounds, the complexity of this chemical is with the compatibility of base oil and

Stabilizers with Ferromagnetic Particles as the incompatibility causes the ferromagnetic Particles to settle gradually and form a lump, which makes the fluid unfit for use and not characteristic of ideal MR fluid.

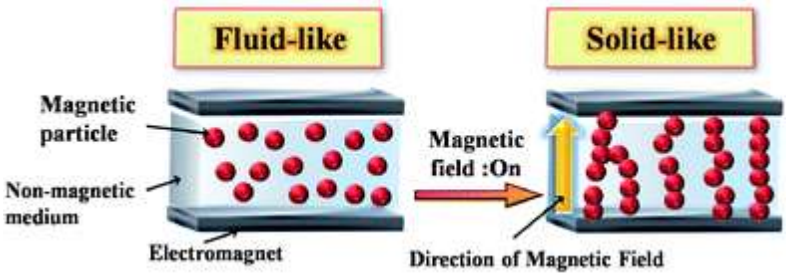


Fig 3 Composition and Working State of MR fluid

Tracking back to its history, MR fluids was first invented by Jacob Rabinow for MR fluid in the 1940s. A laboratory curiosity with little practical use for decades, researchers began

to get serious about it in the late 1980s and 1990s, when other technologies began to converge that made practical use of MR fluid a real possibility. Still, new technologies aside, moving this new material from lab to commercialization faced huge hurdles. Cary, N.C.-based Lord Corporation holds the world's most extensive patent portfolio on MR fluid formulations, which became key to successful commercialization. Lord engineers invented their own MR devices to demonstrate how the material functioned and how it would look in a real application. [Source: ssslab.com[1]]

Magneto-rheological (MR) fluids are now well established as one of the leading materials for use in controllable structures and systems. Commercial application of MR fluids in various fields, particularly in the vibration control, has grown rapidly over the past few years.

1.2 Path To Product Innovation

"Ideas are not light bulbs that switch on out of nowhere"

I came across this subject of Magneto rheology back in 1st year of the course when it was by presented by one of my professor from Automobile Department at the lab using Lord Corp's MR fluid. The sheer simplicity behind this mind boggling technology grew my curiosity to learn deep and work on the development of MR Damper. He then became my Project guide and since then I was inclined towards this subject. The Project was about the designing and fabrication of low cost MR fluid and MR damper. As an Automobile engineer with keen passion into modern suspension technology always kept me working hard to put my mind, soul and energy onto the work that I was about to begin.

Little did I know that the quest would persist for nearly two years, before I could end up making three samples which showed the ideal characteristics of MR fluid .It was highly stable and efficient MR fluid which prompted me to test it for rheological properties.

My early days involved many investigations from various journals relevant to magneto rheology. In the early stages of Research and experimentation, problems such as settling, chemical instability, inability to redisperse, Abrasivity, unstable at low and high temperature, Sedimentation, Thickening after prolonged use, low yield stress etc. appeared , which was troubleshot with lot of experimentation analysis and in depth study of material science and chemical compatibility.

The careful and pragmatic approach helped a lot in troubleshooting the problems. Approaching few eminent chemistry professors of leading universities to get their opinions and suggestions, also proved helpful in development of MR fluid. It involved a

detailed study on selection of materials, keeping key parameters like its shape, size, volume, density, viscosity and other physical properties in mind. Right composition, selection of materials and compatibility was crucial in the formulation of MR fluid. Numerous fluid samples were made and observed visually for its settling rate for days, ability to redisperse, and its responsiveness to magnetic field using an external source of magnetic field. Different combinations and permutations were experimented with the materials and three such samples have shown great results as it had minimal settling, rapid response to magnetic field, stable at high temperature and low temperature, ability to redisperse, and it had flow characteristics of ideal MR fluid.

With my case of research, there is no determined course of action for innovation. Innovation was the product of pure research and experimentation and anyone involved with such mission should have optimistic outlook and relentless pursuit.

2. TESTING & VALIDATION OF INNOVATION

The visual observation and the working of fluid samples didn't mean the fluid samples were MR fluid and were fit and ready for commercial use. The testing of these samples was the much needed step to distinguish its Performance characteristics from commercially available solutions and determine its fitness and rheological characteristics. The sophisticated machine which tests its rheological properties and derive its key technical parameters is MCR 301, which is vital to assess its technical parameters necessary to draft the technical data sheet.

Testing of Magnetorheological properties of formulated MR fluid was done using the aforementioned testing equipment called Anton Paar Physica MCR 301 loaded with MR cell at Indian Institute of science campus, Bangalore. All the three samples varied with Viscosity, density and Yield Strength, Yet the formulation of the samples are same. The Sample 1 achieved Yield Stress of 50.7KPa at 130 KA/m (Low Magnetic field) while Sample 2 & 3 had Yield stress in the range 32-40KPa.

Later, the Designing and fabrication of damper involved designing of fluid flow gap, calculation of geometrical dimensions, magnetic circuit design for electromagnetic piston with key parameters like coil gauge, diameter, thickness, Number of turns in order to achieve optimum field strength at low electrical consumption (0-2 amps).The damper was then tested by supplying current using a controller kit. The effective functioning of formulated MR fluid in fabricated Damper meant that MR damper prototype is functional

and could be tested in the real vehicle. I pursued my passion to exploit its commercialization of technically superior formulated MR fluids.

Back that time, I was thrilled and had great excitement and energy which fueled me to work without any restraints as I want to check the pulse of the market for this product in India

The Test certificate of MR fluid Samples is enclosed in the appendix.

The rheological properties helped me to establish the performance of formulated MR fluid with the following parameters

a) Flow curves of Shear stress vs. Shear rate at B=0T

b) Yield stress vs. magnetic field density (Herschel-Bulkley's model)

c) Shear stress vs. magnetic flux density Viscosity vs. magnetic flied density (Herschel-Bulkley's model

d) Power-law exponent vs. magnetic field density.

One of the typical performance graph is shown below.

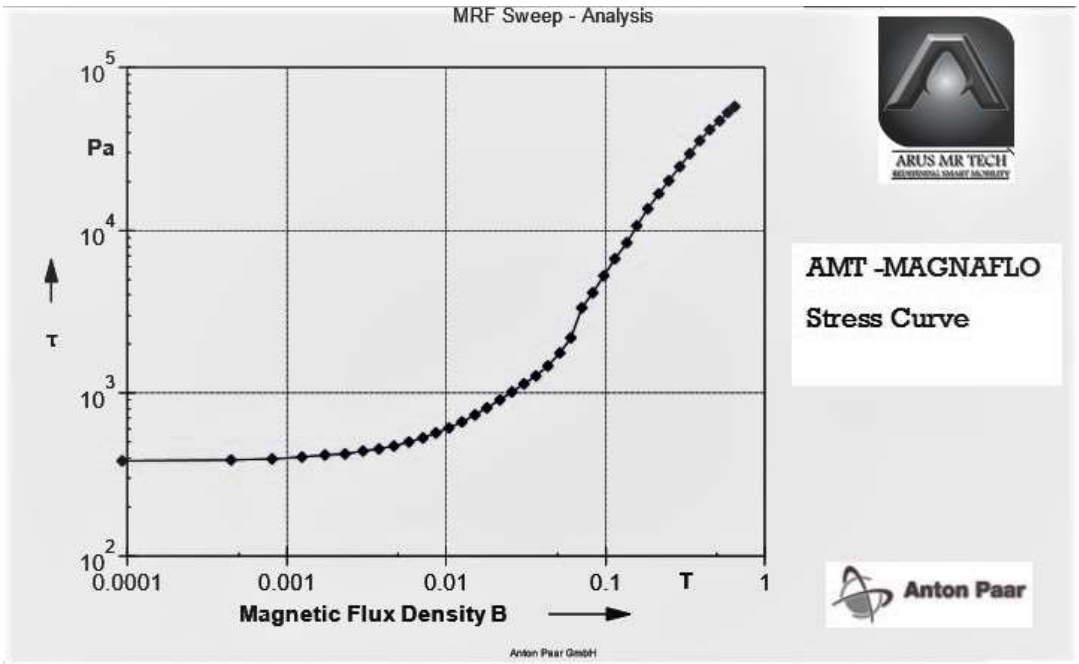


Fig 5 Performance Sheet of AMT MR Fluid

With thorough evaluation and analysis of the above rheological properties, the formulated fluid samples were then studied with the development of MR damper Prototype as shown in the figure below.

Fig 6 MR Damper – Prototype Model AMT

The use of MR fluid in suspension system allows for a better ride due to the flat and stable ride it ensures. The MR system allows for the action of each wheel to be smoothened and isolated. The system can be integrated with vehicle's stability control to enhance stability on gravel, and slippery road surfaces. However, the biggest disadvantage with an MR suspension system is **the cost**, due to which its deployment is limited. So the main objective of the project was to come up with an ideal MR fluid at minimal cost without compromising on its efficiency and functionality.

2.1 Product Technical Documentation & Functional Specifications

The test results were then derived from the thirty page test report and documented into a single page technical data sheet with all the performance and technical characteristics which consumers look for in the fluid. The Tech data sheet was prepared with outlining all the essential data information required by the consumers, and references were taken from Lord Corp Tech data sheet. The three best fluid samples which showed ideal MR fluid characteristics were then named AMT-DAMPRO, AMT-MAGNAFLO and AMT-SMARTEC. The tradenames of the fluid were carefully chosen after a considerable amount of brainstorming and planning. The objective is to set the names meaningful and synonymous to the product, easy to remember leaving it memorable in the minds of consumers and each product had different range of yield stress characteristics, density and viscosity and it also meant it was suitable to different applications.

AMT – Arus MR Tech DAMPRO – Damper's Professional

Tagline: Choose Dampro for a Safer, Smoother & Better Mobility

MAGNAFLO – Magnetic Flow

Tagline: Choose Magnaflo for better stability and control

SMARTEC – Smart Technology

Tagline: Choose Smartec for better durability and high power

The flagship product has been AMT-DAMPRO, since this fluid has perfect technical characteristics, consumers look for in the application of Damper/Shocks and flagship mainly due to the application of MR fluids in Dampers has a large market base compared to other MR fluid based application.

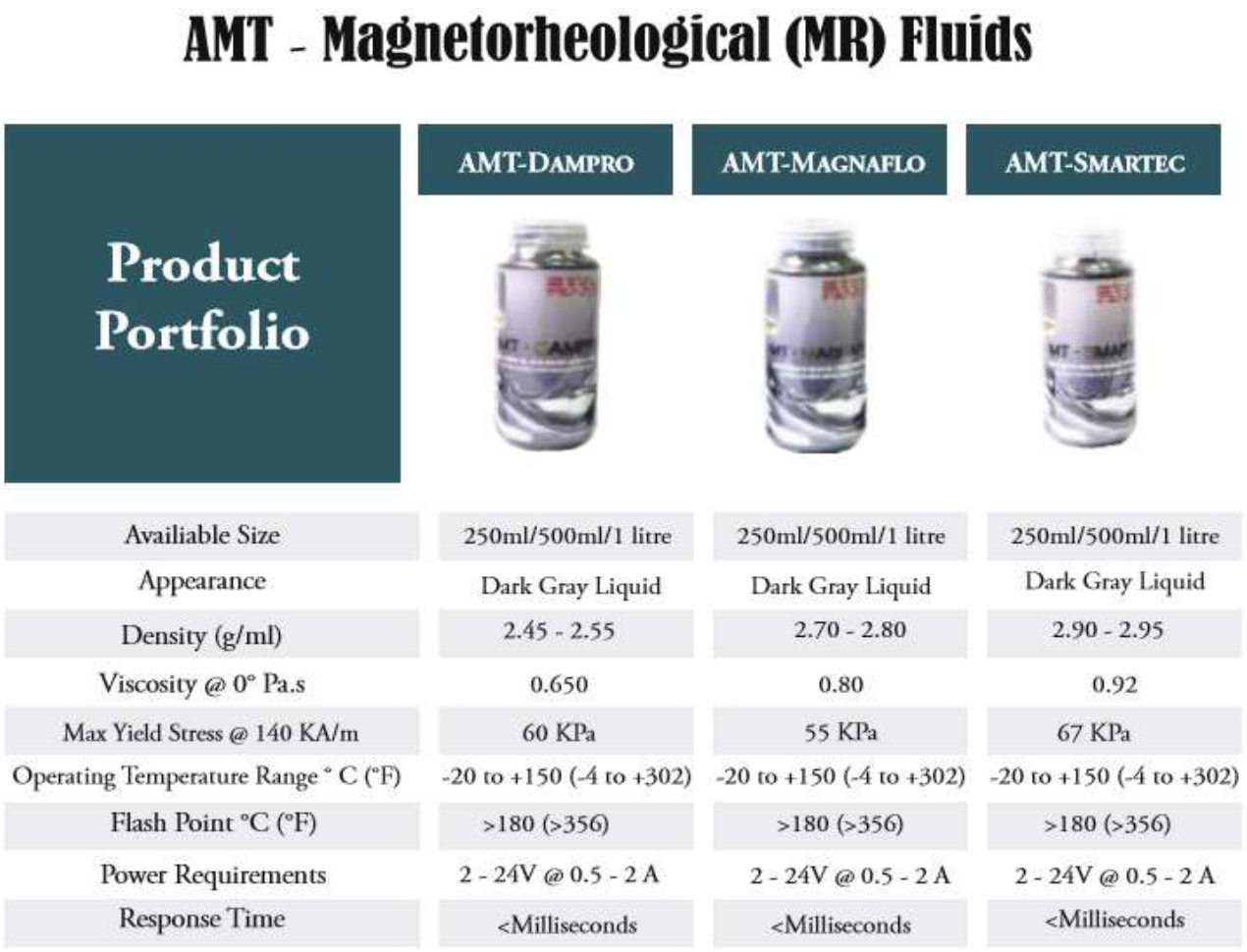


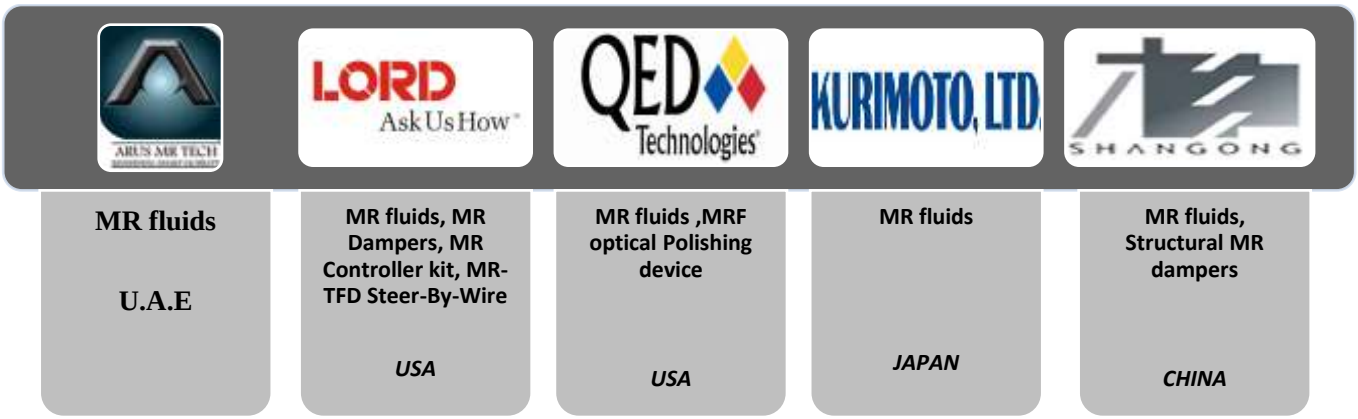
Fig 7 Product Portfolio – Technical Specification Data

3. EVALUATION AND ASSESSMENT OF INNOVATION TO EXPLOIT COMMERCIALIZATION

The evaluation and assessment of innovation was conducted using the benchmark analysis with technical parameters associated with the product. The key technical parameters include the maximum yield stress obtained by the fluid and at what magnetic strength, density, viscosity, flash point, response time, settling ratio, and others include operating temperature range and magnetic permeability. All these determines the efficiency of magnetorheological solutions. The incremental improvements was observed with yield strength of AMT magnetorheological solution, which is higher than the existing range of competitor's product portfolio. This is a relational measure to the damping capability of the solution, which makes the solution technically superior over its competitor's line of solutions.

3.1 Competitors Profile Analysis

Let's distinguish AMT from its competitors in terms of its product portfolio and product's features to delve into its profile & its products performance characteristics–Key Players Profile



Company	Arus MR Tech FZC, Falcon MR Tech	Lord Corp	QED Technologies	Kurimoto Ltd	Ningbo Shangong center of structural monitoring and control engineering Co Ltd
Products	MR fluids, MR Dampers(Custom Made)	MR fluids, MR Dampers, MR syringe Demo, MR Controller kit ,MR-TFD Steer-By-Wire	MR fluids for Optical polishing & MRF optical Polishing device	MR fluids	MR fluids, Structural MR dampers
Variants in MR Fluids	AMT - Dampro ,AMT Magnaflo, AMT- Smartec	MRF – 122 EG ,MRF – 132 DG,MRF – 140 CG	C10+ , D10,D11,D20,C30	Coming soon	SG-MRF 2035

Table 3 AMT Vs Competitor Profile Analysis

Performance & Technical Characteristics

Arus MR Tech / Falcon MR Tech

	AMT – Dampro	AMT – Magnaflo	AMT - Smartec
Appearance	Dark Gray Liquid	Dark Gray Liquid	Dark Gray Liquid
Density g/ml	2.45 – 2.55	2.70-2.80	2.90 – 2.95
Viscosity at 40 ° Pa.s	0.650	0.80	0.92
Max .Yield Stress @ 140 KA/m – 0.75 T	60 KPa	55 KPa	67 KPa
Operating Temperature Range ° C (°F)	-20 to +150 (-4 to +302)	-20 to +150 (-4 to +302)	-20 to +150 (-4 to +302)
Flash Point ° C (°F)	>180 (>356)	>180 (>356)	>180 (>356)
Power Requirements	2-24V at 0.5 – 2 A	2-24V at 0.5 – 2 A	2-24V at 0.5 – 2 A
Response Time	<Milliseconds	<Milliseconds	<Milliseconds

Table 4 Performance Characteristics - AMT

	MRF – 140 CG	MRF – 132 DG	MRF – 122 EG
Appearance	Dark Gray Liquid	Dark Gray Liquid	Dark Gray Liquid
Density g/ml	3.54-3.74	2.95-3.15	2.28-2.48
Viscosity at 40 ° Pa.s	0.280 ± 0.070	0.112 ± 0.02	0.042 ± 0.020
Max .Yield Stress @ 140 KA/m -0.75 T	➢ 53 KPa	38 KPa	25 KPa
Operating Temperature Range ° C (°F)	-40 to +130 (-40 to +266)	-40 to +130 (-40 to +266)	-40 to +130 (-40 to +266)
Flash Point ° C (°F)	>150 (>302)	>150 (>302)	>150 (>302)
Power Requirements	2-24V at 0.5 – 2 A	2-24V at 0.5 – 2 A	2-24V at 0.5 – 2 A
Response Time	<Milliseconds	<Milliseconds	<Milliseconds

Table 5 Performance Characteristics – Competitor A Lord Corp

Ningbo Shangong center of structural monitoring and control engineering Co Ltd

	SG-MRF 2035
Appearance	Dark Gray Liquid
Max .Yield Stress @ 140 KA/m -0.75 T	45 KPa
Density g/ml	3.09
Viscosity at 30 ° Pa.s	0.240
Flash Point ° C	>250℃
Operating Temperature Range ° C	-40～180℃
shear yield strength(1.0T)	55kPa

Table 6 Performance Characteristics – Competitor B

3.2 Technical Characteristics: Pros & Cons

Technical Characteristics Significance: MR Fluid

Pros		Cons
	Yield Strength	
Determines the damping capability of MR fluid in meeting the tough demands of heavy loads. Higher the yield strength, higher the damping power of the fluid.		Lower yield limits the application capability. Limits the damping performance
	Density	
Density determines the compactness, in more sense the weight of the fluid and it directly impacts the weight of the end device. The Optimum density of MR fluid is in the range 2.2 – 2.8		Higher density fluid makes the end device heavier and bulkier. High density fluid doesn't suit the needs of few applications involving wearable protective gears like body armor, haptic devices etc.
	Operating temperature Range	
Operating temperature range determines the effective working temperature range of MR fluid. Wide range of temperature range enables the fluid to work in cold and hot conditions.		Narrow operating temperature range discourages the working capability of MR fluid in extreme weather conditions.
	Viscosity	
Viscosity of MR fluid has double sided advantages, depending on the type of application. Low viscosity fluids finds applications in Dampers, while high viscous fluids are used for actuators, clutch systems.		High viscosity fluids makes the fluid heavier.

Response Speed

The response speed determines how quickly the fluid responds in switching it state from free flowing liquid to Semi Solid state and vice versa.

Rapid response in milliseconds is a desirable performance feature in the MR fluid

Delayed response is an undesirable feature and is an indicator of poor performance.

Power Requirements

Low power requirement enables the fluid to work efficiently and last

Higher power consumption causes the device to heat up and more likely to fail the fluid activator.

3.3 Setting Differentiating Advantages

"You might have the most wonderful product in your hand, but it is worth nothing if people don't know much about it"

Setting differentiating advantages is a key marketing aspect to innovation. As it drives home the point as to why potential and prospective clients, customers should choose our products over the products offered by the competitors. The purchasing behavior of consumers is greatly influenced by the unique selling proposition of the product and the value for money perceived by them. Therefore, setting the differentiating advantages sets apart the competition and resonates strongly in the market, also influences the brand image and identity image of the company.

At AMT, the differentiation strategy appeals to its Prospective/potential clients in two aspects, one in Qualitative terms of technically superior products and other is economical aspect by offering its products at a much lower price compared to its competitors. AMT's personalized technical support also gives it a key differentiating advantages as consumers

ask for technical queries and seek assistance in getting the right solution. However the challenging task is an approach to market the innovation, with so many marketing tools available online to reach the target customers, it is important to communicate the market using the right channel. Some of the untapped marketing solutions from AMT include Online Advertising, Influencer Marketing, and SEO optimization. The offline include direct marketing taking part in relevant upcoming conferences & Exhibitions on Smart Fluids, Anti-vibration technology, Automotive Components & suppliers.

4. COMPREHENSIVE MARKET RESEARCH ANALYSIS

4.1 Market Analysis: Size, Analysis, Future Trends and Projected CAGR (Present and Future)

According to a research agency named BCC, in its report on smart materials have valued the global market at $23.6 billion in 2013 and almost $26 billion in 2014. This is anticipated to reach over $42.2 billion in 2019 at a compound annual growth rate (CAGR) of 10.2% between 2014 and 2019. Motors and actuators make up the largest application segment of the market, with sales of nearly $16.8 billion (70.8% of the market) in 2013, increasing to $30.2 billion (nearly 71.6% of the market) by 2019.

The Asia-Pacific region accounted for the largest production of smart materials in 2013, followed by U.S. and Europe. However, European production is projected to grow somewhat more slowly than the global average (i.e., at a CAGR of 9.9%). The U.S. share of global smart materials production is projected to increase from 28.2% in 2013 to 29% in 2019 [3]

The emerging market of Magnetorheological fluids is in India, Japan, China and South Korea due to a huge shift of technological advancement in these regions with many new O.E.M’s finding their base due to the growing market potential in automotive industry.

4.2 Industry and Market Structure

As per the research, the application capabilities of MR fluids apart from existing applications extends to

Research Capabilities

Research Capabilities	Defense & Aeronautics & Aerospace
	Medical Devices
	Biotechnology
	Semiconductor & Electronics

These new areas of research Capabilities forecasts the new market potential and the heavy research pursued by companies and research institutions promises new product development and technological breakthrough using magnetorheological smart fluids. Some of the latest development include MR fluid based neck collar/neck brace, MR fluid based body armor, and Landing gear application, fly by wire flight control stick, MR fluid in heat transfer applications and also in smart shoes for athletes.

Sector	North-America (U.S. Canada)	Europe (Germany, U.K, France,Czech,Italy , Russia)	Asia Pacific (China, India, Japan, ASEAN)	Middle East & Africa (Egypt,Iran ,South Africa)	Latin America (Brazil, Mexico)
Automobiles	✓	✓	✓	✓	✓
Building & Construction	✓	✓	✓	×	×
Defense	✓	✓	✓	✓	×
Electrical & Electronics	✓	✓	✓	✓	✓
Medical & Prosthetics	✓	✓	✓	✓	✓
Robotics	✓	✓	✓	✓	✓
Others	✓	✓	✓	✓	✓

Table 7 Industry – Market Matrix

4.3 SWOT- Strengths, Weakness, Opportunities, Threats Analysis

Here, the simple and powerful SWOT tool helps in investigating and analyze the internal strengths and weaknesses and the external forces of change with Opportunities and threats. It could help us understand the tradeoffs, Convert our strengths to positive value, strategize to make the most of opportunities, improve on weaknesses and eliminate the threats which could harm the growth of business. The objective of SWOT is to help Arus MR Tech benefit from better decision making to have an overall positive impact in the business growth.

SWOT Analysis

Strengths

- Limited Competition with Oligopolistic Market
- Product USP with fluid's features and performance
- Customer Query management with dedicated technical assistance
- AMT's line of MR fluids is comparatively economical in Price factor
- Operating profit margin and ROI (Financial Performance Indicator)
- Positive word of mouth and Customers feedback on Product experience.

Weaknesses

- Limited capabilities in Order fulfillment & Delivery management (Logistics)
- Lack of marketing and commercial force in comparison to its competitors
- Keeping pace with technological development
- Lack of Product Exposure
- Lack of Consumer Education
- Barrier of adoption
- Capital-Management/R&D investment capability
- Different geographical market and needs

Opportunities

- Production capacity Expansion
- Patent - Intellectual Property
- Market expansion
- Growing areas of application
- New product Research & development
- Create / Co-create
- Build and grow the team
- Niche Market opportunities

Threats

- Growing market demand could see the rise in competition
- Disruptive Innovation replacing Magnetorheological Technology for Vibration/Motion Control
- Possible Acquisition/Merger

5. START UP FORMATION AND BUSINESS MODEL

The company formation in U.A.E and India involved obtaining various permits and government identification numbers and Arus MR Tech is registered on Partnership business structure, while Falcon MR Tech is a sole proprietorship entity. Both locations has its own merits and demerits. The objective for AMT is to strategically allocate the business activities in the region where we could make the most of available resources. Tax exemptions and customs free in the free zone establishment at U.A.E enables easy trading of goods in and out of U.A.E, while the engineering service available in India is skilled and highly available at nominal payroll.

Company policy standards

AMT has developed a framework of company policy standards which aims to comply with Business laws and regulations, promote equal pricing to all customers/Clients, foster relationship with clients on end user satisfaction, Product's technical compliance, and employee policy, return policy, Refund policy, Marketing policy, Privacy policy, and standard packaging and shipping policy.

The main objective is to set and adhere by company policy standards to mitigate the risks and promote the overall health of the company's status, Integrity, reliability, and most important employee and customer satisfaction. With this implementation, AMT takes responsive measures to counteract any problems that arise with conflicts in business activities and for risk management.

5.1 Business Formation and Model Canvas

Business Model Canvas: Arus MR Tech

A sketch of business model is below

The Business Model Canvas

Company Name:	Date:	
Arus MR Tech	19/07/2017	[X] Primary Canvas [ ] Alternative Canvas

Key Partners	Key Activities	Value Proposition	Customer Relationships	Customer Segments
▪ Supplier ▪ Local Dealers ▪ Logistic partners	▪ Inbound Logistics(Procurement) ▪ Production-Packaging, Labelling & Sealing ▪ Outbound Logistics	**AMT-DAMPRO** (Applicable for Shocks/Dampers) Choose Dampro for a Safer, Smoother & Better Mobility **AMT-MAGNAFLO** (Applicable for Brakes & Clutches) Choose Magnaflo for better stability and control **AMT-SMARTEC** Choose Smartec for better durability and high power In addition, *Tailor Make Solutions(specification needs)	▪ Personal assistance ▪ Automated services ▪ Online community	▪ Industrial consumers ▪ Individual Consumers ▪ Government Consumers
	Key Resources ▪ Human resources ▪ Tangible assets.		***Channels*** Direct distribution channel (Web) – Online market tools	

Cost Structure	Revenue Streams
Costs we incur to run our business model could be inferred from the financial data	Sale of Products (AMT Variants) (Payment Modes: Cash/Online Bank transfer/Electronic payment)

A Business Model is a comprehensive set of strategic decisions defining the way AMT:

• creates value • transfers value to its customers • captures value.

Drafting a business model is a powerful tool to evaluate strategic alternatives, by checking in particular their soundness and their consistency with the overall structure of the company

A business model can be described by looking at a set of nine building blocks. To get a good picture of our business model we should describe our:

1. Customer segments: Our groups of customers with distinct characteristics.

- Industrial consumers
- Individual Consumers
- Government Consumers

2. Value proposition: The bundles of products and services that satisfy our customer segments' needs.

AMT-DAMPRO – A fluid engineered for Vibration Control. High performance fluid to attenuate the vibration. Suitable for Valve Mode Operation. It tunes to the dynamics of your vehicle in real Time and offers a high driving precision and a comfortable ride while keeping the vehicle in control.MR Fluid forms the core of Magne Ride suspension touted as the most advanced suspension technology in the history of automotive industry. As per the research, MR fluids have a better damping efficiency by a factor of 15 times over conventional fluid. (*Suitable for Valve Mode Operation)

Choose Dampro for a Safer, Smoother & Better Mobility

AMT-MAGNAFLO – (Applicable for Brakes & Clutches) Magnaflo is a specially blended fluid with proven friction modifiers formulated for Automotive Brakes, Clutches & Engine Mounts. *Highly controllable fluid suitable for Shear Mode operation.

Choose Magnaflo for better stability and control

AMT-SMARTEC is a variant, exclusively formulated for heavy Motion control in Heavy Machineries, Robotic Applications and other wide range of applications. This variant has high Yield strength to take up heavy loads and dissipate the energy with minimal consumption of power.

Choose Smartec for better durability and high power

***In addition to its three best in class variants, Arus MR Tech also offers tailor–made MR fluids that specifically meet our customer requirements. According to the need of working mode of the device for which MRF is required, we can formulate a perfect solution to deliver exactly the results you want. With our customers, we can adapt our MRF precisely to their needs and develop new applications together.

6. Distribution channels: The channels through which we communicate with our customers and through which we offer our value propositions.

Direct distribution channel (Web) – Online market tools (Indiamart, Trade India, official website www.arusmrtech.com), Google AdWords, Just dial, Yellow pages, E Suppliers India)

It opens the door for AMT to join hands with potential indirect distribution channel (owned dealers, dealer of partner, wholesalers) for sales leverage and enhance our product awareness, customer base and brand exposure.

4. Customer relationships: The types of relationships we entertain with each customer segment.

"Getting relationship management right in our business model is crucial today to satisfy customer's expectations. For instance, customers paying a high price for a product or service will expect a high touch relationship, while customers paying a cheap price do not expect more than automated, yet customized relationships"

CRM Strategy for AMT

Customer Relationship management

• Personal assistance
• Automated services
• Online community

5. Revenue stream: The stream through which we earn our revenues from our customers for value creation activities.

* Sale of Products (AMT Variants)

6. Key resources: The key resources on which our business model is built. These key resources include classical ones such as human resources and tangible assets.

Al Rakhees abdullah abdulaziz

- *Business Partner
- *Investor & Shareholder

Key People

- Abdus Samad A.R (*Founder & CEO * Head of Technology and R&D * Production – Head)

- Employee Size: 8 (Managing General Administration – Marketing & Sales-Operations –R&D- Bookkeeping and accounts)
- AMT is making all efforts to grow and build the team with multi-disciplinary background to manage operations which encompasses Supply chain management, play a significant role in delivering operational excellence, Business Development, Finance Management, Research & Development , Logistics management and liaison at a level acceptable to the strategy set by AMT.

7. Key activities: The most important activities performed at AMT

1. Supplier: Supply time of R.M.1 – Minimum 1 month, Other R.M AND Supplies are locally procured from India & U.A.E.

2. Production: Takes place at Arus MR Tech FZC Lab.

Supplier (Raw Materials), Logistics Inbound - Production Arus MR Tech FZC,U.A.E - Packaging, Labelling & Sealing Arus MR Tech FZC,U.A.E - Logistics (Outbound) Aramex, FEDEX , Professional Couriers

Production capability: 25 Liters per day

3. Packaging, Labelling & Sealing – Labels are outsourced, Packaging & sealing are done at Arus MR Tech FZC Lab.

4. Logistics & Courier Partner –Outbound: AMT partners with three different logistics service

i) Procuring Raw materials from the supplier.

ii) Shipment of Finished products to Chennai, India iii) Distribution to local & International clients and customers.

AMT's efficient supply chain management play a significant role in delivering operational excellence, Reporting & Maintaining communication and liaison at a level acceptable to the management.

The supply chain of AMT

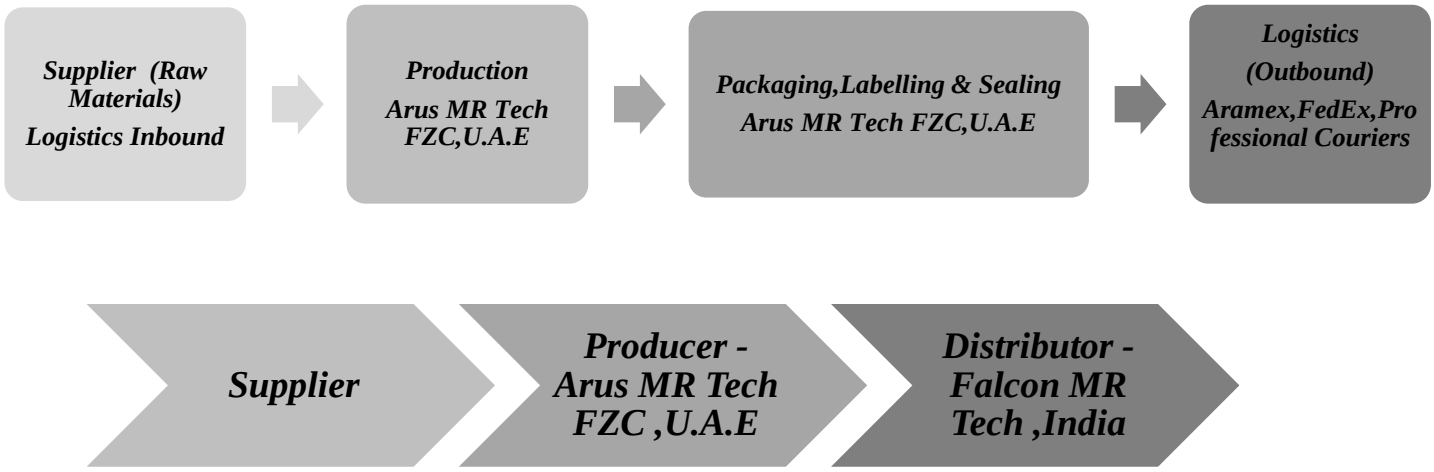


Fig 8 Supply Chain of AMT

AMT's efficient Production planning & Inventory Management is crucial for driving up the sales , on time delivery meeting clients' needs , and business growth as a whole.

8. Partner network: The partners and suppliers we work with.

1. Long standing relationship with supplier network

2. Local Dealers

3. Logistic partners

9. Cost structure: The costs we incur to run our business model

It could be inferred from the financial data which gives insight on our EBITDA and net profit.

5.2 Value Chain Analysis

AMT Value Chain The Performing and critical success factors of Arus MR Tech could be identified using the Porter's Value Chain tool, considering AMT as a

system made up of subsystems each with inputs, transformation processes and outputs.

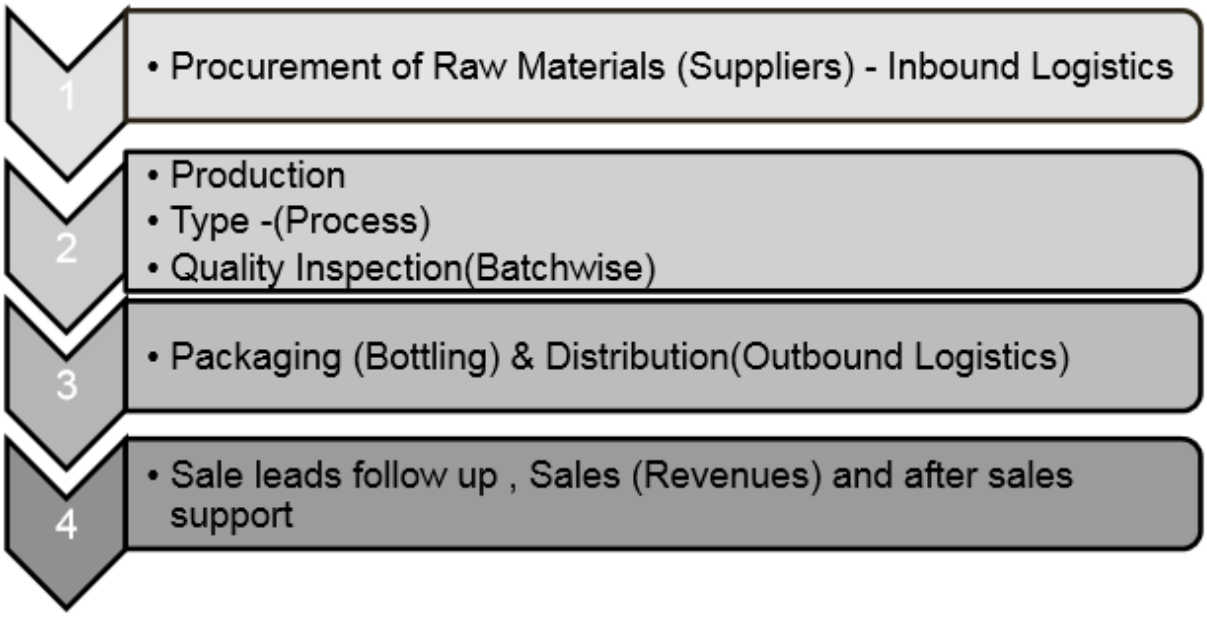


Fig 9 Value Chain -AMT

Value Drivers of AMT

Value Drivers refer to indicators which provide earlier signals (driver) of the value creation

Critical Success factors/KPI's of AMT is identified to be

1. Fluid Performance (Yield strength, Minimal Settling with ease to redisperse)– Competitive factor
2. Pricing factor – Competitive factor
3. Technical Support – Dedicated technical assistance
4. Product availability – Competitive factor
5. Operating profit Margin – Financial Performance indicator
6. ROA – Financial Performance Indicator

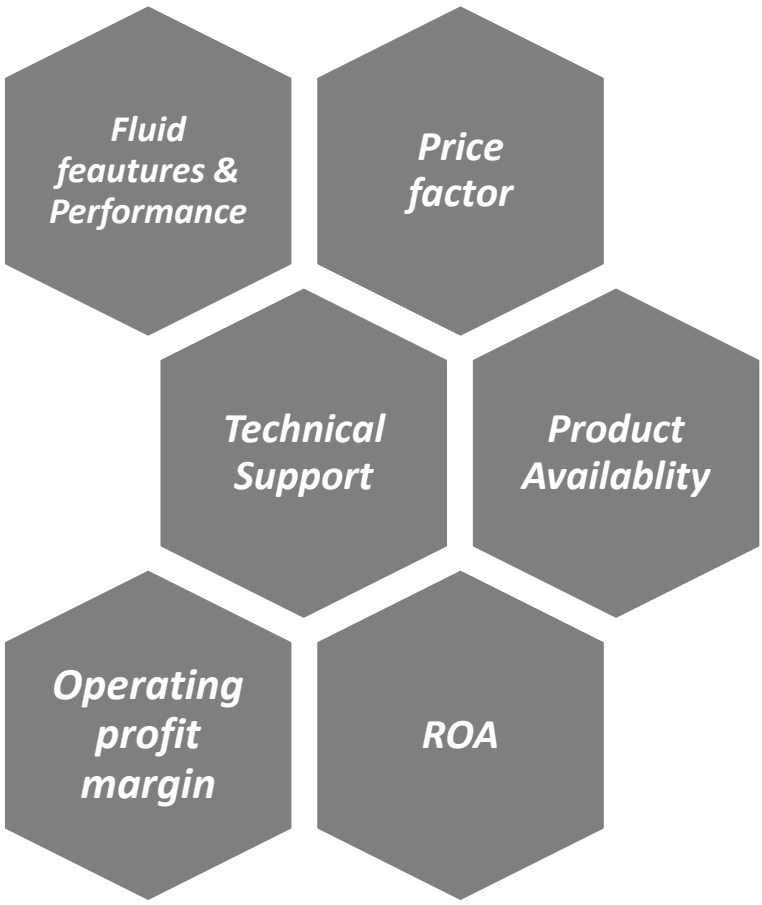


Fig: 10 Value Drivers of AMT

5.3 VOC, CTQ, Data Analysis & Customer Segmentation

"The ironic moment is the moment you think you know everything and then you realize how much there still is to learn"

The voice of customer (VOC) is a method for understanding customers' needs. In the process the "voice" (e.g. expectations, requirements and feedbacks) is captured from the customer to provide them with the best quality in product and/ or service. Only if you know your customers, you can optimally serve their wants and needs.

The VOC can be obtained in variety of ways. The following shows the customer research process with customer identification.

A way to identify your customer is customer segmentation. If customers are not segmented, it could be impossible to get a single "voice". Multiple voices may lead in opposite directions. Therefore is it crucial to identify and focus only on the most important segments by

• Business strategy • Size and • Profit

Gather Customer's needs: The purpose of collecting the data is following analysis of the obtained information. Gathering information is the most crucial step in the process. It is important to know

• What information is needed • why they are needed and • what to do with the collected data.

During this process a research method has to be selected. Furthermore a data collection plan has to be compiled.

Analyze Customers Information: In this step the gathered data will be analyzed by using statistical techniques including organization of the data and prioritizing customers' needs in terms of relative importance. The results will be illustrated graphically.

Determine Critical To Quality (CTQ): CTQ is used to find out the quality characteristic or parameters, which are related to the customers' needs and wants. CTQs are important to the quality of the product or service to ensure the things, which are important to the customer. The identification of specific, quantifiable CTQ characteristics is essential for measurable business improvement.

Customer-Segmentation: Each customer is different and unique and wants to be treated like that. To accomplish this task, companies must know their customers (equal consumers) very well. But companies do not know every of their customers with all their needs and expectations personally but some characteristics apply not only to one single

customer but also to several customers. Those can be divided in groups and treated like "one" customer (customer segmentation). Customers should be grouped or divided according to their need for products and services. For Arus MR Tech FZC, customers can be classified into the three segments "Industrial Consumers (B2B: Business to Business) and "Individual Consumers" (B2C: Business to Consumers) and B2G as shown in the figure below.

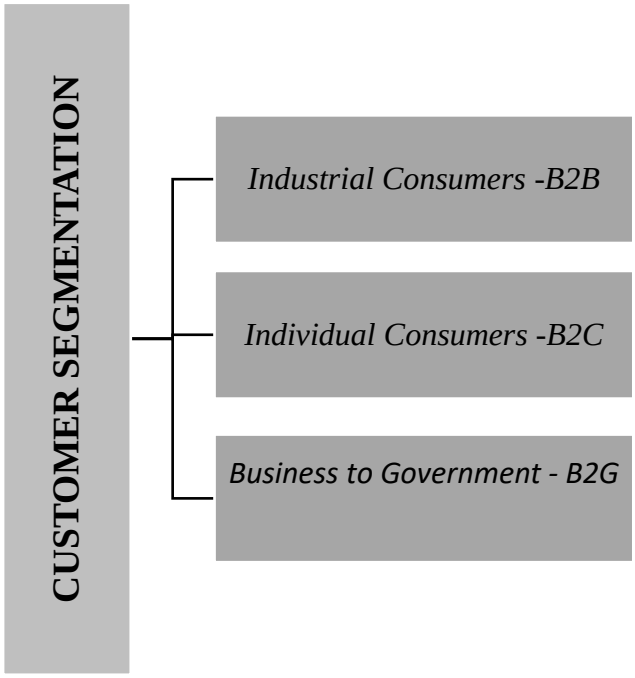


Fig 11 Customer Segmentation -AMT

Industrial Consumers –B2B

Consumers of this segment are companies operating in the industry. The major market for MR fluid comes from Mechanical/Automotive sector. They mainly purchase smart fluids as a component for manufacturing their products for example automotive MR actuators, Dampers. Since the main purpose is to use the smart fluid as an intermediate good to manufacture another product, industrial consumers have high quality expectations in terms of Product and service. Therefore it is integral for Arus MR Tech to maintain high quality standards and excellent service with client management.

The traits attributed to this segment of buyers include long purchase processing steps, some clients initially begin with trial of sample quantity and then go on to purchase on

bulk typically order quantity is high compared to Individual consumers and the payment option available is made flexible for this segment by Arus MR Tech.

A look at the geographical allocation of the Industrial Consumers shows that they are spread across Europe, Asia, America and Oceania, with India and Europe accounting for 76% of the Industrial Consumers, whereas 36% are located in India and 40% are situated in Europe.

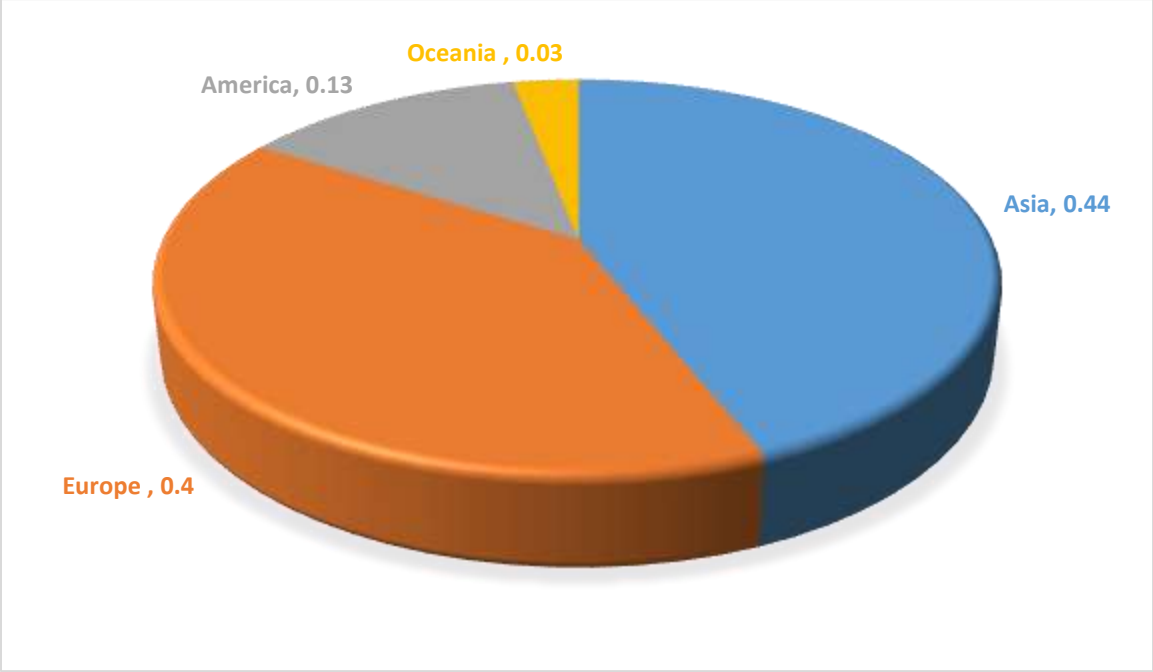


Fig 12 Geographical Pattern of Industrial Consumers

In addition, the different sectors in which the Industrial Consumers are operating were considered. Thus more than half of them are in the automotive sector/mechanical engineering sector and about 18% accounts for Robotics application, followed by 8% in Building & Construction, Defense each and 2% in prosthetic knee dampers.

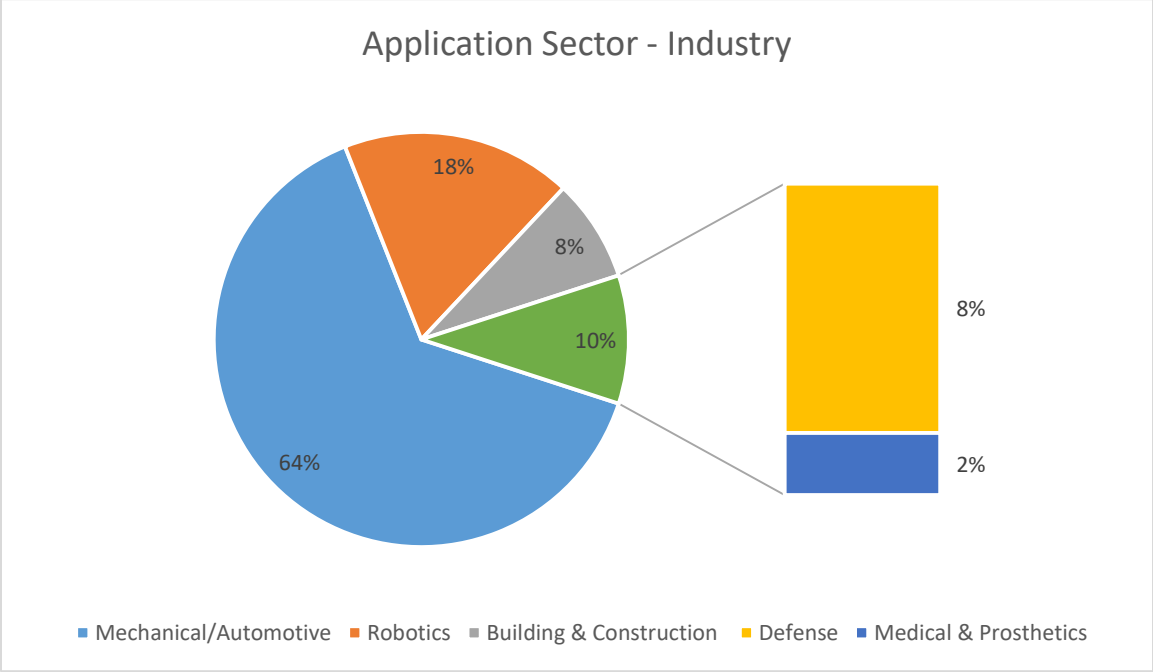


Fig 13 Application Sector – Industry

B2C: Individual consumers are leading universities (including individuals such as PhD Professors and engineering students involved in MR fluids based work) and research institutions. The main reasons for these consumers to purchase MR Fluids are research purposes, focusing on the development of new fields of application. However these segment of consumers are mostly low volume buyers and seek quick service and discounts on price.

B2G: This Segment of buyers represent government institutions mainly from Defense and Military sector and also Aerospace. The purchase process usually begins with the tender proposal and submission, with agreement to terms and conditions and therefore appropriate tender management is crucial to win the bid. The order quantity is usually large and payment terms are usually upon receipt of goods.

VOC Data Gathering

We conducted a survey in form of a questionnaire on the quality of AMT MR Fluids to find out what the customers think about the product. The questionnaire was compiled with nine questions with a mixed scale of 1-5 (with 1 the lowest and 5 the highest rating) and 1-10 (1 the lowest and 10 the highest). Among these nine questions there are 2 open questions. The complete questionnaire can be found in the appendix.

The survey was sent via mail to all the customers of Arus MR Tech. Despite of the risk of a potential low response rate of a mail survey, the reasons for doing so are the following advantages:

• Encourage honest answers (since respondents tend to believe their answers are anonymous)
• Cost effective (no costs in terms of printing and distributing questionnaires)
• Facilitate stratification of data

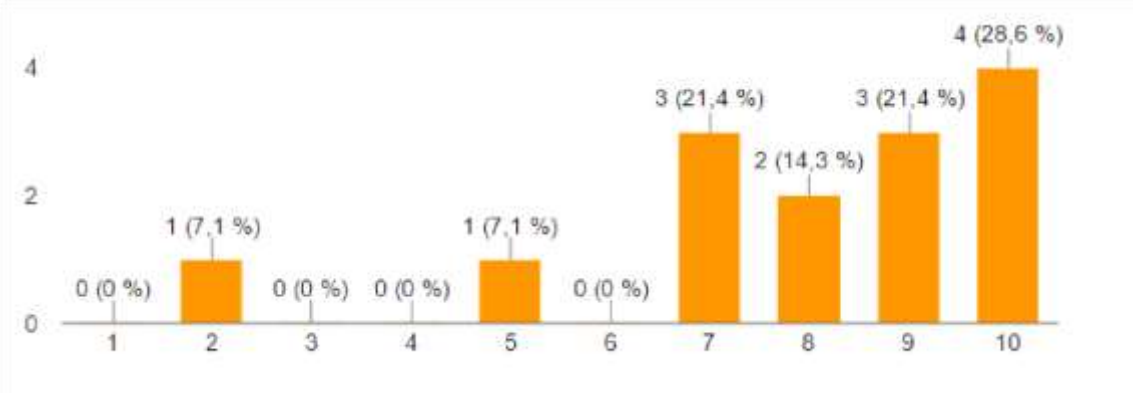
Statistical techniques will then be used to analyze the collected data and those data are presented in graphical forms.

Data Analysis: We made an internet survey and sent it to our representative customers. They were a group of 35 people, because we should have in mind Arus MR Tech is an almost new startup with a growing customer base.

The questions could be classified into three groups. Generic question from number one to number three, importance and rating questions from four to seven and finally open questions eight and nine. A significant difference between the first and the second group is the rating scale, on the first it is from one to ten to have a deeper evaluation but on the second it is from one to five because of the high difficulty in measuring the technical and service factors from a subjective point of view.

The questions could be classified into three groups. Generic question from number one to number three, importance and rating questions from four to seven and finally open questions eight and nine. A significant difference between the first and the second group is the rating scale, on the first it is from one to ten to have a deeper evaluation but on the second it is from one to five because of the high difficulty in measuring the technical and service factors from a subjective point of view.

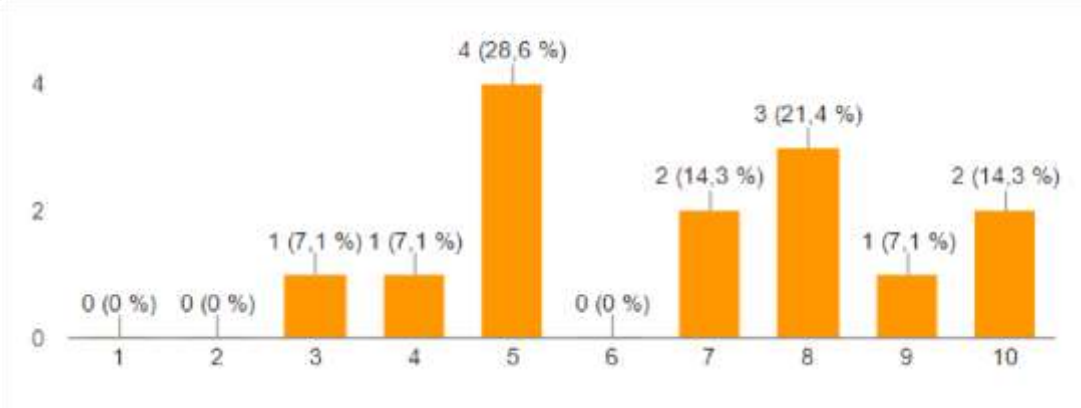
Question 1. Product satisfaction perceived by the customer:



Graph 1 Product Perceptions - Consumers

We can see most of them have a good perception of the product, as 85.7% of them rated the question from 7 to 10.

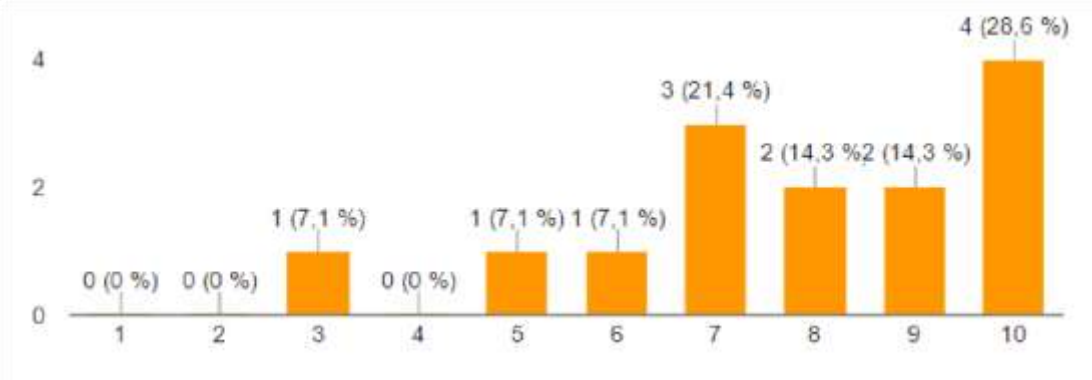
Question 2. Value of money perception:



Graph 2 Value of Money Perception

The result on this question is not as clear as the one before. But even like that 57.1% of them think it has a competitive price (7 or more). But there is a second opinion, 42.8% of them think it is not such a competitive price.

Question 3. General technical performance of the product:

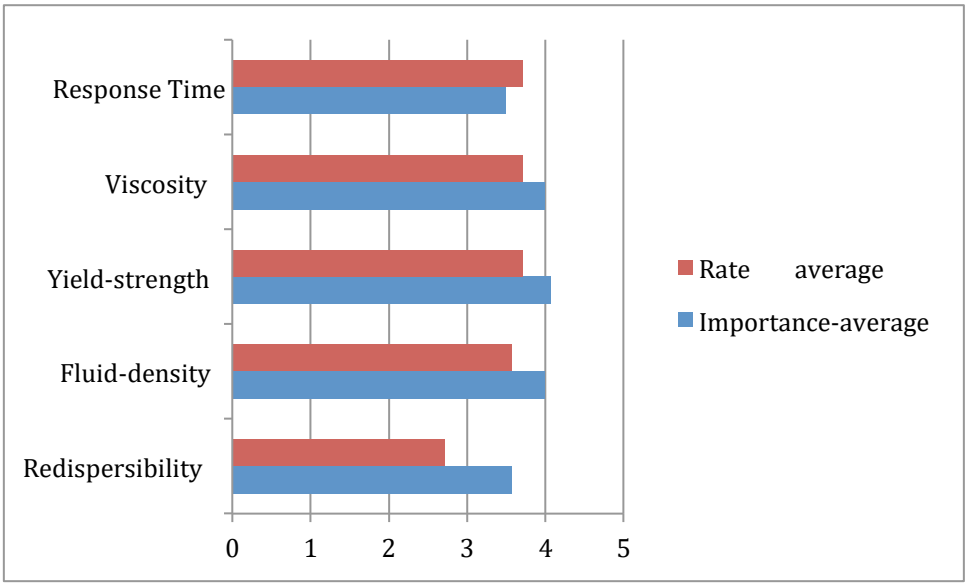


Graph 3 Technical Performance Rating

As in the first question we can see the majority of the customers are satisfied with the technical performance of the question, more precisely the 78.6% of them. This percentage is a bit lower than the general satisfaction but we should not make a conclusion based on such a low sample.

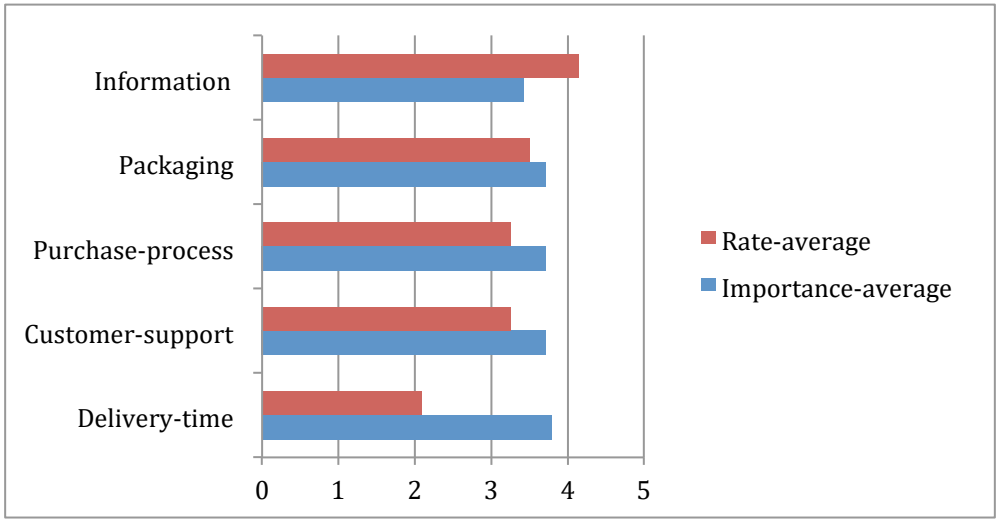
Questions 4 and 5. Analysis of the technical factors of the product:

On this part we have calculated the average and graphed it, to have a first very basic idea of the answers received. Here we can see the results for the technical factors:



Graph 4 Technical Factors Importance Rating

And for the service factors:



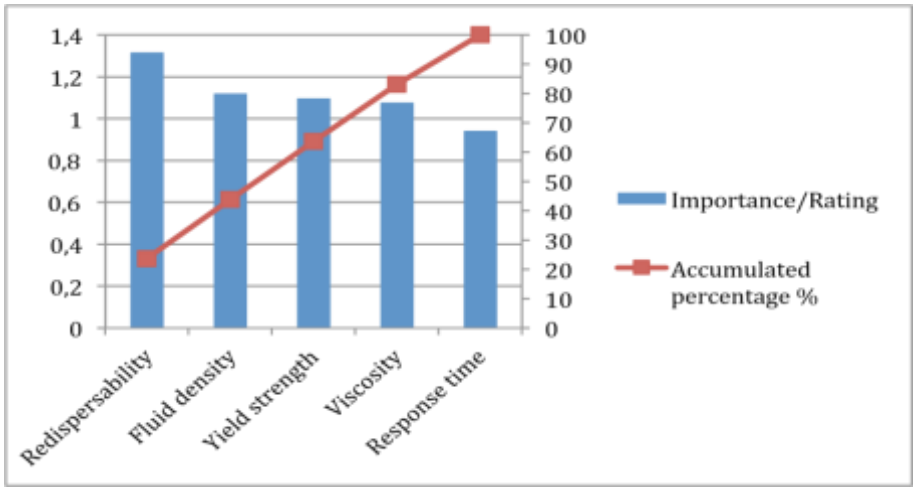
Graph 5 Service Factors Importance Rating

After it we have evaluated the priority of the problems using an Importance/Rating ratio which means the more importance perceived by the customer the higher the ratio will be and the lower the rating the higher the ratio will be. A problem with a low rating and a big importance to the customer will be the first to be solved using this ratio method. The importance and rate values are the sum of all the answers.

	IMPORTANCE	RATE	I/R RATIO	%	ACC. %
Redispersibility	50	38	1,315789	23,7	23,7029
Fluid density	56	50	1,12	20,2	43,87882
Yield strength	57	52	1,096154	19,7	63,62516
Viscosity	56	52	1,076923	19,4	83,02507
Response time	49	52	0,942308	17	100

Table 8 Importance / Rate Ratio – Technical Factors

From this we have done a Pareto analysis which consists in evaluating what percentage of the problems to solve can be done by solving every individual task from the most important to the less important in relative terms.



Graph 6 Pareto Analysis of Technical Factors Importance /Rating

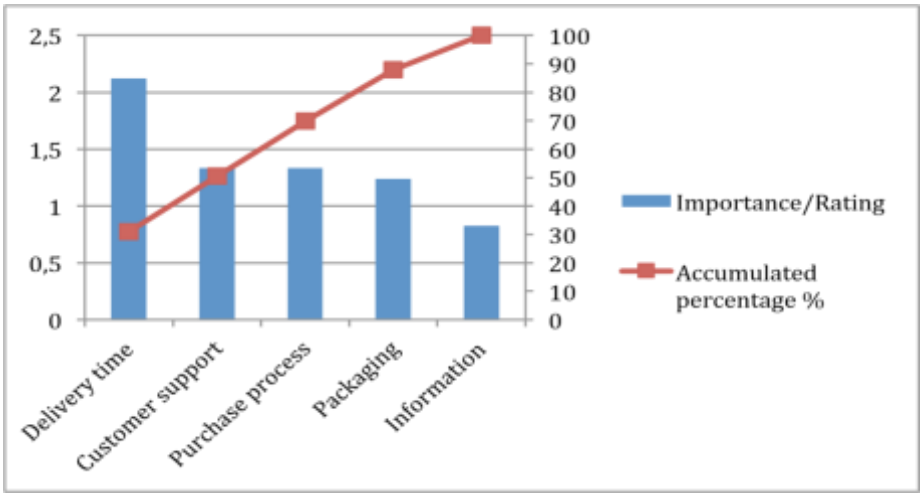
For us the most important issue, from the technical factors, is the ease of redispersibility which has the biggest importance-rating ratio. Just by solving it and the fluid density problems we solve the 43.8%.

Questions 6 and 7. Analysis of the most important factors of the service given:

	IMPORTANCE	RATE	I/R RATIO	%	ACC. %
Delivery time	53	25	2,12	30,9	30,9383
Customer support	52	39	1,333333	19,5	50,39635
Purchase process	52	39	1,333333	19,5	69,8544
Packaging	52	42	1,238095	18,1	87,92259
Information	48	58	0,827586	12,1	100

Table 9 Importance/Ratio –Service Factors

For the service given evaluation analysis, we have used the same ratio method, and after it we have done the Pareto analysis. Just by changing the delivery system we could solve a 30.9% of the total problems. And by improving also the customer support we could go up to a 50.4%.



Graph 7 Pareto Analysis of Service Factors Importance/Rating

The Pareto analysis shows us that in our case just by solving the two bigger problems we can improve the quality perceived by the customer in more than a half.

Question 8. Problems and complaints:

From this open question we could not get a lot of information as most of the customers did not answer this part of the survey. But we received some complaints related to the delivery time and the difficulty of the importation process. It is not a big issue as these factors have been analyzed in the questions below.

Question 9. Good things:

On the one hand we consider this question fundamental to see what the customers most like about our product in order to keep the expected quality or even improve it. On the other hand we could not have this valuable information from most of the customers as they did not answer too much on this part of the survey. But they highlighted the good value of the product for its price.

5.4 Purchase Process and Sales Channel Strategy

The purchase process differs according to the sales channel. Since our sales channel is completely online. The purchase process involved with consumers of AMT entails below:

Product search on web (Information availability) – Purchase enquiry – Enquiry Follow up (Customer support Team) – Order Acceptance/rejection – Order formulation & Packaging – Order Delivery (Outbound Logistics).At AMT, we keep track of the purchase status through the following phases

- Follow-up
- No Reply
- Incorrect-Contact Details
- Requirement-over
- Matured

Since the entry point starts through enquiry, AMT maintains a backlog of all the incoming enquiries with details on incoming Month, Date, No of Enquiries, Customer name & organization, Contact no, Location, Email Id, Requirement, Source of Enquiry and status.

Tools Used: Format: Excel File Name: Enquiry Profile

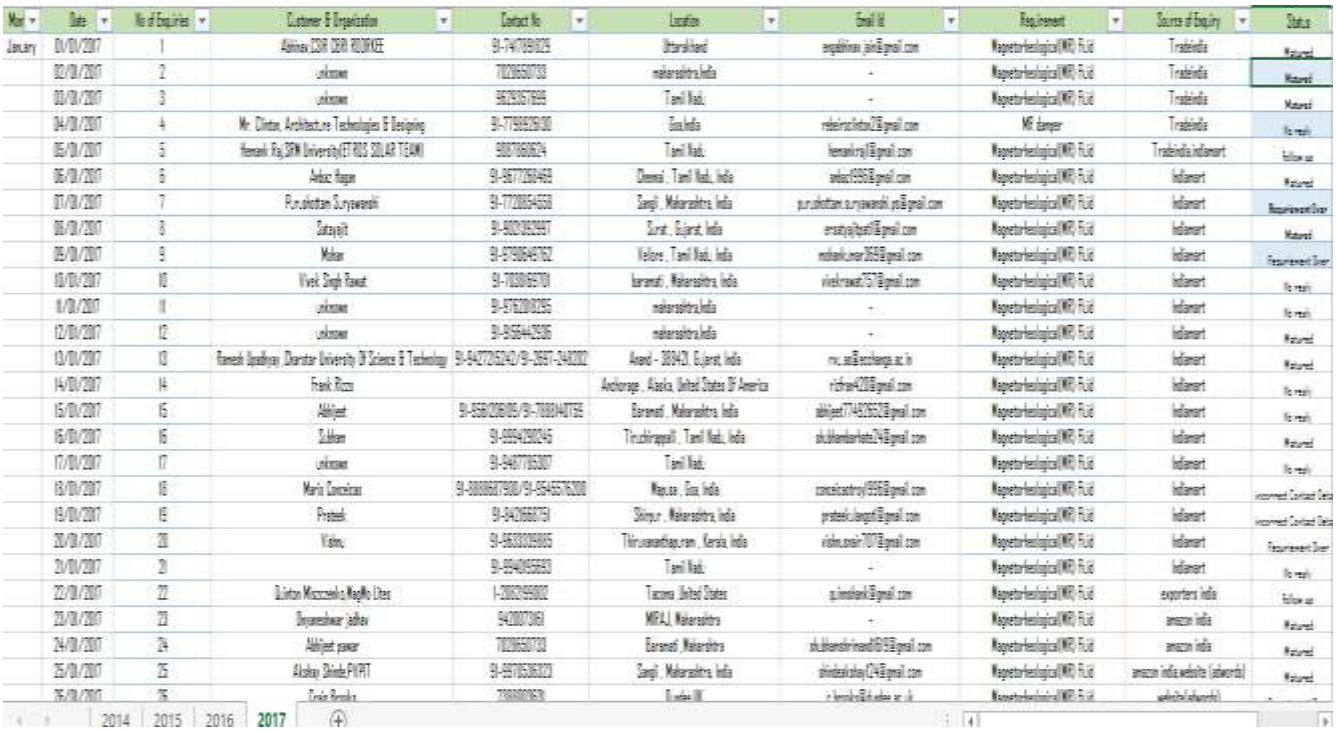


Fig 14 Enquiry Profile Dashboard

Sales Management Strategy

The sales channel at present in AMT is completely online and leaves the scope of improvement with making the most of other sales channel. Available Standard Packaging

AMT Dampro	AMT Magnaflo	AMT Smartec
• 250 ml • 500 ml • 1 litre	• 250 ml • 500 ml • 1 litre	• 250 ml • 500 ml • 1 litre

At AMT, sales channel is classified according to Target customers and User type.

User Type Classification	Target	Sales Channel
(i) Low volume-(250ml –Online marketplace)	B2C (Research Students, Colleges & Research Institutions)	Online marketplace (Amazon/Alibaba)
(ii)Mid Volume- (500ml upto 10 liters)	B2B (Automotive OEM's, B2B dealers)	Website –Cart checkout (Proposed) www.arusmrtech.com
(iii)High volume- (10 liters < Q ≤ 75 liters) & Bulk (75+ liters)	Potential B2B clients and B2G	Distributorship/Dealership Bulk pricing contract with B2B clients

Table 10 Sales Channel Classification

(i) Target Audience: Low volume users – B2C

AMT registered with Amazon India and launched only 250ml, least standard Packaging available to target B2C consumers type, who are also low volume users. The payment options available is Flexible – Cash on Delivery, Electronic Payment.

Scope of Improvement: Amazon seller's Dashboard Management

(ii) Target: Mid Volume users - B2B (Automotive OEM's, B2B dealers)

Currently, the mid volume users place an order through an enquiry feed on website and customer support team follows through to close the sales. It has been observed that customers look for quick information rather waiting for a follow up mail, regarding the product tech data and pricing. In order to solve consumer's problem for lack of product information and pricing available through website, AMT has proposed to include Online Product Catalogue with Price structure (250ml,500ml,1000ml) plus bulk (through

enquiry) through Website feed. And the existing payment mode available is bank transfer which few clients find inconvenient, therefore a safe and secured payment channel to facilitate online payment. Our selection parameters objective is to have a simple payment interface with high quality of service and low maintenance with wide geographic reach and card acceptance.

(iii) High Volume Users - Potential B2B clients and B2G

Currently, AMT doesn't have any offline sales channel as the need for it arises with growing market base in regions outside of AMT's operating regions. Therefore, the sales opportunity of improvement at AMT include to provide an easy and convenient sales channel for high volume users, dealers who could best fit to bridge the gap between Manufacturer and end user and accelerate the sales volume, who have the requirement anywhere from (1 liter > Q >15 liters) & Bulk (15+ liters).

Fig 14 Distribution Channel

Distributorship/Dealership Strategy – Potential B2B clients and B2G -Contract with B2B OEM's – Relevant industry -

Lookout for right distributors is a challenging task ahead for AMT as they can make or break the company's image.

The selection parameters to appoint distributor in case of AMT include Sound Technical knowledge of Products * Strong Industrial connections * Good market reputation * Proven sales team * Minimum Product training required

5.5 Business Process Optimization –Key takeaways

"You have to smell, taste, feel and absorb every part of the game and keep rearranging the pieces until you get it right" – David.S.Kidder , The Startup playbook

Efficient and effective management of business processes is crucial to AMT's scale to growth as the flow of activities linked through the chain of supplier management to production and customer support should be fast and seamless. Any slowdown results in low productivity and affects the overall performance of the activities. Therefore, AMT constantly monitors and reviews the business processes and keeps optimizing it to

streamline the operations. The optimization could be pursued to improve on these four important aspects of the processes, Time/Quality/Productivity/Cost

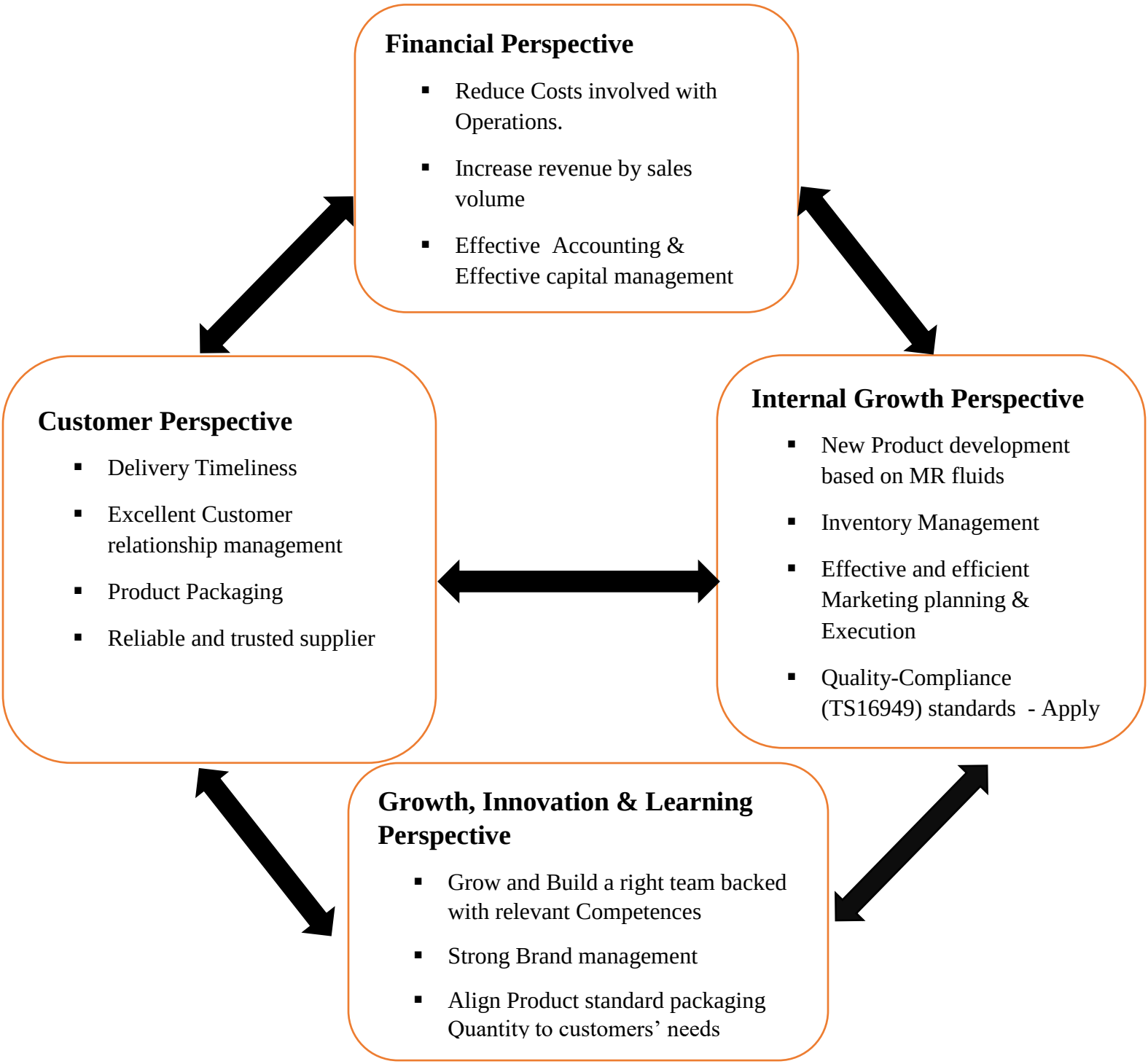


Fig 15 Balanced Scorecard – AMT

5.6 Key Performance Metrics – Performance Tracking & Monitoring

It is rightly so, that you can't set to improve on something, if you don't measure it. The metrics set should be measureable and actionable to track the performance and should be set aligned to the strategy and vision in order to be achievable. They could be deemed very crucial to understand if the particular business area/process/Strategy is working good or bad for the company. [9]

Three possible outcomes could be predicted

Leading Performance

Takeaway: Set the benchmark higher and always improve on the metric.

Neutral

Sustain and try to improve

Lagging

Remedial Actions /Implement action plan if lagging performance persists

The metrics at AMT could be set for the following

Finance Perspective:

Objectives –Measure:

- Maximize Profitability for Investors - Operating profit margin (%) = Operating profit (EBITDA)/Revenues
- Increase the ROA : Return on Asset (%) = Operating profit (EBIT)/Total Assets
- Increase the Asset turnover ratio = Revenues /Total Assets
- Earned Value Efficacy = Budget Cost of Production/ Actual Cost of Production (Bottom-line: The Earned value will give the financial measure of actual production cost over preset budgeted cost. Employees commitment should be focused on keeping the actual cost below to equal to budgeted cost)

Internal Process Perspective – Supplier Management – Production Management – Marketing & Sales Management - Logistics management

Supplier

Objectives - Measures

- Timeliness – Order Timeliness / Responsive to needs
- Long standing Supplier Relationship – Supply fulfillment
- Quality standards consistency – Compliance to Technical specs sheet
- Price – Supplier Pricing / Industry averages

Production:

Objectives- Measures

- Product Quality index– Quality efficiency = No of non compliant products (in liters)/ Total number of production output (In Liters)
- Inventory management – Stock Out cost = Cost of Lost opportunity due to non – fulfillment of order.

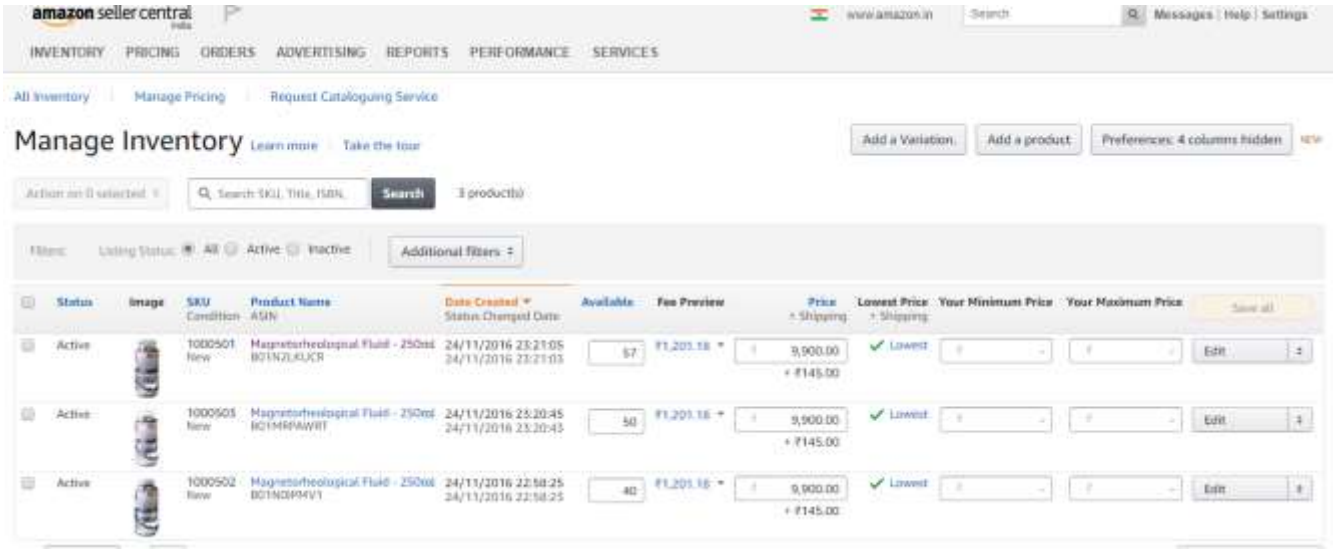


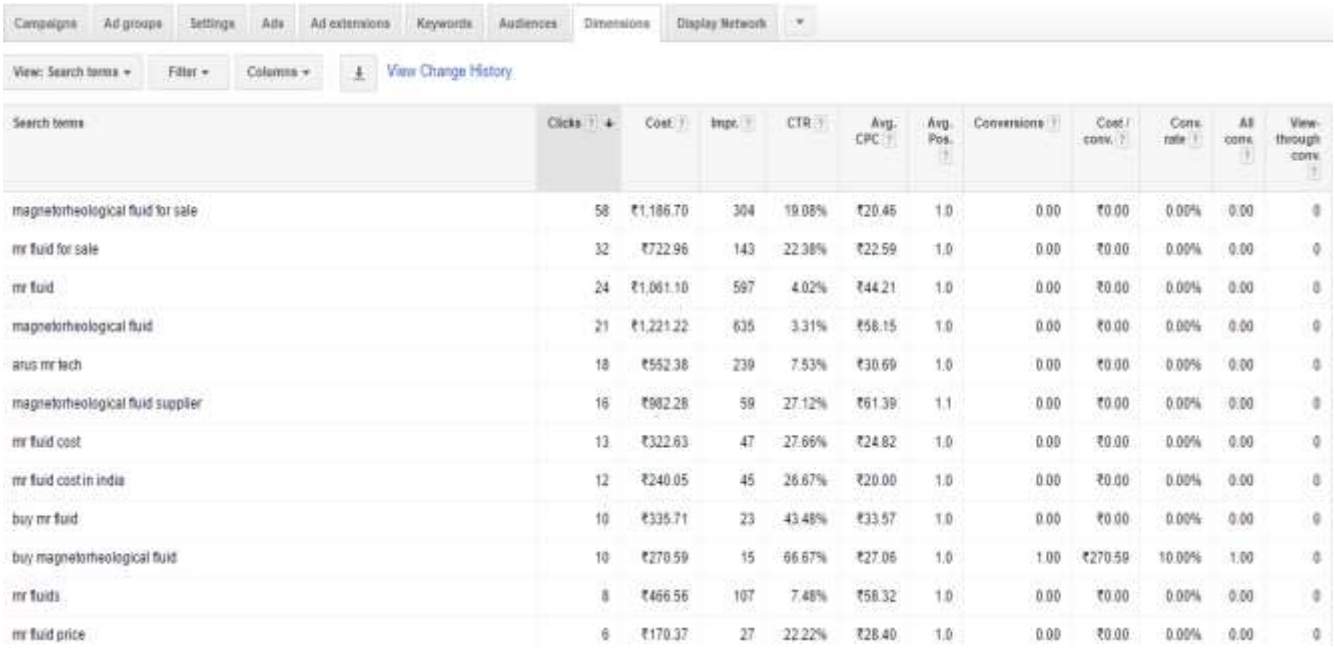
Fig 16 Amazon Seller Dashboard - AMT

Marketing & Sales

Objectives - Measures

- Customer Acquisition cost – Cost per Acquisition = Total Marketing cost /No of Customers acquired
- Lead Conversion rate – No of conversion/Total number of enquiry leads
- Marketing tool index – No of enquiries per source/Total enquiries from all sources
- Sales performance index : Actual Sales /Target Sales
  (Bottom-line: Lower the value, Higher should be the Employees commitment towards achieving the target sales. This metric could be assigned to Marketing & Sales team and the Top management's continuous motivation could be efficient and effective for employees commitment leverage)

Google AdWords Campaign



Campaigns | Ad groups | Settings | Ads | Ad extensions | Keywords | Audiences | Dimensions | Display Network

View: Search terms | Filter | Columns | View Change History

Search terms	Clicks	Cost	Impr.	CTR	Avg. CPC	Avg. Pos.	Conversions	Cost / conv.	Conv. rate	All conv.	View-through conv.
magnetorheological fluid for sale	58	₹1,186.70	304	19.08%	₹20.46	1.0	0.00	₹0.00	0.00%	0.00	0
mr fluid for sale	32	₹722.96	143	22.38%	₹22.59	1.0	0.00	₹0.00	0.00%	0.00	0
mr fluid	24	₹1,061.10	597	4.02%	₹44.21	1.0	0.00	₹0.00	0.00%	0.00	0
magnetorheological fluid	21	₹1,221.22	635	3.31%	₹58.15	1.0	0.00	₹0.00	0.00%	0.00	0
arus mr tech	18	₹552.38	239	7.53%	₹30.69	1.0	0.00	₹0.00	0.00%	0.00	0
magnetorheological fluid supplier	16	₹982.28	59	27.12%	₹61.39	1.1	0.00	₹0.00	0.00%	0.00	0
mr fluid cost	13	₹322.63	47	27.66%	₹24.82	1.0	0.00	₹0.00	0.00%	0.00	0
mr fluid cost in india	12	₹240.05	45	26.67%	₹20.00	1.0	0.00	₹0.00	0.00%	0.00	0
buy mr fluid	10	₹335.71	23	43.48%	₹33.57	1.0	0.00	₹0.00	0.00%	0.00	0
buy magnetorheological fluid	10	₹270.59	15	66.67%	₹27.06	1.0	1.00	₹270.59	10.00%	1.00	0
mr fluids	8	₹466.56	107	7.48%	₹58.32	1.0	0.00	₹0.00	0.00%	0.00	0
mr fluid price	6	₹170.37	27	22.22%	₹28.40	1.0	0.00	₹0.00	0.00%	0.00	0

View: User locations | Filter | Columns | View Change History

Country/Territory	Clicks	Cost	Region	Metro area	City	Most specific location	Impr.	CTR	Avg. CPC	Avg. Pos.
Iran	22	₹1,330.43	Unspecified		Unspecified	Iran	470	4.68%	₹60.47	1.0
India	20	₹631.84	Maharashtra		Pune	Pune	204	9.80%	₹31.59	1.0
India	19	₹386.57	Maharashtra		Unspecified	Maharashtra	230	8.26%	₹20.35	1.0
India	14	₹387.32	Karnataka		Unspecified	Karnataka	114	12.28%	₹27.67	1.0
India	14	₹361.93	Tamil Nadu		Unspecified	Tamil Nadu	178	7.87%	₹25.85	1.1
India	13	₹704.66	Kerala		Unspecified	Kerala	189	6.88%	₹54.20	1.0
India	12	₹460.68	Karnataka		Bengaluru	Bengaluru	300	4.00%	₹38.39	1.0
India	11	₹314.02	Tamil Nadu		Chennai	Chennai	185	5.95%	₹28.55	1.0
United States	9	₹538.37	Massachusetts	Boston MA-Manchester NH	Worcester	01609	23	39.13%	₹59.82	1.0
Canada	5	₹40.10	Alberta		Slave Lake	T0G	11	45.45%	₹8.02	1.1
United Kingdom	5	₹376.33	England		Blackpool	Blackpool	5	100.00%	₹75.27	1.0
United States	5	₹278.52	California	San Francisco-Oakland-San Jose CA	San Jose	95111	23	21.74%	₹55.70	1.0
India	4	₹29.62	Karnataka		Bengaluru	560072	4	100.00%	₹7.40	1.0
India	4	₹132.77	Kerala		Thiruvananthapuram	Thiruvananthapuram	94	4.26%	₹33.19	1.0
India	4	₹43.61	Tamil Nadu		Coimbatore	Coimbatore	115	3.48%	₹10.90	1.0
Iraq	4	₹113.36	Unspecified		Unspecified	Iraq	20	20.00%	₹28.34	1.1
Turkey	4	₹190.03	Ankara		Ankara	Ankara	14	28.57%	₹47.51	1.0
United Kingdom	4	₹154.58	Scotland		Dundee	Dundee	24	16.67%	₹38.64	1.0
United States	4	₹212.52	Delaware	Philadelphia PA	Newark	19713	23	17.39%	₹53.13	1.1
United States	4	₹238.37	Florida	Orlando-Daytona Beach-Melbourne FL	Daytona Beach	32114	11	36.36%	₹59.59	1.5
Canada	3	₹151.24	Ontario		Richmond Hill	L4C	10	30.00%	₹50.41	1.6

Fig 17 Google AdWords Campaign Dashboard - AMT

Logistics

Objectives and Measures

- Delivery timeliness – No of on time delivery/ Total no of delivery
- Delivery Accuracy – No of delivery fulfilled with customers acceptance/Total No of Delivery (Acceptance + Rejection)

Customers Perspective:

Customer Management

Objectives and Measures

- Order Fulfillment – No of Orders fulfilled/No of order taken
- Order Accuracy – No of Orders in full compliance/ Total no of orders(Compliant +Non compliant)
- Customer Satisfaction – No of technical assistance calls/Queries answered/Total no of Technical assistance calls/Queries
- Complaint Ratio = Total No of Complaints Received /Total No of units sold

(Bottom-line: The complaint ratio is a measure of how many complaints are received based on product/service quality and the top management's commitment should always be to minimize and keep the ratio to zero.)

Growth ,Learning and Innovation Perspective:

- New Product Development - Rate of New Product development – Indicator of how fast a new product development process takes.
- Customization Order Cycle Time –Indicator of the cycle time taken to complete a custom order.

6. CHALLENGES BEING A SMALL FIRM, SMALL TEAM

Arus MR Tech enjoys the status of being a small firm as it has limited resources and capabilities, in terms of Production output and employee size. It has a total employee size of 8-11 with two offices operating in Chennai, India and Sharjah, U.A.E and the third proposed R&D center to be established in Milan, Italy.

The proposal to establish an R&D center in Milano, Italy is mainly due to the factors of technological advancement in the European region especially in the automotive sector with the likes of huge automotive O.E.M giants and the research & development collaboration with the faculty of POLIMI and other important determinants to weigh the benefits of strategic location Analysis.

Determinants/Factors	Benefits Associated	Cost associated
R&D personnel	Highly Skilled/Availability – Support from University faculty	R&D expenses are however high.
Accessibility to resources (Raw Materials/Technical testing facility/Production Machinery)	Much superior Quality ,Supplier reliability, Accessibility	Cost associated with the procurement of resources will be comparatively lower as logistics and customs involved will be evaded.
Market Potential & Size	High compared to other regions	-
Technology Adoption	High	-

Ease of setting up an R&D center	High	Company-Formation Expenses
Intellectual Property Formality	Quicker, Easier and cheaper in comparison to India.	Intangible Asset
Technological Breakthrough and Innovation advancement	High	Intangible Asset

Table 11 Strategic Location Analysis

The decision analysis mainly revolved around the above determinants conducive to new Product development and technological adoption.

One of the main challenges faced by Arus MR Tech with being the small team,while there are benefits added to it,at the same time it has its downside too.With increasing client base and production output,It becomes increasingly difficult for Arus MR Tech which has an employee count of just 8 alltogether to keep pace with these factors.

However the main challenges could not be seen just with small team and small firm, others include

Lean capital management with efficient use of funds to support business operations is key to sustain the growth of AMT. Large account of expenses are covered in up keeping the production activities and overheads, which leaves little room for other expenses. Capital use should be channeled towards Marketing, Asset investment (Production equipment/Machinery- tangible asset, Intangible asset- Patent), R&D and SGA (Selling, General and administrative) expenses. Effective and intense marketing strategy would increase our customer base, create new business opportunities with potential clients. Investment in the aforementioned directions would be a significant source for fostering product innovation- R&D investment expands the horizon to innovate and improve on existing parameters eventually leading AMT to develop breakthrough MR based devices and launch new promising variants of MR fluids. Any uncontrolled use of financial resources would consume all our capital at a faster rate that would eventually lead the business down. Therefore, AMT's financial analysis and Accounting control is key to the financial health and overall performance of the company.

6.1 Taking on Big firms – Implementing Judo Strategy

We know, AMT has three competitors who are big and powerful companies geographically based in USA and Japan. While what quite intimidating on one hand is their forces of resources and large market share. On the other hand, the selling point of AMT is its technically superior MR solutions and its less expensive than its competitor's pricing. Relying on its strengths, AMT is strategizing to implement Judo strategy to take on big competition. The idea is to use skill to defeat size to take on the more powerful industry players.

The main principle behind Judo strategy revolves around using skills instead of strength and size to take on its rival opponents. AMT believes in creating a competitive edge by being unique in offering better products at a cheaper price and faster service. Small firms like AMT can benefit from being agile in decision making and product development as opposed to big firms which has long winded bureaucratic processes having a wide decision links. The most important part of the business is client/Customer relationship, which big firms mostly neglect the personalized relationship and ability to customize a product to meet the technical needs of the clients and another weakness of big firms lies in its ability to change, i.e. they are less flexible than small firms and they are risk averse in decision making. [Marketing & Strategy, Vittoria Chiesa]

Judo strategy can be bolstered by AMT, with comprehensive analysis of its competitor's strengths and weaknesses. AMT should try and create a niche market space for itself rather than heading on with its competitors targeting the same market space.

6.2 Barrier to adoption and Consumer Education

It could be well said that MR technology hasn't found a large market base yet mainly due to its few limitations which poses as barriers to adoption. The existing commercial application of MR based automotive suspension comes only in high end sports, luxury and performance cars while the key to mass adoption could be eliminate the barriers.

- Too Expensive than conventional technology
- Lack of Change management by Automotive O.E.M'S.
- Lack of Technology adoption
- Lack of Consumer Education

In contrast, big companies play a huge role by channeling their Marketing and PR resources to promote the MR technology on a big scale with conferences, Tech exhibitions, Auto shows that in turn helps in consumer education and spurs awareness which fuels the growth of technology adoption at a faster rate. Therefore, eliminating barriers for AMT can often be more valuable in a long run rather adding additional reasons to buy. [5]

6.3 Leadership & Entrepreneurship challenges

"As an entrepreneur, you have that wonderful great privilege of being in charge of your destiny" -Barbara Corcoran

Being an entrepreneur of a startup is analogous to being the driver of a vehicle. You are in charge of where the entire vehicle is headed and the journey you set on to embark is all a new route, which you are on for the first time ever. Along the way you encounter bumps in the form of challenges, but with every hurdle you overcome, you enjoy the reward of it or it comes off as a learning experience. The most fascinating aspect is how you as an entrepreneur absorb the challenges and willing to tackle it as it goes on to show what metal an entrepreneur is made of. Of course experience will help you develop entrepreneurial calluses which emboldens your character and makes you a better entrepreneur. It is so important that an entrepreneur has a comprehensive insight on the market and industry which he is operating in. Some of the most important include the key players involved, market size, how to target the potential customers, what are the customers' needs and what

are you offering and how to gain the market share. All of it comes with a significant amount of analysis and study.

The goal should be to always experience the entrepreneurial journey with more joy and contentment and not be dissatisfied with the lack of progress.

The formation of a start up in a country like India wasn't easy as various permits and government identification numbers was required and to add a stat, India ranks 130 worldwide in ease of doing business.However,a new initiative of "Make in India" has exclusive benefits to micro, small and medium enterprises with subsidy on taxes and return filing norms. Falcon MR Tech was formed as a legal business entity in the form of Sole Proprietorship and Arus MR Tech in U.A.E on partnership basis, with major shareholding in my name.

As a CEO and CTO,I was playing multiple roles assuming all the responsibilities be it the decision making, setting company's vision, Planning & strategy implementation and also direct the ongoing R&D and innovation to promote new product development and technological breakthrough with newer applications using MR fluids. The most important task is with employee management. The management style followed by Arus MR Tech is quite permissive allowing its employees to communicate directly with its C – Officers and this has proven to be efficient for the transparency of the business activities & progress.

Quality Policy Standards:

Employees commitment to meet the desired quality goals set by Arus MR TECH is a crucial part for Quality management system at AMT. Dictionary defines "commitment" as the state or quality of being dedicated to a cause or activity. As Arus MR Tech has the production output in small scale at this time, the need for employees involved with Production and Operations are few and the top management involves Chief Executive officer, Chief Technical officer and Investor (Major Business shareholder) and lower down, R&D scientist, Operation manager, Marketing & sales and customer support team comprises of two people. The organization tree involving top management entails below.

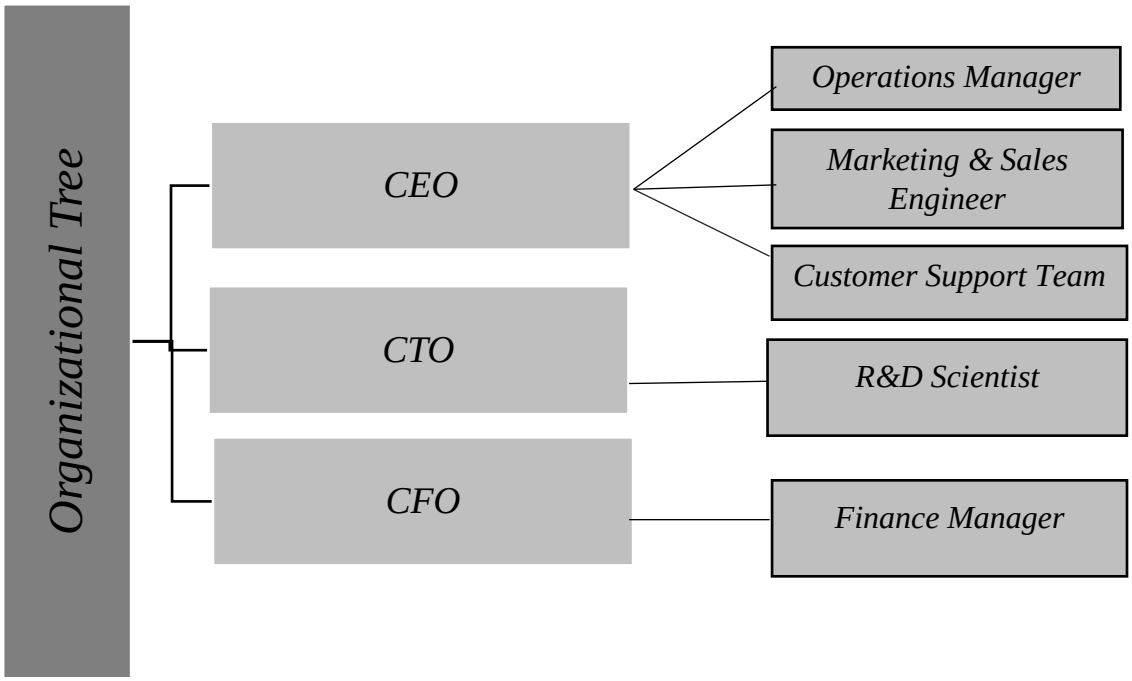


Fig 18 Organizational Tree - AMT

However there is no measure of employees performance & commitment towards achieving quality goals. This has given scope for us to implement the evaluation for employee commitment to align and meet the critical quality goals. The objective is to always to keep the consumers needs first and align the needs to employees effort and commitment towards achieving them.

The employees commitment can be evaluated by their individual performance through their dedicated & assigned tasks. (For example, Sales Target, Complaint Ratio, Customer satisfaction rate%, Earned value, Order fulfillment rate) and the key performance indicators can be adopted in order to monitor and control the performance and commitment of employees.

Someone rightly said so, it takes teamwork to make your dream work. Hiring the right people is critical to an organizations success and helps to maximize the results to effort ratio.

Therefore Top management's focus on employee's satisfaction leads to commitment towards product and process quality leading to overall productivity, better quality products/service and lower employee turnover. Thus Top management's involvement is

crucial in achieving employee's satisfaction and therefore benefit from their commitment and effort.

7. SOLUTIONS – PROBLEM SOLVING APPROACH

7.1 New potential markets and framework to target new markets set in different geographical locations

The main challenges lies for AMT is to scale up in increasing the market share, this could be accomplished by finding new potential markets set in different geographical locations and capture the market opportunity.

The systematic approach in finding potential markets could begin with evaluation of current market trends set in different geographical locations and assess the competition position in order to weigh the competitive advantages and the risks associated with it, then estimate the possible market size in that region and then conduct pilot study to monitor potential client's /customers response to products through a survey and then analyze the overall results and weigh the pros and cons to decide the feasibility of new potential market.

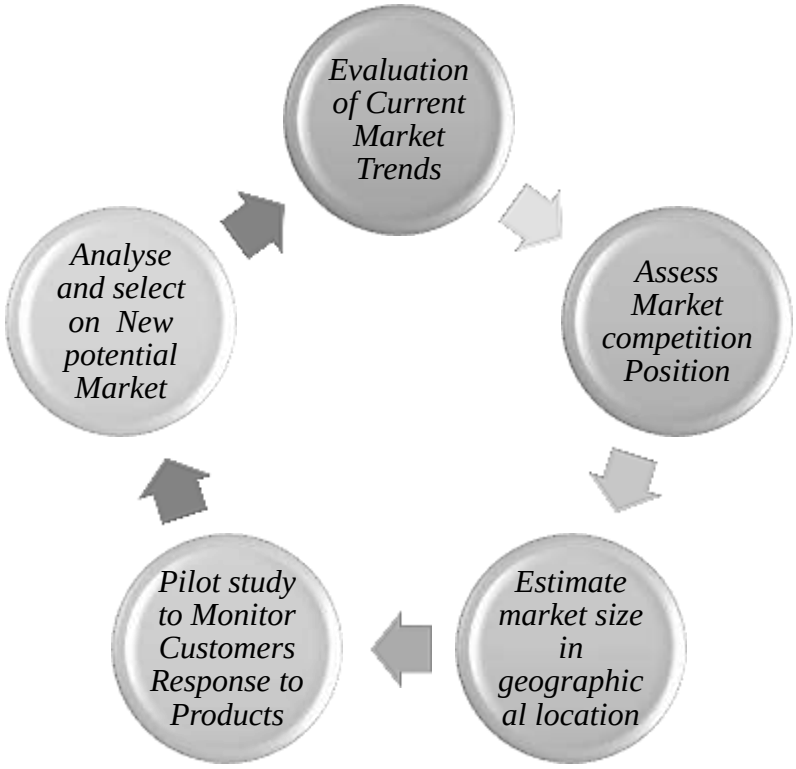


Fig 19 New Market Identification Framework

7.2 Dealing with growing Market Expansion and new areas of product application – Tailor make solutions to niche market

Magnetorheological fluids has seen significant growth in the scope of application in the recent years and it means market opportunity for AMT to discover. This is mainly due to the new technological innovation breakthrough which spurs the growth of MR fluid applications, thanks to the heavy ongoing research at research labs and universities all over, and many emerging O.E.M's involved in the research and development process. AMT's source of information about new applications has mainly come from its consumers, who buy solutions describing their end use and technical needs. AMT should learn to cope with growing product application and address potential client's technical needs more efficiently and effectively with tailor make (Customized) formulations.

As these applications work in different operating conditions and require different technical needs in the MR solutions. Therefore, AMT strategized to develop tailor make solutions to meet the needs of its potential clients. This required additional capital for AMT, to invest in machinery and testing equipments.

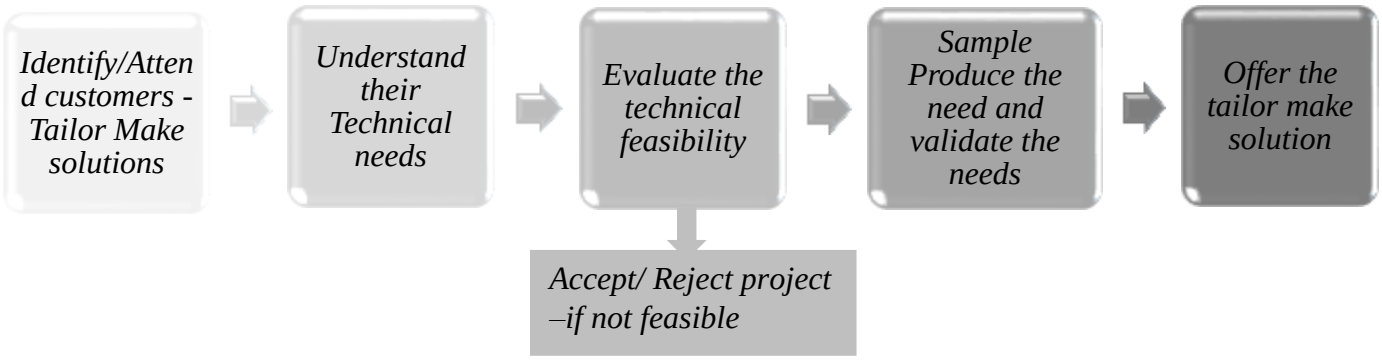


Fig 20 Tailor Make Order Formulation

7.3 New Product research & Development – Create or Co-create

AMT's main strategy to accomplish its vision by 2020 is by staying ahead of competition and this means that AMT has a challenge to find a niche market space offering a new product based on its line of MR solutions. This will set a differentiating advantage over its competitors

AMT has to adopt mechanism for continuous innovation in order to spur new product research and development and expand into new products and services. This can be done by deep commitment to innovation having customer centric approach. The solution to meet the objective is to create or co-create in joint collaboration with potential clients or research institutions. If AMT pursues the creation strategy, then it has to build resources for development considering the risk evaluation of the return on investment, this would be a capital and labor intensive process while co-creation strategy require sharing of resources and any outcome will be a mutual benefit to both. AMT, being a small firm and limited resources would pursue to direct capital resources in co-creation strategy. Currently AMT is laying the groundwork for future possible collaboration with a technical university to leverage its new product research and development.

Break at Whirlpool as a Research intern

During my internship as Manufacturing research and development at Whirlpool EMEA, I discovered the application of Magnetorheological based dampers for washing machines replacing hydraulic dampers which serves to offer quieter operation with reduced vibration level which eventually impacts the overall panel life and better user experience. This application was studied years ago by Indesit group in collaboration with POLIMI and published a paper concluding that the end results showed a significant improvement in vibration reduction at all working conditions of the machine and had a greater noise reduction. With Manager's support, I was fortunate to get in touch with the group again hoping to revive the commercial application of it, However the team had great interest in the beginning which led to several online meetings and when things got elevated to senior level, The project was put on hold due to budget constraints and

8. FUTURE OUTLOOK

8.1 Product Innovation Management

The future of AMT is how well firm adapts and responds to the market and technological evolution with its product innovation. AMT would prepare itself by adopting the mechanism for continuous improvement and innovation in terms of both products offered by AMT (AMT DAMPRO, AMT – MAGNFLO, AMT – SMARTEC) by leveraging in terms of technical factors combined with services (In terms of Information availability, Delivery time, Customer/Technical support, Customization flexibility).

This continuous improvement mechanism is essential for AMT to monitor and improve their product/service attributes on a consistent basis thereby sustaining and increasing the value for its consumers and the company achieving through highest quality products combined with excellent service at lowest price and shortest lead time. As Arus MR Tech is in an Oligopolistic Market (Few sellers, Increasing Buyers),the key success to drive and thrive in a competitive market is to create a competitive and differentiating advantage over its existing competitors and match its products technical specs (Functional Utility) to ever growing customer's needs.

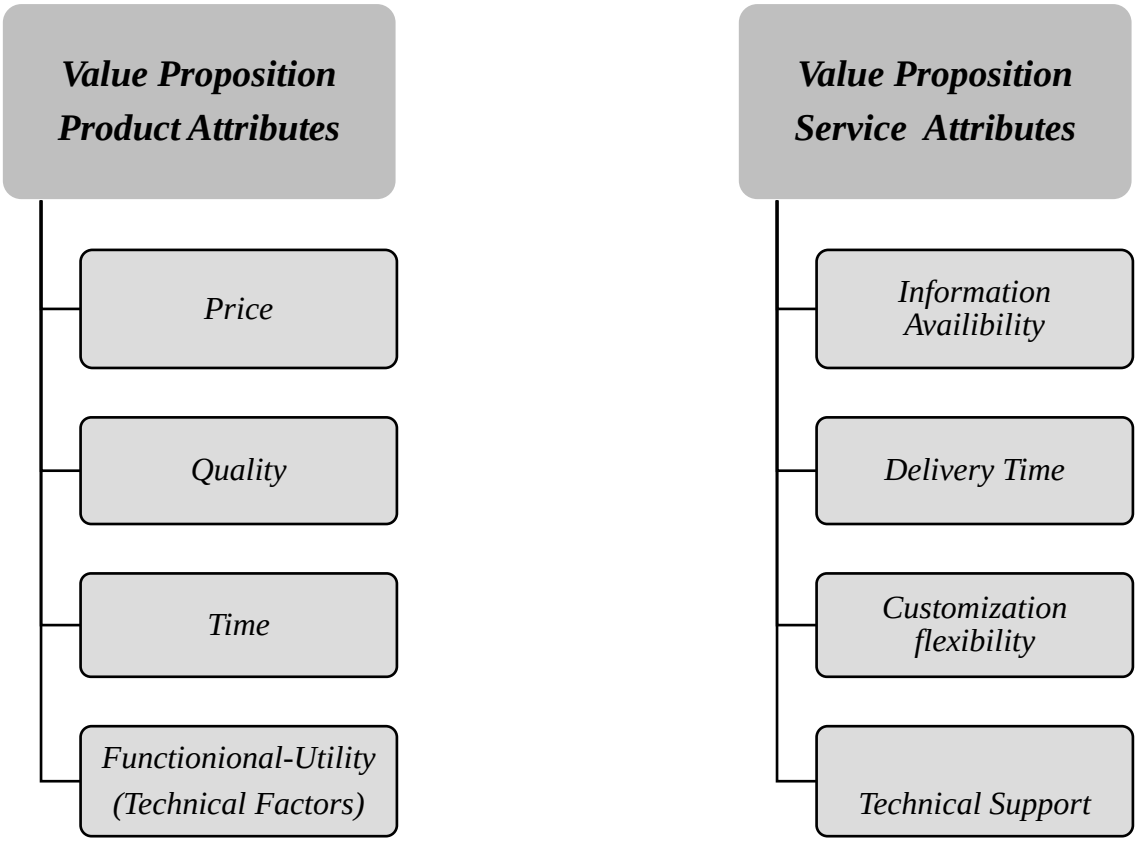


Fig 21 Value Proposition Product/Service Attributes

With evolving consumer's needs, and with ever changing technological trends ,the end users will always expect innovation in products with better features and also improved service quality all at a very competitive pricing. Hence continuous improvement is the main key to retain the existing customers and grow the client base.

8.2 Ongoing R&D, Sustainability Growth and Client Base Management

AMT's other sources of leverage is in ongoing R&D, Sustainability growth and client base Management as they play a vital role in supporting the growth and profitability of the business. The ongoing R&D at AMT aims for innovation in two directions, one in further improving the existing line of MR solutions and the other include new product development with MR fluid based devices.

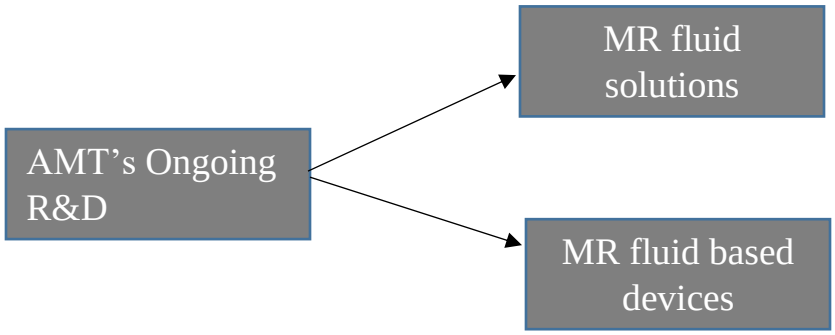


Fig 22 AMT's Ongoing R&D

For instance, the development of prototype MR damper is in first phase of the process with product design stage, and is supported by computed aided design and technical documentation, which is a part of ongoing project at AMT.

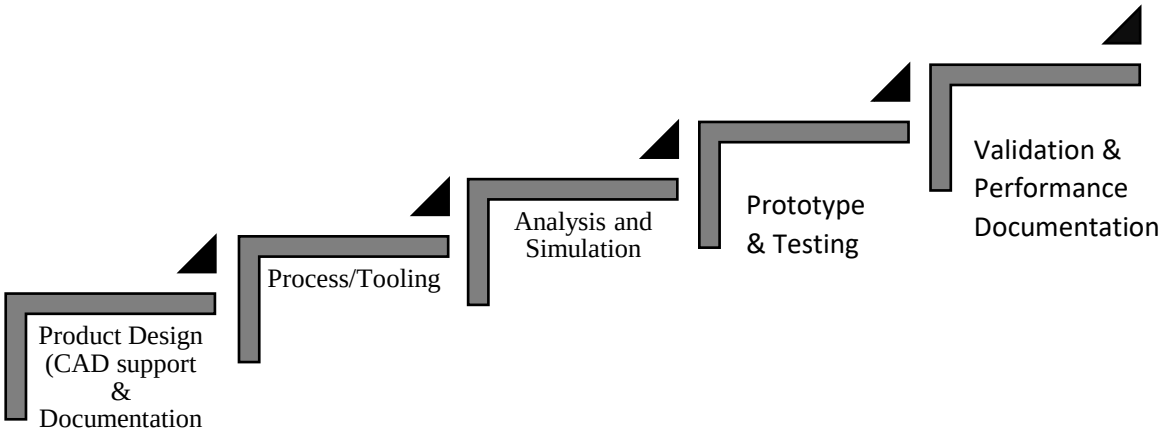


Fig 23 AMT MR Damper – Product Development Process

The management of sustainable growth is crucial to achieve and create long-term value for AMT's shareholders and stakeholders without relying much on its capital

investment. Therefore operational excellence practices by streamlining the business processes and striving for continuous improvement. It should aim to reduce non value added activities reducing the cost and thereby improving the productivity and quality of the products and services offered by AMT. With AMT's healthy operating profit margin, which is a positive indicator for AMT's Progress in business, should be re-invested for subsequent production and in operating expenses of the business.

AMT's purchase, distribution channels and optimization of Logistics (Inbound and Outbound) is key to meet the responsive needs of growing client base management at AMT. Proper client base management would stimulate and help gain market share and market impact could be significant for AMT. With that comes the need for more responsibility in managing the customer relationship with service excellence and without losing the touch of personalization.

AMT is looking forward to put its strategy with product innovation at place and go big in the market in terms of offering its products (MR solutions and MR devices) to redefine the smart mobility.

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LIST OF FIGURE, GRAPHS, AND TABLES

APPENDIX

Test Certificate of formulated MR samples

Anton Paar

To whomsoever it may concern.

This is to certify that measurement and analysis of Magneoto-Rheological samples has been performed by Anton Paar India Pvt Ltd. The samples measured were Sample 1, 2 & 3. Flow curve, Viscosity under influence of Magnetic Field and Yield stress at constant Magnetic field were measured. The subsequent obtained flow curve was fit using the Power Law (Ostwald Model).

All measurements were performed at Indian Institute of Science, Dept. of Chemical Engineering, Bangalore. The instrument used for measurement was MCR 301 with MRD 70 and PP 20 accessory.

The measurements was performed on 19 Jun 2014, along with Mr A R Abdus Samad, BE (Automobile Engineer) by Pramod Raghunanda, Head – Application Labs, Anton Paar India Pvt Ltd.

Pramod Raghunanda
Head – Application Labs
Anton Paar India Pvt. Ltd.

Survey

1. To what extent the product has satisfied your purpose/ need?
   (1 not satisfied at all 10 completely satisfied)

2. How would you rate the “value of money”?
   (1 the most expensive 10 the cheapest)

3. How would you rate the overall technical performance of the product?
   (1 very low 10 excellent)

4. How important are the following Technical factors for your end use application?
   (1 not important at all 5 very important)

   Yield Strength (KA/m) • Fluid Density (g/ml) • Viscosity (Pa.s) • Response Time (In milliseconds) • Ease of redispersibility

5. How would you rate the experienced quality of the following technical factors (being 1 the lowest and 5 the highest scores)
   Yield Strength (KA/m) • Fluid Density (g/ml) • Viscosity (Pa.s) • Response Time (In milliseconds) • Ease of redispersibility

6. How important are the following factors to you? (1 not important at all 5 very important)
   • Information availability • Purchase process • Customer support • Delivery time • Product Packaging

7. How would you rate the following factors?

   (Being 1 the lowest and 5 the highest scores)
   • Information availability • Purchase process • Customer support • Delivery time • Product Packaging

8. What problems or minor issues did you find during the whole experience? (Open question)

9. What do you like most about our product? (Open question)