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### JOURNAL FOR ALUMINIUM CASTING TECHNOLOGY

Volume 76 - June 2026



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*Dear Readers,*  
**We always look forward to your Feedback and comments on the Journal.  
Please do write to us.**

## Articles for GDCTECH Journal

We invite Expert Articles on technical techno commercial and management aspects of Diecasting Industry, for publishing in GDCTECH Bimonthly Journal. We believe that these articles serve as good source of knowledge for foundry industry people. Please contact GDCTECH office for any further information.

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ments, contents, opinions and point of views expressed by the authors.*

**Note: Some images in some articles may not be clear. Interested readers may contact the author**

## The Editor's Desk



**Ms. Kruttika Apshankar Kher**  
Editor



**Chandrashekhar N. Kate**  
Co Editor

Dear Readers,

We are very much excited to start as new Committee Members for GDC TECH Forum Journal's Editorial Board from June 2026 onwards.

GDCTech has completed a milestone of publishing of 75 Journal Issues, dedicated for the Die Casting Industry. Under the guidance of Mr R T Kulkarni, effort of Anand Joshi and focussed participation of other Executive Committee Members, GDC TECH has been publishing the journal with various technical articles supported by advertisements from various industrial partners and has continued running since the year 2012.

Due to the ongoing war effect, there are significant global level supply chain disruptions, a steep hike in the energy costs, inflationary pressures and capital scarcity, all of which have affected the working of MSMEs and developed new challenges for all of us.

To overcome uncertainty situations, Die Casting Industry should focus on technological upgradation, energy conservation, overall continuous improvement in the environmental area, renewable energy and team work, (with support of AI tools).

Readers can suggest topics for publishing articles, in the upcoming magazines.  
We look forward for your support in future.

On behalf of the Editorial Board, we are pleased to publish 76th issue of GDC TECH Forum Journal.

Thanking you,  
Warm Regards,

**Krutika Apshankar-Kher**  
Editor

**Chandrashekhar N Kate**  
Co Editor



## Team Building in Die Casting Industries *A Strategic Imperative for Sustainable Growth*

Anil S. Kulkarni

President - GDCTECH FORUM, Chairman - POOJA CASTINGS PVT. LTD.

In today's rapidly evolving manufacturing environment, the die casting industry faces unprecedented challenges and opportunities. Rising customer expectations, stringent quality standards, cost competitiveness, technological advancements and global competition are reshaping the way industries operate. Amidst all these transformations, one factor remains constant and indispensable - **the power of teamwork.**

While advanced machinery, automation, and sophisticated technology are important, the real strength of any die casting organization lies in its people. Machines may perform operations, but it is the collective efforts of skilled and motivated teams that drive operational excellence, innovation and sustainable success.

### Understanding the Importance of Team Building

The die casting industry operates in a highly integrated and precision-driven environment. From raw material handling, melting, die preparation, casting, trimming, machining, quality inspection, maintenance, dispatch and customer coordination—every stage is interconnected.

A minor communication gap or lack of coordination between teams can result in production delays, quality issues, machine downtime, increased rejections, or even safety concerns. Therefore, team building is not merely a human resource activity; it is a business necessity and strategic investment.

Strong teams foster trust, accountability, discipline and collaboration—qualities essential for achieving excellence in manufacturing.

### Why Team Building Matters in Die Casting Industry

#### 1. Improving Productivity and Efficiency

In a die casting setup, speed and precision are critical. Well-coordinated teams streamline operations, reduce wastage, avoid duplication of efforts and improve cycle efficiency. When employees work with a shared understanding of goals, productivity naturally improves.

#### 2. Enhancing Product Quality

Quality is the foundation of customer confidence. Teamwork ensures that every department—from production to quality assurance—functions cohesively to maintain consistency and minimize defects. A collaborative culture promotes ownership and accountability at every stage.

#### 3. Strengthening Workplace Safety

Die casting operations involve high temperatures, molten metal, hydraulic systems and heavy machinery, making workplace safety a top priority. Teams that communicate effectively and support one another contribute significantly to reducing workplace accidents and improving safety compliance.

#### 4. Encouraging Innovation and Problem Solving

Many shop-floor improvements emerge from collective brainstorming and practical experience. When employees feel empowered and connected, they willingly share ideas that contribute to process optimization, cost reduction and enhanced efficiency.

#### 5. Building Employee Engagement

Employees who feel valued and respected are more committed to organizational goals. Effective team building strengthens workplace relationships, improves morale and reduces attrition.

### Building Effective Teams: The Way Forward

Successful team building requires continuous effort and commitment from leadership. Organizations in the die casting sector can adopt practical initiatives such as:

- Daily shift briefings and toolbox meetings
- Cross-functional problem-solving sessions
- Quality circles and Kaizen activities
- Technical and behavioral skill development programs
- Safety awareness and team exercises
- Employee recognition and appreciation initiatives

- Team-based performance reviews

Such practices create a culture of participation, responsibility and mutual respect.

### Leadership: The Foundation of Strong Teams

Leadership plays a decisive role in shaping organizational culture. Leaders must go beyond supervision and become mentors who inspire collaboration and trust.

An effective leader:

- Encourages transparent communication
- Promotes teamwork over individual silos
- Invests in people development
- Appreciates contributions openly
- Leads with integrity and vision

When leadership actively promotes team spirit, organizations experience higher performance, stronger employee commitment and long-term stability.

### Conclusion

The future of the die casting industry will not be determined solely by technology or infrastructure but by the ability of organizations to build cohesive, capable and committed teams.

In an industry where precision, quality, speed and safety are paramount, **team building becomes the backbone of organizational success.**

At GDC Tech Forum, we strongly believe that:

**“Strong Teams Build Strong Industries.”**

By nurturing collaboration, encouraging knowledge sharing and investing in people, we can collectively strengthen not only our organizations but the entire die casting ecosystem for generations to come.



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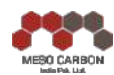
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**AUTHORS HAVE CONFIRMED FOR PRESENTING THE PAPERS**





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## Are You Facing Challenges in implementation of Casting Simulation Software? Here's How to Overcome Them

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### ABSTRACT

Casting simulation software has transformed modern foundry operations by enabling virtual validation of gating design and casting processes before production. Despite its proven ability to reduce defects, improve yield, shorten development time, and minimize shop-floor trials, many foundries still struggle to utilize simulation software effectively. Common barriers include high software investment, lack of skilled manpower, incorrect input parameters, mismatch between simulation and actual results, resistance to digital transformation, and inadequate understanding of simulation process physics. This paper discusses the major practical challenges faced during the implementation and utilization of casting simulation software and presents systematic solutions to overcome them. The study also highlights best practices for successful adoption and demonstrates how simulation can become a strategic tool for improving quality, productivity, and competitiveness in foundry industries.

Keywords: Casting Simulation, ADSTEFAN, Hitachi ICS, Foundry Digitization, Defect Prediction, Process Optimization, Virtual Trials, Yield Improvement, Industry 4.0, Smart Foundry

### 1. INTRODUCTION

The foundry industry has historically relied on experience-based decision-making and trial-and-error methods for gating and process optimization. However, increasing demand for high-quality castings, reduced lead time, and lower manufacturing costs has enhanced the adoption of digital engineering tools such as casting simulation software.

Casting simulation enables engineers to visualize mold filling, solidification, cooling, stress development, and defect formation in a virtual environment before actual production begins. Modern software platforms can predict shrinkage porosity, air entrapment, cold shuts, hot spots, core gas defects, cracks, die erosion, blow holes, warpage, and residual stresses with high accuracy.

Although casting simulation has become increasingly important, many foundries still face difficulties in utilizing these tools effectively. Studies indicate that adoption remains limited in several regions due to technical, financial, and organizational challenges.

This paper aims to identify the most common challenges encountered while implementing casting simulation software and proposes practical methods to overcome them.

### 2. Importance of Casting Simulation in Modern Foundries

Casting simulation software offers several advantages:

- Reduction in casting defects
- Reduction in rejection rates
- Reduction in shop-floor trials
- Faster product development
- Casting yield improvement
- Optimization of gating and risering systems
- Reduction in material wastage
- Improve customer confidence

Modern industries production increasingly depends on simulation-driven development approaches.

The concept of "First Time Right Casting" has become achievable due to advancements in simulation technologies.

### 3. Major Challenges in Utilizing Casting Simulation Software

#### 3.1 Investment Cost

One of the biggest barriers for foundries, especially MSMEs, is the initial investment associated with software licensing, workstation hardware, training, and annual maintenance.

Many foundries consider simulation software an

additional expense rather than a long-term investment. Instead of questioning whether they can afford simulation software, foundries should ask: “Can we afford continued defects, repeated trials, delayed development, and increasing competition without simulation?”

#### **Challenges:**

- Expensive software licenses
- Requirement of high-performance hardware
- Annual maintenance costs
- Training expenses

#### **Solutions**

- Start with critical high-rejection components
- Evaluate ROI through pilot projects
- Implement phased digital transformation
- Train a small, dedicated engineering team

Collaborate closely with simulation providers even a small reduction in rejection percentage can generate significant savings. According to industry estimates, reducing scrap from 5% to 4% can save substantial annual costs for medium-sized foundries.

### **3.2 Lack of Skilled Simulation Engineers**

Simulation software is not a “magic tool.” Accurate results depend heavily on the engineer’s understanding of casting processes, metallurgy, and manufacturing practices.

Many foundries purchase software but fail to obtain expected benefits because simulation engineer lack practical foundry knowledge.

#### **Challenges:**

- Improper boundary conditions
- Misinterpretation of results
- Inability to correlate shop-floor defects

#### **Solutions**

- Train simulation engineers in both foundry and simulation
- Conduct regular workshops and case study reviews
- Build internal knowledge databases
- Encourage collaboration between shopfloor and design teams
- Regular interaction and collaboration closely with simulation providers

### **3.3 Incorrect Input Parameters**

Simulation accuracy depends directly on input data quality. Incorrect boundary conditions or process parameters can generate misleading results.

#### **Frequently Incorrect Inputs**

- Process parameters consideration
- Pouring temperature
- Heat transfer coefficients
- Filling time
- Core / Chill/ Vents missing/ wrong consideration

#### **Leads to:**

- Mismatch between simulation and actual defects
- Wrong feeder optimization
- Improper gating modifications
- Increased rejection
- 

#### **Solutions**

- Calibrate software using actual shop-floor trials
  - Maintain validated material databases
  - Record real production parameters
  - Use thermal analysis and process monitoring
- Validation and calibration are essential for achieving reliable simulation results.

### **3.4 Gap Between Simulation and Reality**

One of the most common complaints among foundries is:

“Simulation results do not match actual production results.”

This challenge occurs because real foundry conditions are highly dynamic and difficult to model perfectly.

#### **Factors causing mismatch include:**

- Variations in operator practices and handling
- Fluctuations in furnace operating conditions
- Inconsistencies in pouring temperature and pouring methods

Research has shown that simulation software should be viewed as an engineering support tool rather than an automatic solution generator.

#### **Solutions**

- Use simulation as a decision-support system
- Continuously correlate simulation with production data
- Build process standardization
- Improve shop-floor consistency

### **3.5 Resistance to Digital Transformation**

Many experienced foundry professionals continue to rely on conventional methods

developed through years of practical experience.

Common Concerns

- “We already know how to make castings.”
- “Trials are cheaper than software.”
- “Simulation is only theoretical.”

This resistance slows digital adoption in many foundries.

### Solutions

- Work on real case-study savings
- Start with high-rejection components
- Showcase reduction in trials
- Create management awareness programs

Simulation should complement foundry expertise, not replace it.

### 3.6 Long Computation Time

Complex castings with fine mesh sizes require significant computational resources.

### Challenges

- Long simulation runtime
- Delayed project completion
- Hardware limitations

### Solutions

- Use optimized meshing techniques
- Apply localized mesh refinement
- Upgrade computing infrastructure
- Utilize GPU computing

Modern computing technologies have significantly reduced simulation time compared to earlier systems.

### 3.7 Difficulty in Interpreting Results

Many users can generate simulation results but cannot correctly interpret defect predictions.

Common Interpretation Errors

- Misreading porosity plots
- Wrong hotspot analysis
- Incorrect filling pattern evaluation
- Ignoring velocity-related turbulence

### Solutions

- Develop standard interpretation guidelines
- Compare defect maps with actual casting radiography
- Conduct cross-functional review meetings
- Learn through defect correlation studies

Post-processing and visualization are critical factors influencing software adoption success.

## 4. Best Practices for Successful Casting Simulation Implementation

### 4.1 Start with Critical Components

Begin simulation implementation on:

- High rejection parts
- Expensive castings
- New product development projects

This creates measurable ROI quickly.

### 4.2 Develop a Simulation Database

Maintain records of:

- Previous projects
- Defect patterns
- Process parameters
- Successful gating designs
- Material properties

This reduces future development time.

### 4.3 Standardize Shop-Floor Practices

Simulation accuracy improves when production processes are standardized.

Important areas include:

- Pouring practices
- Mold assembly
- Furnace temperature control
- Control process parameters (KPI's)

### 4.4 Validate Continuously

Simulation must be validated using:

- Radiography
- Section cutting
- Metallurgical analysis
- Production feedback

Continuous validation improves prediction accuracy.

### 4.5 Use Simulation Early in Product Development

Simulation should be applied during the design stage rather than after tooling completion.

Early-stage simulation helps:

- Reduce physical shop floor trials.
- Reduce tooling modification
- Reduce energy consumption and manpower involved in trials.

Research indicates that design changes become increasingly expensive in later manufacturing stages.

## 6. Case Study Example

Shrinkage Reduction in a Magnesium Casting

We have considered an Engine Head cover component of Magnesium – AZ91D which is

produced through High Pressure Die Casting Process.

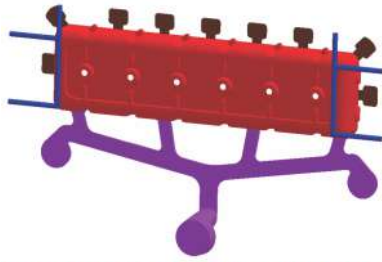


Figure1.1: Initial Gating design for Engine head Component

Gating and process was developed with of Yield 62.4%.

### Initial Condition

- Rejection rate: 90%
- Defects–Shrinkage porosity

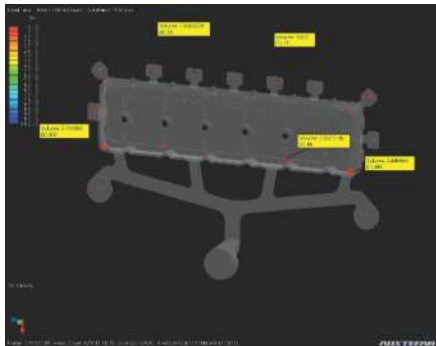


Figure1.2: Shrinkage porosity observed in the initial gating design

### Simulation Approach

By conducting 2 successive simulations for gating design modifications, the problems faced were resolved in optimized gating design as shown in figure 1.3 and yield improved from 62.4 % to 65.10%. Highlights of design changes are:

- Modification of ingate locations.
- Change in cooling lines
- Yield improved from 62.4 % to 65.10%

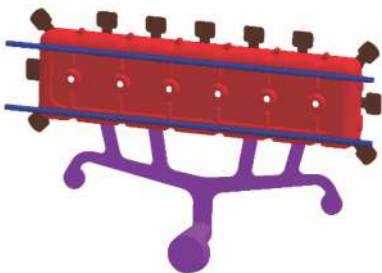


Figure 1.3: Optimized Methoding design for Engine head Component

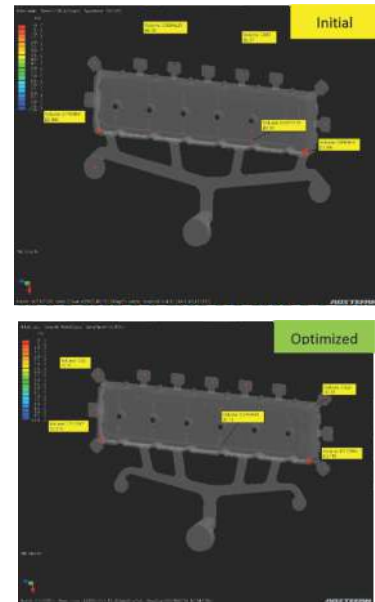


Figure 1.5: Comparison of Shrinkage porosity results between Initial gating and Optimized gating design

Thus, by identifying defects in early RFQ stage and optimizing gating in virtual casting simulation, casting manufacturer can optimize yield, save raw material utilization by reducing casting trials number and within less lead time quality casting can be produced.

### 7. Conclusion

Casting simulation software has become an essential engineering tool for modern foundries aiming to improve quality, reduce defects, and shorten product development cycles. However, successful utilization requires more than software installation. Challenges such as high investment costs, lack of skilled manpower, inaccurate inputs, resistance to digital transformation, and interpretation difficulties must be addressed systematically.

The key to successful implementation lies in:

- Proper training
- Continuous validation
- Shop-floor standardization
- Management commitment
- Integration of simulation with practical foundry knowledge
- Regular interaction and collaboration closely with simulation providers

Foundries that effectively overcome these barriers can achieve substantial improvements in productivity, quality, yield, and competitiveness. As Industry 4.0 adoption accelerates, casting simulation will become a core pillar of digital foundry operations.

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**Vishwas Kale,**  
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## Dedicated Contribution of Mr Anand Joshi as Editor for GDC TECH Forum Journal.

The editor, Anand Joshi has bid farewell after seventy-five issues of the journal. The long innings is remarkable in many ways and speaks a lot about the editor. Any new venture in its infancy needs a special care to make it grow. The GDC Tech journal with a humble beginning with a few pages very soon became an interesting knowledge center. It touched many aspects like technology, management, news and activities of the forum. This was not an easy task.

Anand with his excellent academic and professional background has interacted with many facets of the professional world. Not only in India but outside too. His close rapport with the established authors as well as with new writers with potential was exemplary. This helped him to select appropriate topics, request them to write on those and sometimes even disagree politely what they had proposed! But the long-term relationship established was never in trouble!

I am a witness to all this journey from the issue one and also as an author for many articles. His enthusiasm of doing something new translated into interviews of many successful and upcoming technologists. The benefit of this editor to me was, my many writings were possible on varied topics.

He is not only a good metallurgist but also a very accomplished management expert, even a Guru! This talent possibly helped him to keep quality of content in the journal.

He has brought the journal at a peak and surely the new Editor, Kruttika Apshankar would carry it forward to further heights.

On behalf of all members, readers and whosoever is associated with the journal, I thank his profusely and say Goodbye to him as the Editor, but his valuable insights will always be there to guide further.

Panel discussion on  
**WAR, ENERGY, MANPOWER & METAL:  
 FOUNDRY INDUSTRY OUTLOOK**  
 Saturday April 25<sup>th</sup> at MCCIA, Bhosari, Pune - 411026



**96th Coffee-TALK!!**

by Great Die Casting Technology Forum (GDCTECH) Received an amazing response by the industry !

Now we are looking forward to the 100th Coffee-TALK in August 2026 !



Heartiest thanks to Shri. Vaibhav

Karmakar for announcing his SPONSORSHIP for the 100th Coffee-TALK! Yesterday's coffee-TALK was focused on impact of US Iran- war on Indian foundries. Insights were shared by our amazing panelist,

\* Shri. Kishor Dukare (Business head, Uno Minda),

\* Shri. Anil Patil (Partner, MAP Alloys) &

\* Shri. Sagar Kaushik (Director, Victory Precisions)

Audience also participated in the discussion, with many questions, suggestions and experiences. The entire video of this Coffee-TALK will be on a YouTube channel. It's link is in the comments section. The younger generation in die casting business is taking more and more interest in arranging Coffee-TALKs. Today, Sahil Kaushik , Chetan Patil & Akshay Bhagwat played a spectacular part on the dias with introductions to GDCTECH , introduction of the panelist, and the vote of thanks. Great Die Casting Technology Forum (GDCTECH) wants to encourage younger generations' ideas, thoughts & active participation in future Coffee-TALKs.

See you next month for Great Die Casting Technology Forum (GDCTECH) 's Coffee-TALK !!!



**TRAINING PROGRAMME**



Two days Training Programme on “Melting/Holding Furnaces, Fuels, Crucible Care, Molten Metal Treatment & Quality Assessment” Faculties are Mr. Anand Joshi & Mr. Shrikant Bhat held on 15-16 May 2026 in Arkey conference Hall, Pune 411 004

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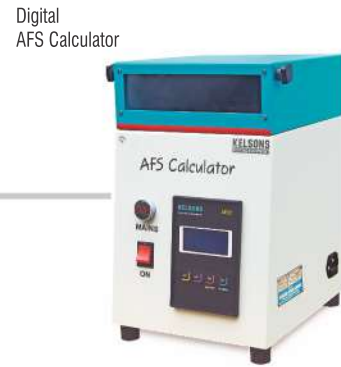
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Digital Universal Strength Machine



Digital Core Gas Determinator



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## Will AI Take Away My Job?

Karthikeyan Jawahar, Director, KARMA INNOVATION, karthikeyan.j@karmainnovations.com

The Industrial Evolution from Manual Labour to System Orchestration in Aluminium Foundries

The pervasive anxiety about the future of employment in the heavy manufacturing sector is perhaps most acutely felt in the aluminium casting industry, where the transition from traditional craftsmanship to high-tech automation has accelerated for decades. For senior managers and C-suite executives overseeing these operations, the question of whether artificial intelligence (AI) will displace the human workforce is not merely a theoretical concern but a central pillar of their strategic planning. However, a rigorous analysis of current technological deployments and leadership sentiment reveals a far more optimistic reality. Rather than serving as a replacement for human intellect, AI is emerging as the ultimate tool for human augmentation, designed to eliminate the mental drudgery that has historically limited operational efficiency. [1, 2]

The paradigm shift currently underway is best described as a move from manual labour to system orchestration. In this new industrial era, the role of the metallurgist, the quality manager, and the plant operator is not being erased but redefined. By offloading "micro-decisions"—the millisecond-by-millisecond adjustments to furnace temperature, alloy additions, or defect classification—to autonomous systems, human professionals are freed to focus on high-level strategy, plant expansion, and the development of radical new alloy compositions. [3, 4] The "Peace of Mind" that modern technology promises is not the peace of a silent factory floor, but the confidence that every process is being monitored and optimised at a speed and precision beyond human capability. [5]

### The Psychological Transition: From Fear to Interest

The initial reaction to any disruptive technology is often fear, rooted in the uncertainty of one's future value within the organisation. Yet, the most successful leaders in the global tech and manufacturing space—from Satya Nadella to Jensen Huang—consistently frame AI as a "co-pilot" for

human ingenuity. [1, 2] For the foundry professional, showing interest in AI is a survival mechanism. As Mark Cuban famously noted, those who do not understand and embrace these tools risk becoming "dinosaurs" within a few short years. [2]

The transformation of the aluminium industry mirrors the earlier adoption of the internet and the microprocessor. It is an infrastructure buildout that will eventually touch every aspect of the foundry, from the sourcing of scrap to the final inspection of high-precision components. [1, 6] By viewing AI as a "runtime" for all future operations, senior managers can begin to incorporate these tools into their day-to-day activities, leveraging data to make better decisions faster. [1]

### Karma Innovations: A Case Study in Automated Quality Excellence

A primary concern for any aluminium casting foundry is the reliability of its quality control, particularly for safety-critical components such as alloy wheels in the automotive industry. Traditionally, film-based X-ray inspection was the standard, but it has become impractical to sustain in high-volume environments due to the sheer number of areas requiring inspection and the time required for film development. [7, 8] Karma Innovations and Solutions Private Limited has addressed this bottleneck by developing a Machine Learning based Automated Decision Making System (ADM) for digital radiography. [7]

### The Architecture of Automated Decision Making

Karma's innovation represents a significant leap from traditional digital radiography. While basic digital systems allow for faster image acquisition, they still require a human operator to spend hours staring at screens to identify minute defects. Karma's ADMS utilises a proprietary Machine Learning algorithm to automatically identify and mark discontinuities on digital images. [7] This system is not static; it can be extended and trained on any number of specific manufacturer designs, allowing it to adapt as a foundry's product portfolio evolves. [7]

The technology is aligned with international standards, such as ASTM E2422, which provides digital reference images of discontinuities such as gas holes, gas porosity, shrinkage, and foreign materials. [5] By integrating these standards into an automated grading pipeline, the system can distinguish between a "flaw" (a detectable imperfection that may not be rejectable) and a "defect" (a violation of specified acceptance criteria). [9] This distinction is critical for reducing "scrap snowball" effects, where acceptable parts are erroneously rejected due to operator fatigue or inconsistent grading. [3]

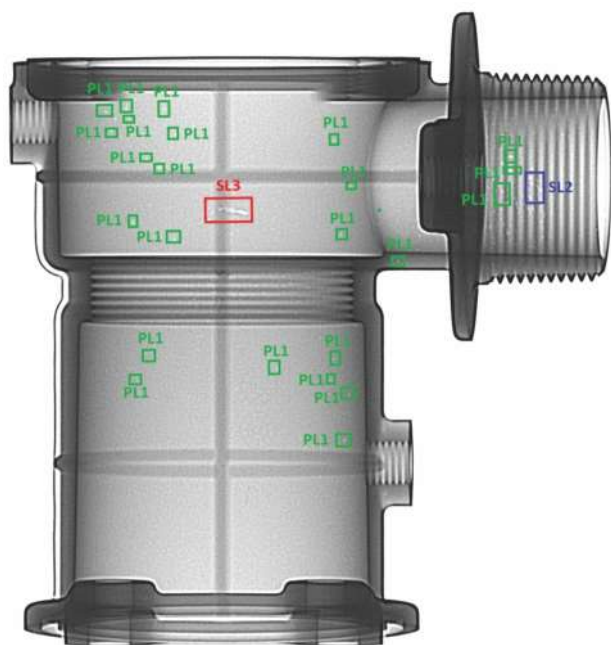
## Technical and Operational Specifications of Karma DR Systems

System Component	Performance Characteristic	Operational Benefit
X-Ray Generator	Oil-based cooling for 24/7 duty cycle. [5]	Eliminates the need for air conditioning; supports continuous production. [5]
Mechanical Handling	Up to a 5-axis component manipulator table. [5]	Provides full geometric coverage of complex castings. [5]
ML Algorithm	Automated marking and classification of defects. [7]	Reduces operator fatigue and ensures consistent 100% inspection. [5]
Software Interface	Ergonomic, intuitive controls with video streaming. [5]	Faster operator training and immediate system familiarity. [5]
Installation	Modular "plug and play" design. [5]	Installation time is usually less than one day, minimising downtime. [5]

The implementation of such a system provides C-suite executives with tangible business outcomes:

1. Accelerated product development through faster feedback loops,
2. 100% inspection capability for liability protection, and
3. A drastic reduction in process costs compared to film-based methods. [5]

It transforms the quality department from a bottleneck into a data-driven centre of excellence.



### Industry Applications: AI in Modern Foundry Environments

Beyond the walls of the quality lab, AI is being deployed across the broader foundry ecosystem to solve long-standing metallurgical and operational challenges. The move toward "Smart Foundries" involves the integration of IoT-enabled sensors and

machine-learning analytics to monitor variables like mould temperature, metal flow, and cooling rates in real-time. [10]

### Advanced Simulation and Process Optimisation

In the realm of casting simulation, software providers are revolutionising how processes are designed. Hitachi ICS Japan's Advanced Defect Prediction Tool (ADPT) for the ADSTEFAN software integrates machine learning with physical modelling to identify potential shrinkage porosity and air entrapment faster than traditional methods. [11] Similarly, AI-driven optimisation in tools like FLOW-3D(x) allows for "runner-balancing," where surrogate models (such as Radial Basis Function interpolation) map how variables like gate thickness affect final quality, replacing repetitive manual trial-and-error. [11] For semi-solid die casting, researchers have developed Multi-Layer Perceptron (MLP) models that analyse real-time injection pressure data. These models act as early-warning systems, predicting porosity or surface imperfections before the part is even removed from the die, thereby reducing waste at the source. [11]

### Real-Time Corrective Action in HPDC

Modern High-Pressure Die Casting (HPDC) machines are increasingly equipped with AI modules that automate machine corrections. These systems can auto-correct plunger profiles and cooling cycles based on data from each individual shot. [11] This reduces the foundry's dependence on highly skilled operators who must manually adjust parameters throughout a shift to compensate for thermal changes in the die or variations in the melt. [10, 11]

### Strategic Sourcing: Mastering the Secondary Aluminium Market

For senior management, the sourcing of aluminium scrap is a critical variable in maintaining profitability. The secondary aluminium market is notoriously volatile, with prices influenced by complex global factors including trade policies, energy prices, and raw material availability. [12, 13]

### AI-Driven Price Forecasting

AI models, specifically Deep Feedforward Neural Networks (FFNN) and Long Short-Term Memory (LSTM) models, are now being used to capture the non-linear behaviours of aluminium pricing. [14] By analysing historical price patterns alongside economic indicators such as GDP growth and inflation, these models provide "AI scrap metal forecasting" that enables procurement teams to identify "optimal buy" windows. [12, 13]

The precision of these models is significantly higher than that of traditional linear methods. For instance, Support Vector Regression (SVR) utilises kernel functions to transform input data into higher-dimensional spaces, enabling the identification of subtle market trends that human analysts might overlook. [14]

### Advanced Scrap Sorting and Quality Grading

The transition to a "Green Aluminium" mandate has made accurate scrap sorting a regulatory and economic necessity. [3] AI-driven Laser-Induced Breakdown Spectroscopy (LIBS) now allows recycling facilities to sort scrap aluminium by alloy grade with 99% accuracy. [3] This precision allows foundries to achieve the "best composition" using available scraps, reducing raw material costs and the facility's overall carbon footprint. [11, 15]

Intelligence Capability	Impact on Sourcing	Economic Benefit
Predictive Supply Modeling	Correlation of vehicle production data with future scrap availability. [16]	15-20% reduction in inventory costs. [16]
Pricing Optimization	Real-time analysis of global commodity exchanges. [12]	5-8% reduction in procurement costs. [16]
Automated Sorting (LIBS)	Accurate identification of wrought vs. cast aluminium fractions. [17, 18]	Up to 95% recovery rates for high-value alloys. [15, 17]

### Precision Marketing: Reaching the Modern Industrial Buyer

The traditional "directory and PPC" marketing strategies for foundries are being replaced by "Agentic AI" workflows designed to navigate a spec-heavy buying journey. [19] For a foundry managing thousands of SKUs and specialised capabilities, AI offers a way to speak directly to the needs of procurement officers and engineers.

### Closing the SKU Coverage Gap

A common marketing failure in the industrial sector is the "SKU coverage gap," where a manufacturer publishes content for only a small fraction of its actual products. [19] Agentic AI allows firms to compress the "spec-to-content" cycle by reading data from ERP, PIM, and CAD systems to produce technical descriptions at scale. [19] This ensures that when a potential customer searches for a very specific casting requirement, the foundry's technical capabilities are visible and cited in AI search engines like Perplexity or ChatGPT. [19]

### RFQ Automation and Lead Scoring

Foundries often struggle with the time-intensive process of responding to Requests for Quotation (RFQs). AI agents can now ingest distributor RFQs, match them to specific SKUs based on technical fit, and automatically draft quotes. [19] This has been shown to compress the "intake-to-quote" window by over 60%. [19] Additionally, "spec-aware lead scoring" helps sales teams prioritise prospects based on technical-fit signals rather than just firmographics, leading to a significant lift in MQL-to-SQL conversion rates. [19]

### Operational Efficiency: Automating Routine Administrative Drudgery

The administrative burden on foundry managers—from scheduling shifts to documenting maintenance logs—can consume up to 22.5% of the

working week. [20] AI workflow automation tools are designed to reclaim this time, allowing managers to focus on floor-level improvements and team leadership.

### Administrative Productivity Tools

Tools like Kore.ai, Zapier, and Airtable allow foundries to connect disparate work apps and automate repetitive documentation. [21, 22] For example, Scribe automatically generates step-by-step SOPs (Standard Operating Procedures) by capturing an operator's screen movements, which is invaluable for onboarding and training. [20] AI-driven personal assistants like Xembly or Supamail can manage calendars and summarise technical email threads, saving over 90 minutes of daily administrative work. [20, 23]

### Energy and Floor Efficiency

In the aluminium industry, electricity can account for nearly 40% of production costs. [3] Agentic AI models utilise Deep Reinforcement Learning to autonomously manage bath temperatures and alumina feeding in smelting pots. [3] By processing thousands of data points per second—including voltage fluctuations and acoustic signatures—the AI adjusts parameters faster than any human operator could. [3] This "autonomous management" leads to a 3-5% increase in energy efficiency, which translates into millions of dollars in savings for large-scale operations. [3, 24]

Optimization Target	AI Mechanism	Reported Benefit
Smelter Potlines	Deep Reinforcement Learning for voltage/feed control. [3]	3-5% increase in energy efficiency. [3]
Maintenance Backlog	NLP analysis of maintenance logs and sensor fusion. [3, 25]	28% reduction in maintenance backlog. [25]
Casting Recovery	ML prediction of head/butt lengths and pit efficiency. [24]	2-3% increase in net recovery. [24]
Specific Energy Use	Real-time monitoring of furnace and burner efficiency. [25]	14.63% increase in overall energy efficiency. [25]

### The Human Factor: AI in Recruitment and Talent Management

Finding and retaining the right personnel is the greatest challenge facing the manufacturing sector today. AI is transforming recruitment from a reactive task to a strategic workforce development function. [26, 27]

### Intelligent Candidate Matching

AI-powered scoring algorithms, such as SniperAI or FactoryFix, evaluate applicants based on their

technical backgrounds with specific machines (e.g., CNC operators or maintenance technicians). [27, 28] These tools can recognise terminology differences and relevant experience that manual resume screening might miss, reducing the "time-to-shortlist" by up to 97%. [27, 29]

### Engagement and Retention

Research indicates that manufacturing candidates are 80% more likely to respond to text messages than emails. [28] AI-powered text messaging platforms ensure that foundries can engage top talent before they are enticed by other offers. [28] Furthermore, by placing workers in roles precisely aligned with their technical skills and career goals, AI improves early-matching accuracy, leading to greater reliability and lower turnover across production teams. [29]

### A Roadmap for AI Integration in Aluminium Foundries

For senior managers ready to embark on this journey, a phased approach is essential to ensure technical success and organisational buy-in.

#### Phase 1: Maturity Assessment and Strategic Alignment (Weeks 1-4)

The process begins with a "digital maturity assessment" to evaluate the foundry's starting point. Leaders must identify the most expensive operational problems—downtime, scrap, or energy costs—and ensure that the AI vision aligns with the company's 3-5 year business strategy. [30, 31]

- **Data Audit:** Determine which machines are equipped with sensors and if production data is being stored in a centralised system. [31]
- **Stakeholder Mapping:** Identify executive sponsors, technical leads, and "change champions" on the foundry floor. [32]
- **Phase 2: Pilot Design and Technology Evaluation (Weeks 5-10)**

Choose a high-impact, low-complexity use case for a pilot project. For many foundries, this is often AI-driven quality control (like the Karma Innovations radiography system) or predictive maintenance for a critical furnace. [30, 32]

- **Build vs. Buy:** Assess whether to develop custom models for proprietary processes or purchase established AI solutions. [33]

- **KPI Definition:** Establish SMART goals for the pilot, such as "Reduce customer churn by 20%" or "Reduce scrap rate on Line 3 by 15%". [30]

### Phase 3: Build, Integrate, and Redesign Workflows (Months 3-6)

This phase focuses on the technical integration of AI into existing systems like ERP, MES, and SCADA. [31, 33]

- **Budgeting (The 40-30-20-10 Rule):** Allocate 40% for integration/data work, 30% for software/infrastructure, 20% for training/change management, and 10% for ongoing operations. [30, 32]
- **Process Redesign:** Map how AI changes existing workflows to ensure that the human-AI partnership is effective. [32]

### Phase 4: Training and Cultural Adoption (Ongoing)

Address the "fear factor" directly through transparent communication and hands-on training. Framing AI as a tool for "augmentation, not replacement" is critical for building trust among the workforce. [32, 34]

### Summary: Leading the AI-Enabled Foundry

The aluminium casting industry is not merely adopting new software; it is undergoing a fundamental reimagining of what it means to be a "manufacturer." The evidence is clear: AI does not replace the metallurgist, the quality inspector, or the plant manager. Instead, it empowers them. By offloading millisecond-by-millisecond adjustments and repetitive administrative tasks to autonomous systems, AI frees human creativity to solve the industry's most pressing challenges - from achieving "Green Aluminium" status to designing the next generation of high-performance aerospace alloys. [2, 3]

For the reader, the question is no longer "Will AI take away my job?" but "How quickly can I learn to lead an AI-augmented team?" The foundry of the future is a high-tech, data-driven engine where humans and machines work in coherence to achieve unprecedented levels of precision and efficiency. The tools developed by pioneers like Karma Innovations are not just instruments of automation; they are the keys to a more secure, profitable, and human-centric industrial future. Embracing this technology is the ultimate competitive advantage, ensuring that your

facility—and your career—remains at the forefront of the modern world.

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# Defect Analysis & Remedial Measures

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## General Methodology of Analysis and elimination (reduction) of defects in Aluminium Gravity Die Castings

### Defects in Aluminium Gravity Die Castings:

#### Introduction:

The type of defects that causes rejection of a casting can be classified in to groups

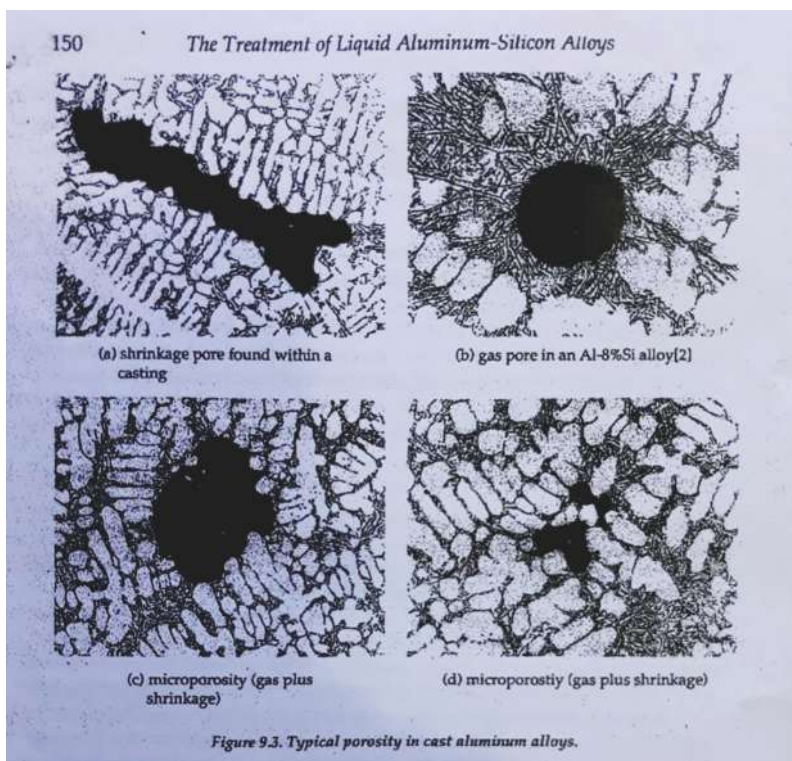
1. Oxides and Inclusions
2. Gas related Porosity
3. Shrinkage Porosity
4. Others – Hot tear, misruns, rough surface, sand drops etc.

#### Defects:

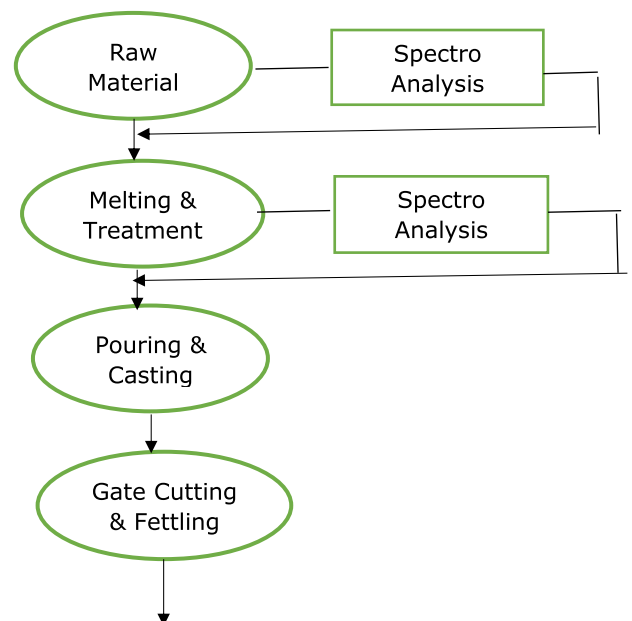
- a. Seen by naked eyes (surface defects)
- b. Seen after machining
- c. Seen for dimensions related
- d. Seen after further treatment, testing

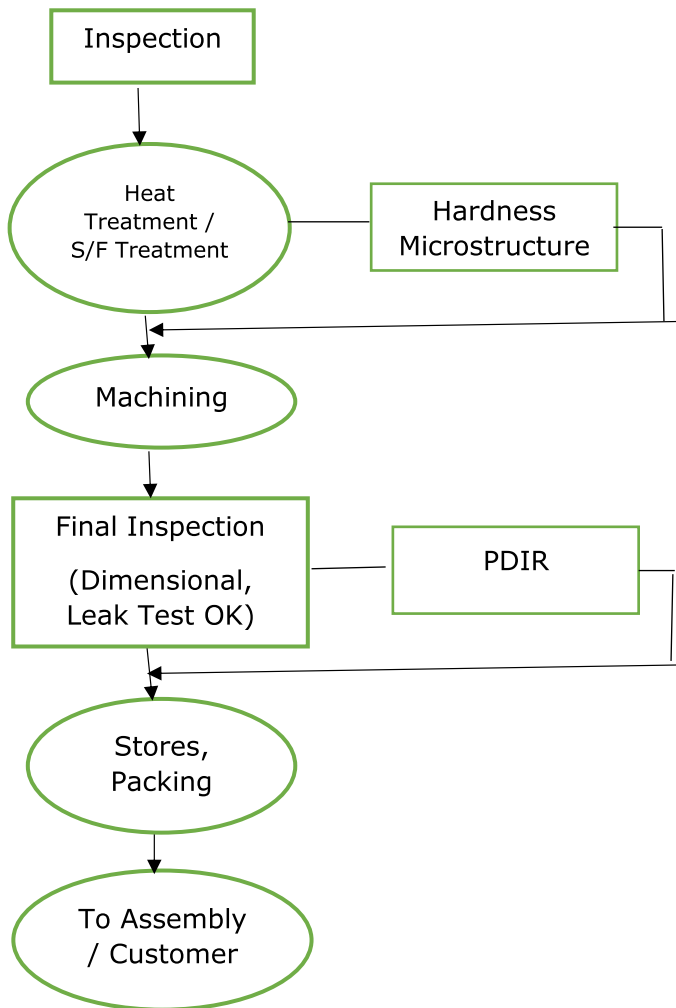
#### Various defects shown

Shrinkage, Blow Hole, Hot Tear, Gas porosity:



#### FLOW CHART FOR CASTING





### Defect Control and Reduction:

Once the casting is properly methodized and the tooling is proven, the analysis needed for defects generated due to various causes. The defects elimination (reduction) requires systematic **problem-solving** approach.

Generally, steps involved are:

- Defects proper Identification
- Proper data preparation with quantification for analysis
- **Brain storming** to list the causes for various defects
- Do **Pareto Analysis**, Draw **Cause & Effect diagram**,
- Identify most probable causes (using data available, observations, experience, knowledge)
- Prepare Action Plan, Implement AP, record data / observations
- Analyze, monitor actions effectiveness
- Modify actions as required
- Analyze data, repeat above steps till targeted results achieved
- Proper documentation of modified / new process

parameters for routine production, with all concerned people are fully aware of modified / new process parameters.

- Proper record keeping to ensure with

1. Casting Identification
2. Defect description including location (photo of defective casting), displaying defective castings
3. Total number of castings produced, defective castings alloy batch wise / shift wise / operator wise / furnace wise / die wise / cavity wise

### Problem Solving:

#### What:

- Problem solving methods are systematic approaches for identifying a problem or a needed improvement, finding the root cause of a problem, identifying and evaluating solutions, implementing the solution, measuring the improvement, and ensuring permanent integration of the solution so the problem will not arise again.

#### Why:

- To provide a step by step procedure that can be repeatably applied to most problems or process improvements.
- To reduce the amount of time to make an improvement or solve a problem.
- To provide a structure to follow that helps ensure positive solutions.
- To standardize the mechanism for improvement and problem solution.
- To aid in communication and facilitate learning.

#### When:

- When product or process improvements are needed.
- When problems surface in all areas of design, manufacturing, and business processes.

#### How:

- Various problem-solving models have been proposed, but they are generally similar and follow the usual scientific method. See figures. for sample problem solving flows.

#### Discussion:

Logical and thorough implementation of the analytic tools and methods discussed in this document will

lead to long-lasting improvements with all the associated benefits.

### **Brainstorming:**

#### **Teamwork**

##### **What:**

- A technique that uses group interaction to generate ideas to solve a common problem.

##### **Why:**

- To produce many diverse ideas in a short period of time.
- To generate creative ideas.
- To stimulate and gain ideas from various functions.
- To increase involvement of team members and elicit buy in.
- To improve the quality of the solution.

##### **When:**

- Identifying candidate key characteristics.
- Identifying problem areas and activities on a flowchart.
- Identifying causes when constructing a cause and effect diagram.
- Identifying customers/suppliers in a process.
- Identifying improvement opportunities.
- Identifying sources of variation.

##### **How:**

- Assemble a cross-functional team.
- Clearly state the problem and make sure that all team members understand it.
- Encourage team members to present their ideas one at a time. Do not hold back any ideas and be creative.
- Record suggestions exactly as presented. Make no judgments until all ideas are recorded.
- Have the team discuss and clarify any items or ideas in question.
- Have the team members evaluate which items are worth working on to accomplish the goal.

### **Structure-Tree Diagram**

##### **What:**

- The Structure-Tree diagram graphically represents the hierarchical relationship among a group of related parts, processes, activities, key

characteristics, causes and effects, people, or most anything else. This tool is often used in lieu of the cause and effect diagram due to its ease of understanding, flexibility, and readability.

##### **Why:**

- Helps identify key characteristics and key process parameters.
- Illustrates the various causes affecting a process problem.
- Helps a team reach a common understanding of a problem or situation.
- Exposes gaps in existing knowledge of a problem or situation.
- Helps reduce the incidence of uninformed decision making.

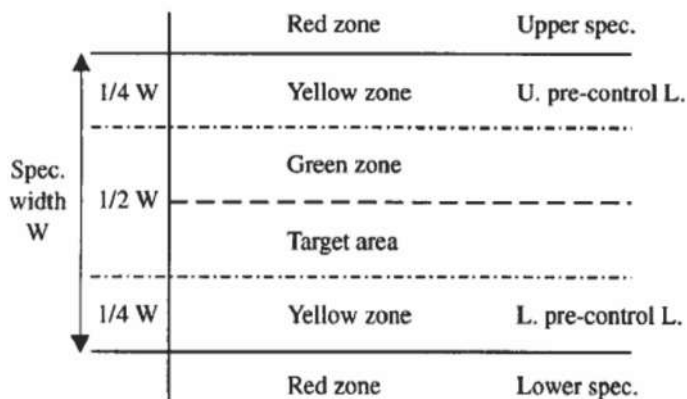
##### **When:**

- Performing key characteristic flow down.
- Looking for all potential causes of a problem.
- Organizing brainstorming lists into a logical hierarchy.
- Identifying sources of process variation.
- Breaking down an assembly into subassemblies, details, and processes.
- Problem solving; root-cause analysis.

##### **How:**

- Identify the problem, top-level part, key characteristic, or other item that would represent the top of a hierarchy. Place in a box at the top of the page.
- During the brainstorming exercise, identify all items that either report to, affect, or go into the highest level in the hierarchy. Second-tier items are placed in boxes just below the top box. The process is repeated for each second-tier box, and so on, building a hierarchical tree. Each box is connected by a line to the appropriate next higher-level box. The process is continued to the lowest level needed, such as root-cause level, detail part or process level, lowest key characteristic level, and so on.

The same information used to build the cause and effect diagram could be represented using a structure-tree diagram, as shown below.



### Pareto Analysis:

#### What:

- A bar chart where the bars are arranged in descending order of magnitude. The bars may represent defect categories, locations, and so on. The magnitude (length) of the bars may represent frequencies, percentages.

#### Why:

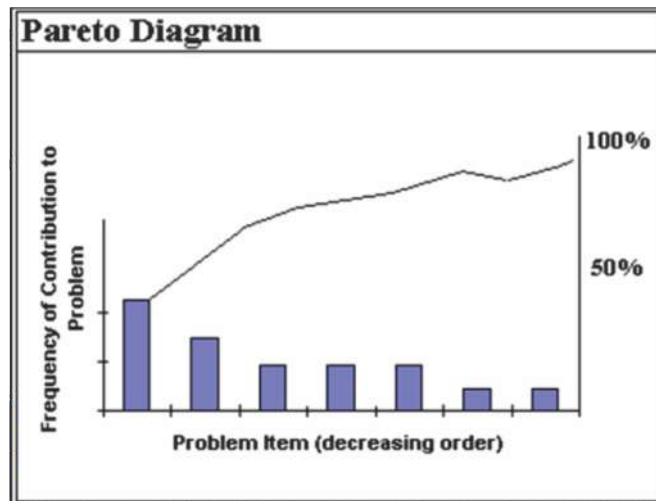
- To prioritize actions needed to solve complex problems.
- To sort out the “vital few” from the “trivial many.”
- To separate important from unimportant causes contributing to a problem.
- To measure improvement after changes have been made.

#### When:

- Many factors contribute to a problem.
- Attention needs to be directed only to the few factors that account for most of the problem.
- Analyzing the results of a risk analysis.

#### How:

- Identify the problem and the time period for the study.
- Define the types of data to be analyzed (e.g., defects, locations).
- Define the form of measurement to be used (e.g., frequency, percentage).
- Collect representative data and categorize.
- Count and arrange the data in descending order.
- If possible, assign costs to each category, multiply frequency by cost, and reprioritize.
- Make a bar chart of the data and clearly label categories.
- Analyze results and prepare improvement activities for “vital few.”



### Pareto Problem-Solving Method:

- Pareto analysis is used to rank order the reasons for problems so that corrective action can be taken on the major causes of the problem. Pareto charts for a problem often lend themselves to further dissection.
- As a rule, start to work on one of the tallest bars in figure. Construct a new Pareto to describe its components. Continue to break down the components until elementary levels are reached. Working problems at the most elementary levels will result in improvement at the higher level.
- Once the causes for the tallest bar have been resolved, proceed to the next tallest.
- Continue this process until the root causes have been eliminated or reduced to a satisfactory level.

#### Strengths:

- Progress can be measured.
- Efforts and resources are focused.
- The chart is easy to use and understand.
- It is an effective communication tool.

#### Weaknesses:

- The “vital few” could be misleading if only the number of occurrences are analyzed without regard to costs per defect.

Pareto diagrams are named after Vilfredo Pareto, an Italian sociologist and economist, who invented this method of information presentation toward the end of the 19th century.

### Cause and Effect Diagram:

#### What:

- A tool used to graphically display the relationship

between an effect (e.g., a problem or key characteristic) and the causes that influence it.

**Why:**

- Helps identify lower level key characteristics and key process parameters affecting key characteristics.
- Helps identify the various causes affecting a process problem.
- Helps a group reach a common understanding of a problem.
- Exposes gaps in existing knowledge of a problem.
- Helps reduce the incidence of uninformed decision making.

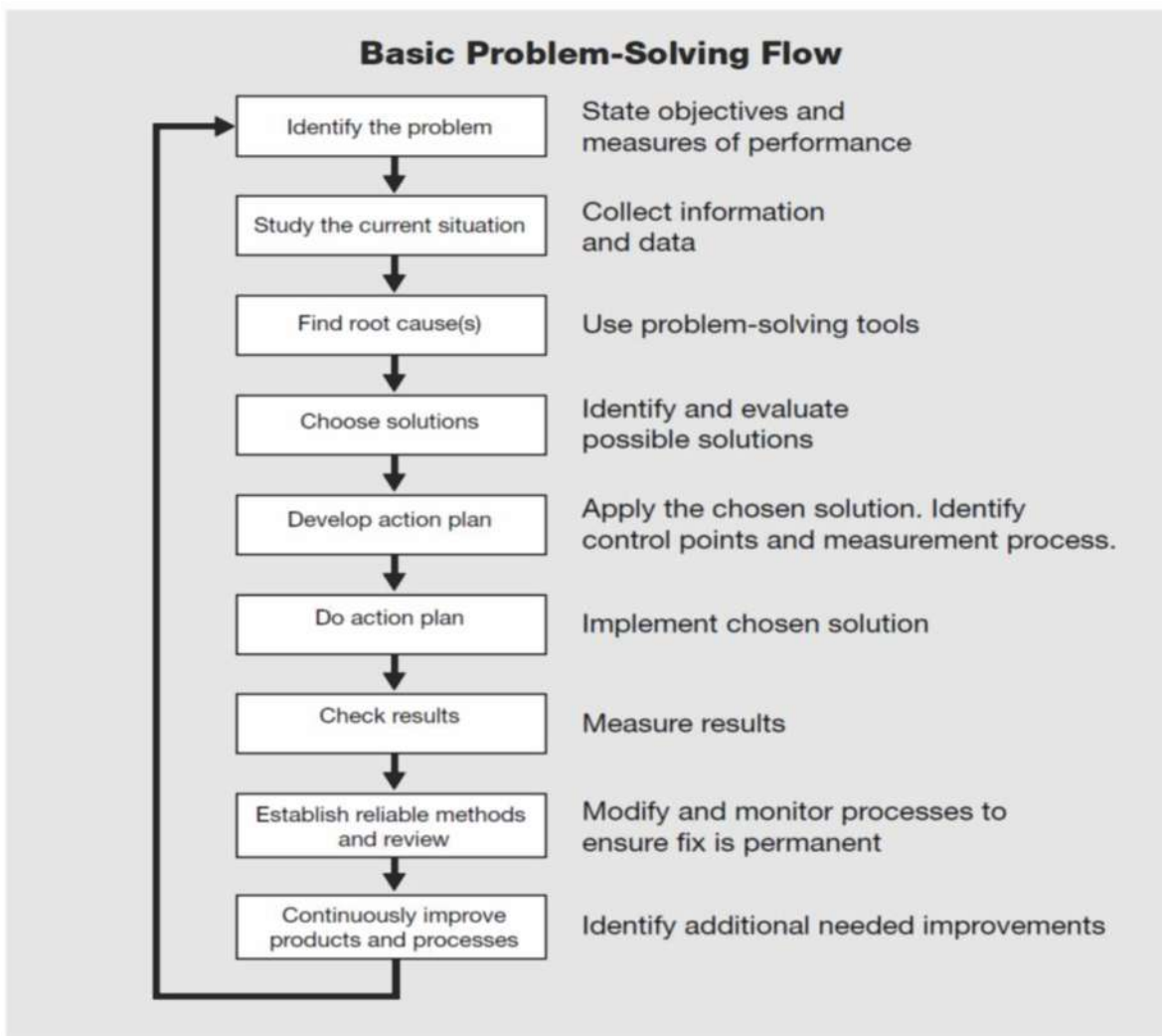
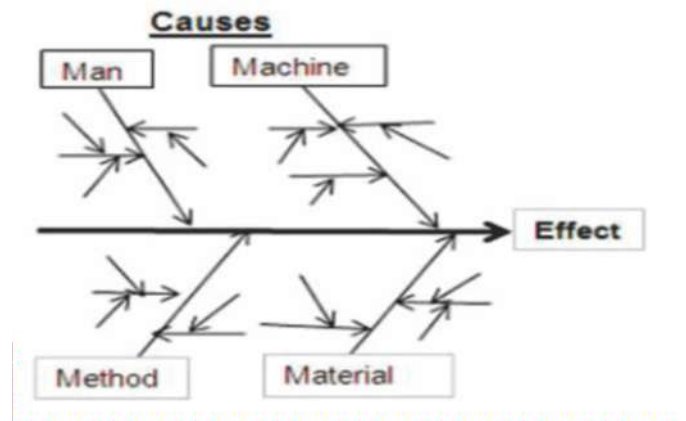
**When:**

- Performing key characteristic flow down.
- Looking for all potential causes of a problem.
- Organizing brainstorming lists into causes and effects.
- Identifying sources of process variation.
- Linking process output to process parameters.

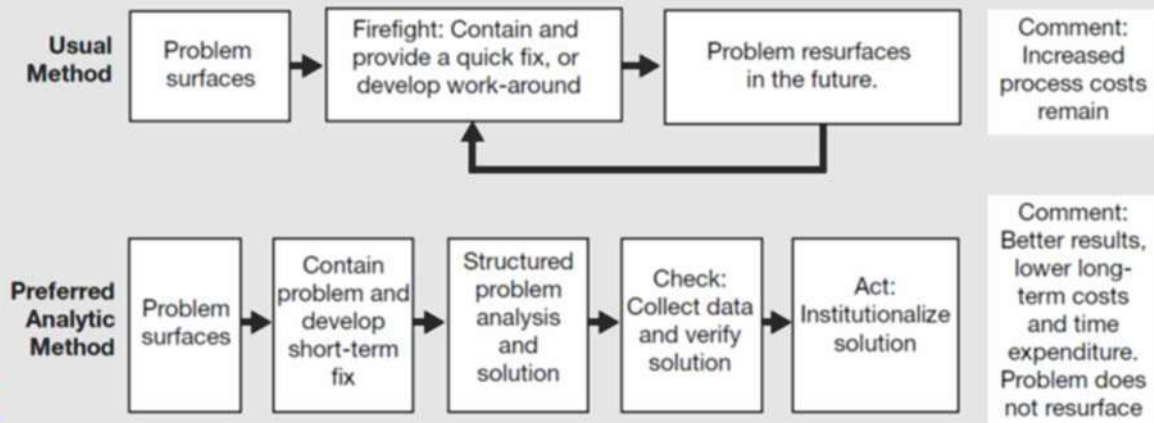
- Performing a DOE.

**How:**

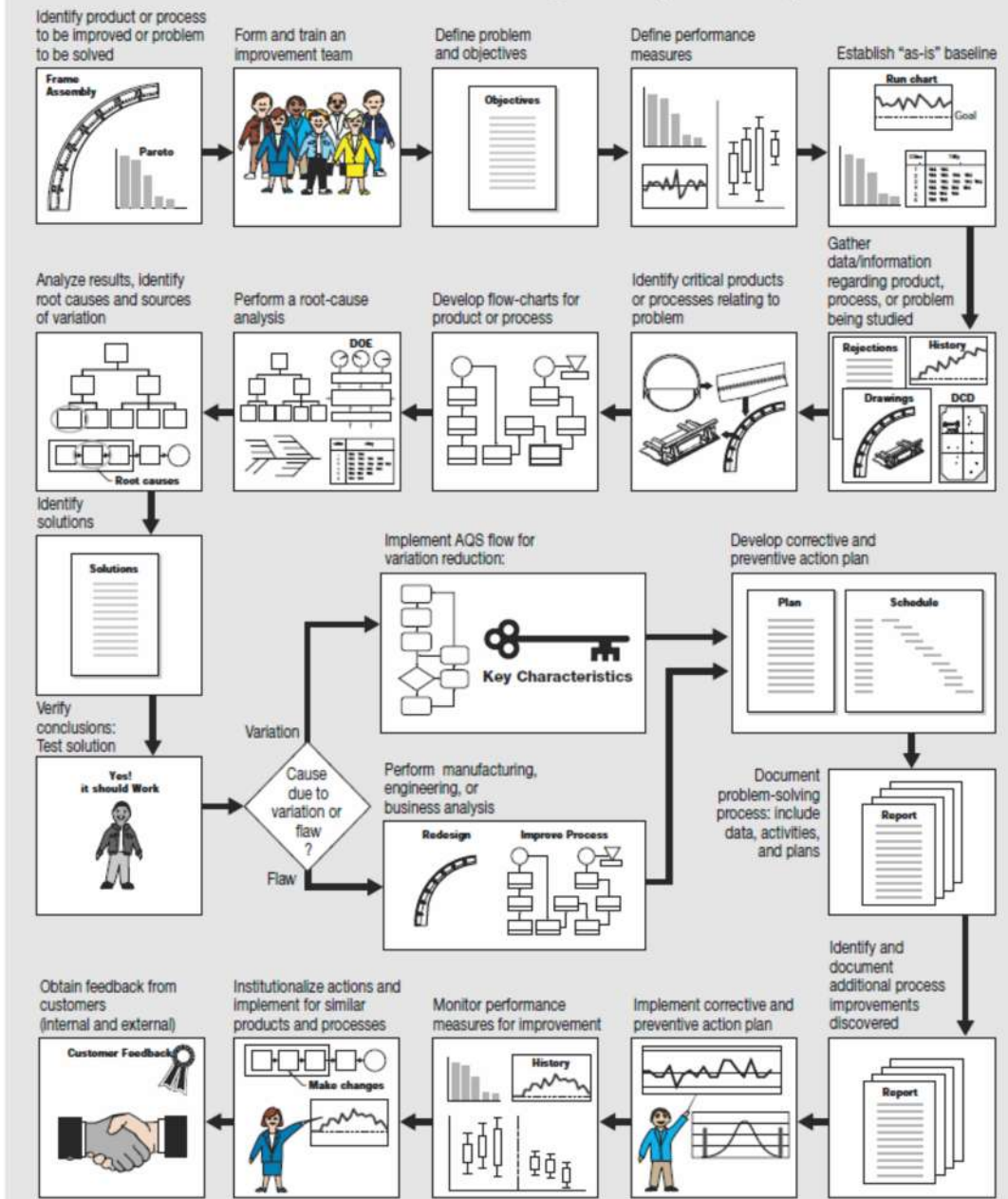
- Generate potential causes of a problem (or effect) through structured brainstorming.
- Place the problem statement, event, or key characteristic in a box on righthand side of paper.
- Draw a horizontal line to the left.
- Decide upon the major cause categories of the event, problem, or key characteristics.



## Usual Versus Preferred Problem-Solving Approaches



## Basic Problem-Solving Flow (Detailed)





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## 1. Introduction

Magnesium is commercially available with purities exceeding 99.8% however it is rarely used for engineering applications in its unalloyed form. Most of the alloying elements present in commercial magnesium alloys are aluminium, zinc, Manganese, Zirconium, Cerium, Yttrium and Silver.

Whereas the pressure die-casting technique is extensively used for processing of magnesium alloys, the forming technologies extruding and forging are only applied with low percentage. This is due to higher specific process costs, so that the use of magnesium wrought alloys is limited to special applications.

The plasticity of metallic materials generally depends on the number of available slip planes. Due to its hcp lattice structure magnesium has only one slip plane – the (0001) basal plane – resulting in a limited deformability at ambient temperature. Thus, the activation of additional (pyramidal) slip plane becomes necessary to obtain the sufficient plasticity required for technical processes. This can be achieved with increased temperatures (above 2220C).

The material flow can be characterized by three phases:

- Slip occurs on the basal planes, i.e. only suitable oriented crystals can slip (increase of work)
- Deformation of the polycrystal conglomerate (decrease of work)
- Increasing work hardening.

In this context it is evident that grain size, pressing temperature and strain rate are important processing

## Light Weight Construction using Extruded and Forged Semi-Finished Products Made of Magnesium Alloys

Suraj Narvekar, Country Head - India Operations, RAUCH FURNACE TECHNOLOGY GmbH

parameters allowing just slight variations compared to the cubic metals aluminium, copper and iron making the manufacturing process more complex in comparison to pressure diecasting. However, processed wrought alloys provide superior quality, e.g. pressure sealed parts free of pores and shrinkage cavities, as well as excellent mechanical properties due to advanced microstructures received by thermo mechanical treatment (See Fig 1 and Table 1).

Against this background the present paper gives a survey of production and properties of extrusions and forgings made of magnesium alloys as well as some examples for different engineering applications.

## 2. Manufacturing of cast stock

The extrusion and forging stock for nearly all magnesium wrought alloys is produced by the semicontinuous direct chill casting method which is also preferably used for aluminium wrought alloys. Both the conventional nozzle/float process and the hop-top process are employed. Special characteristics (1) of magnesium are as follows:

- Due to its high affinity to oxygen the melt must be adequately protected against oxidation by means of salt and a protective gas.
- For many magnesium alloys the content of corrosion-susceptible iron can be reduced to 0.001 percent by allowing the melt to settle.
- Fine-grained cast structures can be obtained in Mg-Al-Zn alloys by adding carbon-bearing agents and in Mg-Zn alloys by adding zirconium.

This it is possible to produce round ingots having a diameter of upto 800 mm. As a general rule, these are machined and homogenised for subsequent extrusion or forging.

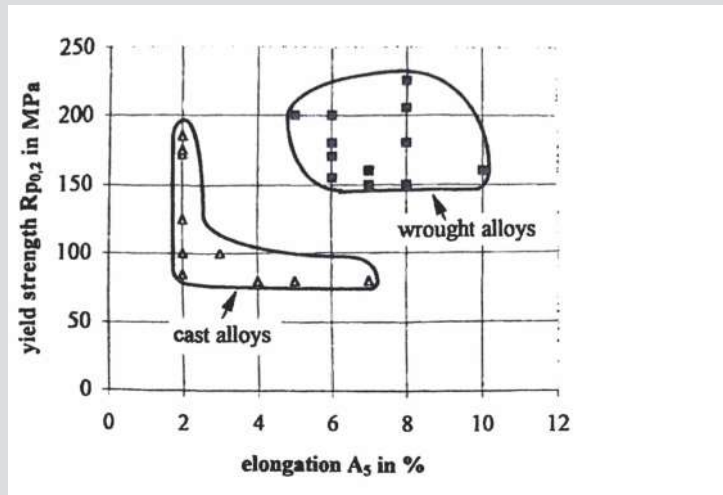


Fig 1: Strength-Ductility of cast and wrought magnesium alloys in comparison. Properties quoted are the specifications minima listed for different alloys and those in the most favourable flow direction.

International designation	Typical Chemical Composition (%)	Typical Tensile Values Rp0.2/Rm/A5 (MPa/MPa/%)	General Characteristics
M 2	Mg-2Mn	160/215/4	extrusion alloy with premium extrudability, good weldability, high corrosion resistance
AZ 31	Mg-3Al-1Zn	160/240/10	extrusion and forging alloy with good strength - ductility relationship, feasible as high purity type with high corrosion resistance
AZ 61	Mg-6Al-1Zn	190/270/9	
AZ 80	Mg-8Al-0.5Zn	215/300/8	excellent forging alloy
ZK 30	Mg-3Zn-0.6Zr	215/300/9	
ZK 60	Mg-6Zn-0.6Zr	235/315/8	
WE 43	Mg-4Y-3RE.-0.5Zr	160/260/6	extrusion and forging alloy with high strength at elevated temperature
WE 54	Mg-5.25Y-3.5RE.-0.5Zr	180/280/6	

Table I : Wrought Alloys used for extrusions and Forgings

### 3. Extrusion:

The manufacturing route, the working conditions and the possible shapes of magnesium extrusions are described below. Magnesium alloys can be extruded just like aluminium materials, and in industrial practice the non-lubricated direct extrusion method leaving a scull in the container is universally used (2). As in the case of aluminium materials, the dies are of the flat type resulting in a front-end 'dead zone' during the extrusion process. The scull and the 'dead zone' ensure smooth metallic surfaces.

magnesium alloys range from 300 to 400°C. With a view to the low heat capacity of magnesium alloys both the container and the die should have these same temperatures to ensure isothermal working. The limits for the upper billet temperature and the extrusion speed are determined by the onset of hot shortness. The minimum billet temperature is normally dependent on the available pressure of the extrusion facility and should not be lower than 300°C to achieve adequate formability of the magnesium alloys.

The typical billet temperatures for extruding

Typical wrought alloys for extrusion purposes are of the AM, AZ AND ZK type, as well as the WE type if high temperature strength is required. Within this group of materials it is the AZ alloys which are most widely used due to their favourable combination of properties at room temperature. The AZ 31 alloy can be readily extruded at speeds of up to 20m/min which fall, however, by a factor of almost 10 as the alloy additions increase, e.g. in the AZ 81 alloy.

As regards the possible shapes, the cross-sections of magnesium extrusions can be freely designed within wide limits, just like aluminium extrusions. With a view to the difficulty of producing specific shapes, a distinction is made between solid extrusions and hollow extrusions (Fig.2)

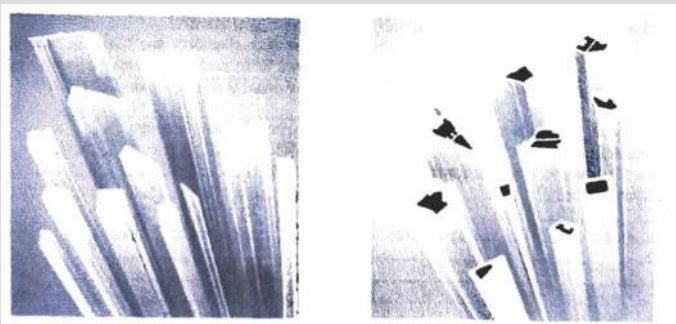


Fig 2: Examples for solid (left) hollow extrusions (right) made of different magnesium alloys

Solid extrusions include bars and geometric shapes without enclosed surfaces. As shown in Fig 3, solid sections are made with flat dies.

Hollow extrusions with one closed space are made with a mandrel (Fig.3) Alloys AM20, AZ 31 and within certain limits, AZ 61 are also extruded by using bridge dies. Here the outer contour is

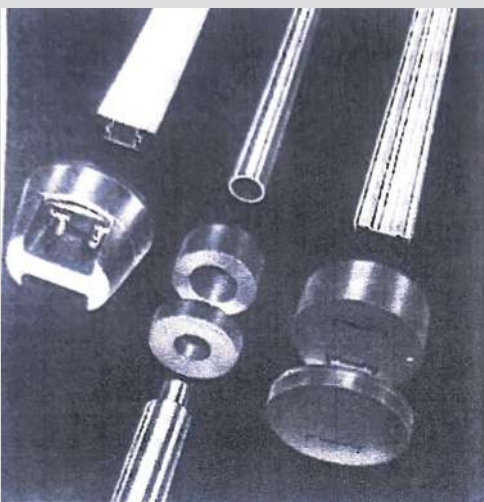


Fig 3: Dies for magnesium extrusions (From right to Left): Flat die for shaped extrusions, mandrel with flat die for hollow extrusions, bridge die for hollow extrusions produced by the die, as in the case of solid extrusions, while the inner contour of the closed space is formed within the bridge die by a mandrel resting on the die bridges (Fig.3). During actual extrusion these bridges split the billet into several branches which recombine in the 'welding chambers' and receive the required shape while passing through the gap between the mandrel and the extrusion die. The metal branches are joined by welding, and as the welding chambers are filled with metal preventing the entry of oxygen from the air, no oxide film will be formed. The welds that are to be found on all hollow extrusions can only be detected by microstructural investigation.

This method allows to manufacture hollow extrusions having the following features:

- Several Closed spaces
- Very thin walls down to 1 mm with small thickness tolerances
- Complex closed spaces.

Due to the good weldability of magnesium the welds inherent in this particular method are of high quality.

### 3.1 Finishing Operations

#### 3.1.1 Stretching

A stretching operation is performed to straighten the extrusions in the longitudinal direction. This is normally done at 200-300°C to ensure adequate ductility, especially in case of complicated shapes.

#### 3.1.2. Heat Treatment

Magnesium alloys ZK 60, WE 43 and WE 54 are preferably heat treated either to condition T5 (artificially aged) or T6 (solution heat treated and artificially aged)

In extrusions made from ZK alloys such heat treatment results in increasing isotropy of the mechanical properties as well as higher ductility (3). While the room temperature properties of WE alloy extrusions are hardly affected by the heat treatment, their temperature stability at elevated operating temperatures is much higher.

Magnesium alloys AZ 61 and AZ 80 are also suitable for age hardening (3), in the T5 and T6 conditions

their properties are slightly higher, but the loss of ductility is very great. Because the relationship between the strength and ductility of ZK alloys in the as-extruded condition is much more favourable, these are not normally heat treated.

### 3.1.2 Bending

The bending ability of magnesium extrusions at room temperature is rather limited, because actual deformation takes place over a few slip planes only. The bending limits for different alloys as determined on a round bar are shown in Table 2.

Alloy	bending angle	
	D = d	D = 5d
M 2	26	26
AZ 31	77	180
AZ 61	53	180
AZ 80	30	77

Tab. 2: Bending at room temperature of round rods in different Mg alloys with diameter 20mm (failure criteria : first crack) after (4).

## 3.2 Material Properties of Extrusions

### 3.2.1. Static Strength

The initial assessment of the strength of any material is normally based on its tensile properties.

Table 3 shows typical longitudinal and transverse values for extruded bars obtained under tensile loads. The table also lists the compressive yield

strength in the longitudinal direction of these extrusions.

A comparison shown that the longitudinal tensile and compressive values as well as the longitudinal and transverse tensile values differ significantly. While the longitudinal yield strength obtained under tensile load ranges from 180 to 280 MPa and from 250 to 320 MPa, the longitudinal values under compressive load are 30-40% lower. The transverse values obtained under tensile loads are 20-40% and in the case of M2, even 70% lower. These differences are due to the deformation mechanisms of the hexagonal lattice structure.

The above findings are of practical importance for calculating the permissible surface pressure and buckling load of extrusions. The fact that the strength differs depending on the actual direction of loading must be considered.

In case where a good strength is required at elevated temperatures of up to 300°C., Rare earths such as yttrium etc., as alloying element in combination with a fine-grained structure were found to have a beneficial effect. For example, the zirconium-refined alloy WE 54 with a 9% addition of Rare Earths has an almost uniform strength over the whole range from room temperature to 300°C (Fig 4). On the other hand, the strengths of AZ and ZK – Type alloys show a nearly linear drop between room temperature and 300°C.

alloy	condition	tensile (L)			compression (L)	tensile (T)		
		R <sub>p0.2</sub> (MPa)	R <sub>m</sub> (MPa)	A <sub>5</sub> (%)	R <sub>p0.2</sub> (D) (MPa)	R <sub>p0.2</sub> (MPa)	R <sub>m</sub> (MPa)	A <sub>5</sub> (%)
M 2	F	180	250	4	110	-	-	-
AZ 31	F	180	250	14	110	110	225	13
AZ 61	F	220	300	12	130	137	294	12
AZ 80	F	240	340	10	145	170	323	11
ZK 30	T 6	240	290	14	190	220	280	16
ZK 60	T 6	280	320	12	230	250	310	14
WE 43	T 6	170	260	12	165	165	250	14
WE 54	T 6	190	280	10	180	185	275	13

Table 3: Tensile and compression Strength.

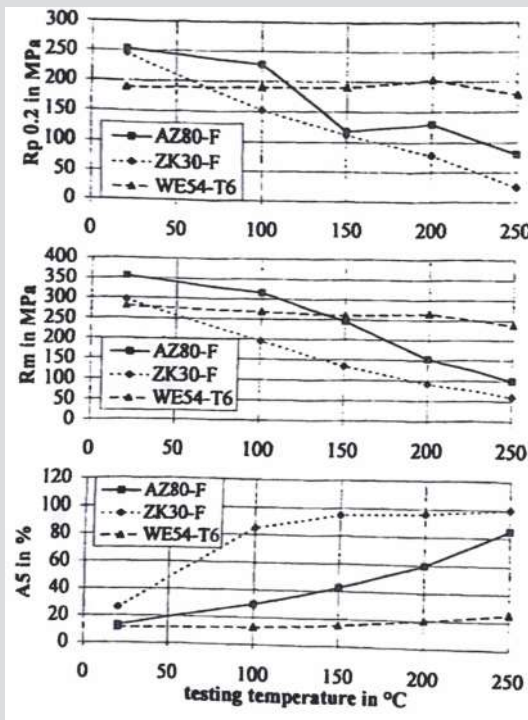


Fig 4 : Tensile properties of an extruded bar made of AZ, ZK and WE alloys at elevated temperatures.

The use of Rare Earths as alloying elements also has a very beneficial effect on creep behaviour in the case of long-term loading at elevated temperatures, as demonstrated by the comparison between the alloys WE 54 and AZ 80, see Fig. 5

At sub-zero temperatures all magnesium alloys behave favourably. No ductile-brittle transition has been observed at temperature down to -200°C

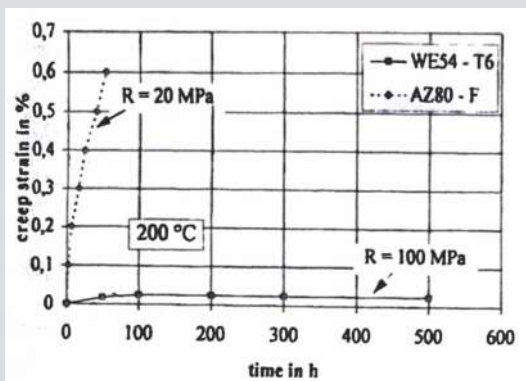


Fig 5 : Creep behaviour of extruded bars made of WE 54-T6 and AZ80-F

### 3.2.2 Toughness

Fracture toughness is an indicator for the notch sensitivity of any material Table 4 summarises the fracture toughness values for flat bars made from magnesium alloys AZ 80, 61, ZW 3 and WE 54 based on own investigations in accordance with ASTM-E399. The most favourable values are those for those for the AZ-type alloys in the F condition which are, however, still below those obtained on age-hardened aluminium alloys, such as 6082-T6 and 7075-T6. As a

result of age hardening, the values for AZ 80-T6 as well as ZW 3-T6 and WE 54-T6 fall to a very low level. This means that in the presence of internal defects and incipient cracks the behaviour of magnesium components is less damage tolerant than that of aluminium material.

alloy	condition	fracture toughness $K_{IC}$ (MPa m <sup>1/2</sup> )	
		L-T	T-L
AZ 80	F	23	20
AZ 80	T 6	16	14
AZ 61	F	24	20
ZK 30	T 6	16	16
WE 54	T 6	16	17
AA6082	T 6	36	29
AA7075	T 6	29	24

Table 4 : Fracture toughness of different magnesium and aluminium wrought alloys

### 3.2.3: Dynamic Strength

The Dynamic strength of wrought magnesium alloys is characterised by the following results of own rotating bend tests performed on longitudinal samples taken from extruded bars.

As shown in Table 5, the fatigue strength of AZ 80 in the F and T6 conditions as well as ZK 60 and WE 54 in the T6 condition at stress amplitudes of 140-160 MPa is without any exception on the same level as the medium strength aluminium alloy 6082-T6

R = -1, $k_t = 1$	AZ 80 - F	AZ 80 - T6	ZK 60 - T6	WE 54 - T6	AA6082 - T6
dynamic strength $5 \times 10^7$ LW (MPa)	145	145	140	160	150

Table 5 : Dynamic strength of wrought Mg-alloys in comparison to an Al-Alloy

### 3.3. Typical Applications

Magnesium extrusions offer a vast potential for light-weight constructions. Some typical examples are listed below.

- High speed reciprocating components for computer hardware as well as textile, printing and packing machines.
- Structural parts for the aerospace industry
- Housings for motor cars, aircraft and military equipment
- Frames for suitcases and luggage containers.

More recently, the prospects for the use of magnesium extrusions as complete systems rather than individual components have greatly improved. Typical examples are extruded motor-car frames joined together with weldable castings and forgings. If the many current development programmes based on this new concept are successful, the use of magnesium extrusions will increase significantly.



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## STRATEGIC INITIATIVE FOR LONG-TERM PLANNING

**Kishor Dukare**

Vice President, (2W Alloy Wheel Division), MINDA INDUSTRIES LTD., dukarekishor444@gmail.com

The GDCTECH Core Team, together with the Office Bearers and Executive Committee, felt the need to review and update the forum's direction and activities. The foundry industry today is under tremendous pressure due to several prevailing factors: shifting domestic and international geopolitical situations, rapid technological changes across the globe, increasingly stringent customer requirements, rising competition, disruptive technologies on the horizon, and the growing importance of sustainability.

In view of these challenges, and to support Indian MSME Foundries more effectively, the team decided to organize a two-day strategic session. The program was held on 1st and 2nd May 2026 at a beautiful venue provided by GDCTECH's active member and supporter, Mr. Sagar Kaushik. Twenty active members participated in this "Strategic Meeting," which was designed and coordinated by Mr. Kishor Dukare, Vice President of GDCTECH.

A month before the workshop, extensive preparation was carried out. This included studying the current domestic and international situation, conducting a SWOT analysis of Indian MSME Foundries, identifying their needs and expectations from GDCTECH, analyzing the forum's own strengths and weaknesses, and anticipating future challenges. Survey forms were circulated among members, and the collected data was carefully analyzed to form the foundation of the discussions.

During the two-day session:

- All collected and analyzed data was presented to the team
- Members engaged in deep brainstorming and review sessions
- Presentations were delivered by key contributors, including Mr. Dukare, Mr. NB, and Mr. JL
- Detailed strategic discussions focused on defining GDCTECH's direction and goals for the next five years

Several initiatives were identified, committees were formed, and chairpersons appointed to drive the strategic goals forward.

The way ahead is clear. Over the next three months, each committee chairman will form their team, set measurable short-term and long-term objectives, and prepare internal strategies to achieve them. This structured approach ensures accountability and progress toward the forum's vision.

The workshop was a resounding success. The team now has a clear direction, defined targets, and most importantly, a strengthened sense of collective leadership. GDCTECH has taken a significant step toward elevating the forum to the next level, ensuring it remains a strong pillar of support for Indian MSME Foundries.

Thanks to all the participants for their dedication and contributions.





## GDCTECH Executive Committee Strategic Meet – Press Release

Advait Athavale, Owner - SHARV Consultancy, Member - GDCTECH Executive Committee  
advaitathavale@gmail.com



### Pune, India – May 2026

The GDCTECH Executive Committee convened for a two-day strategic meeting to chart the future course of the organization and reinforce its role as a unifying platform for the Indian die-casting industry. The meet highlighted GDCTECH's commitment to fostering collaboration, synergy, and collective growth across the sector.

#### Leadership Transition

With the retirement of Shri R. T. Kulkarni from day-to-day operations, the Committee emphasized the importance of building a strong and cohesive leadership team to guide GDCTECH into its next phase of growth.

#### Strategic Initiative

Shri Anil Ji Kulkarni (Chairman, Pooja Castings & President, GDCTECH) proposed the strategic meet, which received unanimous support from the Executive Committee. The program was designed and conducted by Shri Kishor Ji Dukare (CEO, Uno Minda & Vice President, GDCTECH), ensuring active participation and meaningful dialogue throughout.

#### Event Hosting

The event was graciously hosted by Shri Sagar Ji Kaushik (President, Victory Precision) at his farmhouse, where excellent hospitality and arrangements created a conducive environment for productive discussions.

#### Key Contributions

**Presentations:** Shri Jitendra Ji Lakhota (CEO, Aakar

Foundry) and Shri Nitin Ji Bhagwat (Owner, Noble Castings) delivered valuable insights.

**Coordination:** Shri Anil Ji Kulkarni meticulously managed invitations, transport, felicitations, and overall event coordination.

**Motivation:** Shri Jagdish Aher conducted an inspiring session on goal setting, entrepreneurship, team building, and leadership.

**Support:** Shri Ravindra Ghogare and Ms. Purnima Madam contributed wholeheartedly, ensuring a positive atmosphere.

**Guidance:** Industry veteran Shri Viren Ji Joshi provided direction on GDCTECH's mission, activities, and long-term strategy.

#### Major Discussions

The Committee deliberated extensively on:

- GDCTECH's future vision and mission
- Industry expectations and organizational objectives
- Action plans for sustainable growth
- Inputs collected via Google Forms from members were analyzed and discussed collectively, ensuring inclusivity in decision-making.

#### Outcomes

**The two-day strategic meet resulted in:**

A clear roadmap for GDCTECH's future  
Strong motivation and alignment among members  
Defined organizational objectives and action plans  
Reinforced commitment to advancing the Indian die-casting industry



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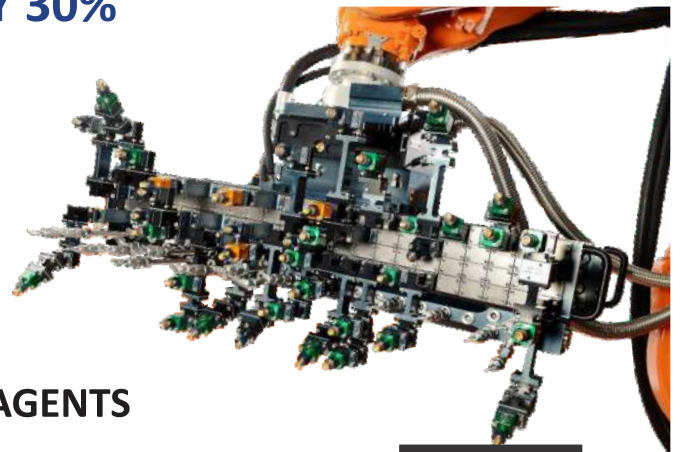
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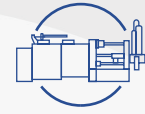


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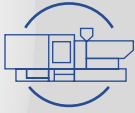
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## Haitian Die Casting (Die Casting Equipment)

Haitian Die Casting, a subsidiary of Haitian Group, specializes in die casting and magnesium thixomolding machines. Headquartered in Ningbo, it operates three manufacturing bases covering over 200,000 m<sup>2</sup>, offering a full range of HDC cold-chamber, HMG magnesium thixomolding, and HDZ hot-chamber machines. With sales and service centers in over 20 countries (including India, Mexico, Brazil, Italy, Turkey, Indonesia, Thailand, and Vietnam), it steadily promotes localized operations and deepens international cooperation.

### Haitian International (Injection Molding Machinery)



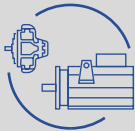
As the core business, Haitian International ranks No.1 globally in the sales and output of injection molding machines. It offers a full range of precision equipment, widely applied in automotive, 3C, medical, packaging and other fields, featuring high efficiency, energy conservation and intelligence.

### Haitian Precision (CNC Machine Tools)



A pioneer in China's high-end machine tools, Haitian Precision provides gantry, vertical and horizontal machining centers. With high precision and stability, its products serve high-end fields such as mold manufacturing, aerospace and rail transit.

### Haitian Drive (Drive Systems)



Focusing on the R&D and manufacturing of servo drives, hydraulic systems and electronic controls, Haitian Drive provides independent supporting for all Haitian equipment and also empowers industrial automation and new energy industries.

### Haitian Intelligent (Intelligent Manufacturing)



Haitian Intelligent provides industrial automation and smart factory solutions, including manipulators, automated production lines and digital management platforms, helping enterprises achieve digital transformation.

### Haitian Laser (Laser Equipment)



Forward-looking layout in laser technology, Haitian Laser focuses on laser cutting, welding, cladding and 3D printing, expanding new application scenarios such as high-precision processing and additive manufacturing.

The six industries are interrelated and complementary, forming a complete industrial chain from core components to complete sets of equipment, delivering the strength of Chinese intelligent manufacturing to the world.





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Electrical Stationary  
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Electrical Hydraulic  
Tilting Furnace



Nitrogen Degassing  
Machine (auto)



Density Index Unit

## Other Products for the Aluminium Industry

- Electrical Furnaces (Crucible)
- Fuel Fired Furnaces
- Electrical & Fuel Fired Tilting Furnaces
- Heat Treatment Furnaces
- Rotary Degassing Unit
- Density Index Unit

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- ◎ Multiple hydraulic oil filtration systems, ensuring continuous and stable production

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