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Your Guide to Foundries in Pakistan

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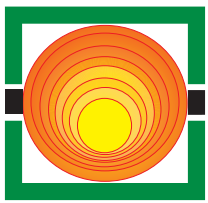
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PRESIDENT MESSAGE

Pakistan Foundry Association (PFA) has successfully done hand holding of more than 30 foundries in shifting from molasses moulding process to Alphasheet No-bake process. I am delighted to note that adoption of Alphasheet moulding technology has produced enormous results when taken up on common platform of Pakistan Foundry Association. I acknowledge the efforts of our team. To support PFA's work, Millat Tractors Limited (MTL) hosted an interactive learning session for foundries working for Millat as vendors and other foundry entrepreneurs on 23rd October, 2020 on "cluster development on Alphasheet moulding Technology". This well attended session was very interactive and the participants learnt about "why" and "how" the foundries are shifting to Alphasheet moulding.

As foundries in Pakistan are urged to prepare for export markets, one of the event for foundry industry is the upcoming "19th China International Foundry Expo (METAL CHINA 2021)" to be held from May 26-28, 2021 in Shanghai. It is an important international trade fair for foundry technology. It provides opportunity for information exchange for the



metallurgy industries covering the entire valued chain: from raw materials, machines and processes right to the end product.

I suggest PFA members' participation is important as we have the potential to export worldwide and can get business contacts from Metal China 2021. We must find international customers to expand their own business export our foundry products to improve economy of Pakistan.

To creating future with good quality metallurgical engineers for foundry industry, PFA members should support our engineering universities in producing hands-on metallurgical engineers by providing internships (on the job training) to the students of B.SC Metallurgical and Materials Engineering.

Your support to PFA team for internships will be appreciated.

Sikandar Mustafa Khan
President-PFA

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Cluster Development Session on Alphaset Moulding Technology

Report by: Pervez Mughal, Secretary-PFA

Reference: “Success story of New Rehman Foundry” published in ELEMENT magazine 3rd Qtr, 2020; the endeavors in upgrading Foundry cluster from molasses sand molding to new technology of Alphaset –No bake molding, initiated by PFA team, were continued. Cluster development session on use of Alphaset resin casting technology was held on 23rd October, 2020 at Millat Tractors Limited (MTL) premises, organized by MTL management led by Mr. Ehsan-UI-Haq, General Manager-Engineering & Supply Chain. It was very well attended by the PFA executive committee & foundry entrepreneurs and MTL foundry vendors.

Mr. Sikandar Mustafa Khan, Chairman Millat Group & President-PFA chaired the session. He acknowledged the role of PFA team in guiding foundries in adoption of Alphaset Technology through hand holding. This technology will not only reduce the rejections and repairs as compared to molasses sand technology, but will also improve quality of castings. He also thanked Qadri Group for making Alphaset resin and washed sand available in small quantities for foundries enabling them to move onto new technology.



Mr. Asim Qadri, General Secretary PFA, profoundly thanked Mr. Sikandar Mustafa Khan for making himself available to honor the session. He also appreciated efforts of MTL management for organizing a wonderful event for PFA at MTL premises. He thanked to Mr. Irfan Aqeel- CEO-Millat Tractors, & Mr. Masud Akhtar, Vice president of PFA and Director-KSB Pumps, for their presence.

He highlighted the importance of the event for PFA in moving towards the goal of technological support for foundry industry

which was achieved under the captaincy of Mr. Pervez Mughal-Secretary-PFA.

He said that PFA team has achieved two major milestones, one is the introduction and adoption of simulation technology in Pakistan and the other is transferring foundries from Molasses sand to no-Bake Alphaset technology.



Asim Qadri-General Secretary-PFA Addressing The Foundry Entrepreneurs

Mr. Pervez Mughal, Secretary-PFA informed the house that the initiative was embarked with the training of 22 foundry entrepreneurs from SME sector, at Qadri Group foundry. After the introduction of technology, PFA technical team reached Foundry to Foundry and provided necessary “Know-How”, gave practical “demonstrations” and extended support through follow-up visits with respect to addressing teething issues.

PFA team has done “handholding” of more than 30 Foundries out of which Foundries

such as Ravi Spherocast, Matchless Engg, Paras, M. Usman & Sons, Alam Pumps, Gohar Industries have also established success stories, while many others are in the pipeline.

After covering the Lahore cluster, PFA will move to interact with Foundry Clusters at Gujranwala, Faisalabad & Karachi. All such initiatives are being driven by the PFA mission of “Economic Growth & Competitiveness of small and medium foundries”



Pervez Mughal-Secretary-PFA Addressing The Foundry Entrepreneurs



Mr. Munir Ahmad- MD of New Rehman Foundry shared his “motivation” that drove him to take the lead in successful adoption of Alphaset-Process in place of molasses process being used since too long. He also shared his satisfaction on the positive results w.r.t cost, quality and casting defects. He also shared his commitment; “not to revert back to molasses process in future”.



Engr. Usman Ghani,
PFA Foundry
Engineer
elaborated following
themes in his speech:

How to use Alpha-set Molding Process(Method)

- ▶ Silica sand(washed, dried and graded i.e. AFS 50-55)
- ▶ Resin (1.5-2.0 %of the Weight of Silica sand)
- ▶ Hardener (20-25% of the Weight of Resin)

Important points related to Alphaset Process:

- ▶ Resin & Hardener Quantity
- ▶ Hardening time
- ▶ Additions issues
- ▶ Reclamation method
- ▶ Mixing time
- ▶ Reclamation level
- ▶ Mixing method
- ▶ Steel Support
- ▶ Sand condition
- ▶ Seasonal Effects
- ▶ Molding time
- ▶ Shot blast
- ▶ Pattern Withdrwal Time
- ▶ Extra Machining cost

Major Casting defects caused by Molasses sand which are addressed effectively by Alphaset Process

- ▶ Blow holes & pin Holes (Low Permeability)
- ▶ Unavailability of good quality molasses
- ▶ Metal penetration
- ▶ Addition of molasses without calculation
- ▶ calculation base)
- ▶ Sand inclusions
- ▶ Laborious knocking out of cores
- ▶ Gas Porosity
- ▶ Coating
- ▶ Seasonal effects(rainy & fogy)
- ▶ Dimensional inaccuracy
- ▶ (improper ramming)
- ▶ Swelling(Low Hardness)
- ▶ Flaskless molding
- ▶ Baking & Baking time
- ▶ Poor Surface finish
- ▶ Long core & Mold storage

Participants took keen interests and made the session quite interactive by asking questions to have better understanding about the New Alphaset process.

To conclude the session, Mr. Abdul Wahid Khan Majid, Deputy General Manager-Engineering (Host of the session) thanked the participants and the senior leadership of PFA for gracing this event by their active participation. In his closing remarks he said, we look forward for the bright future of the foundries and invited all the participants for sumptuous lunch organized by MTL management.



Group Photo



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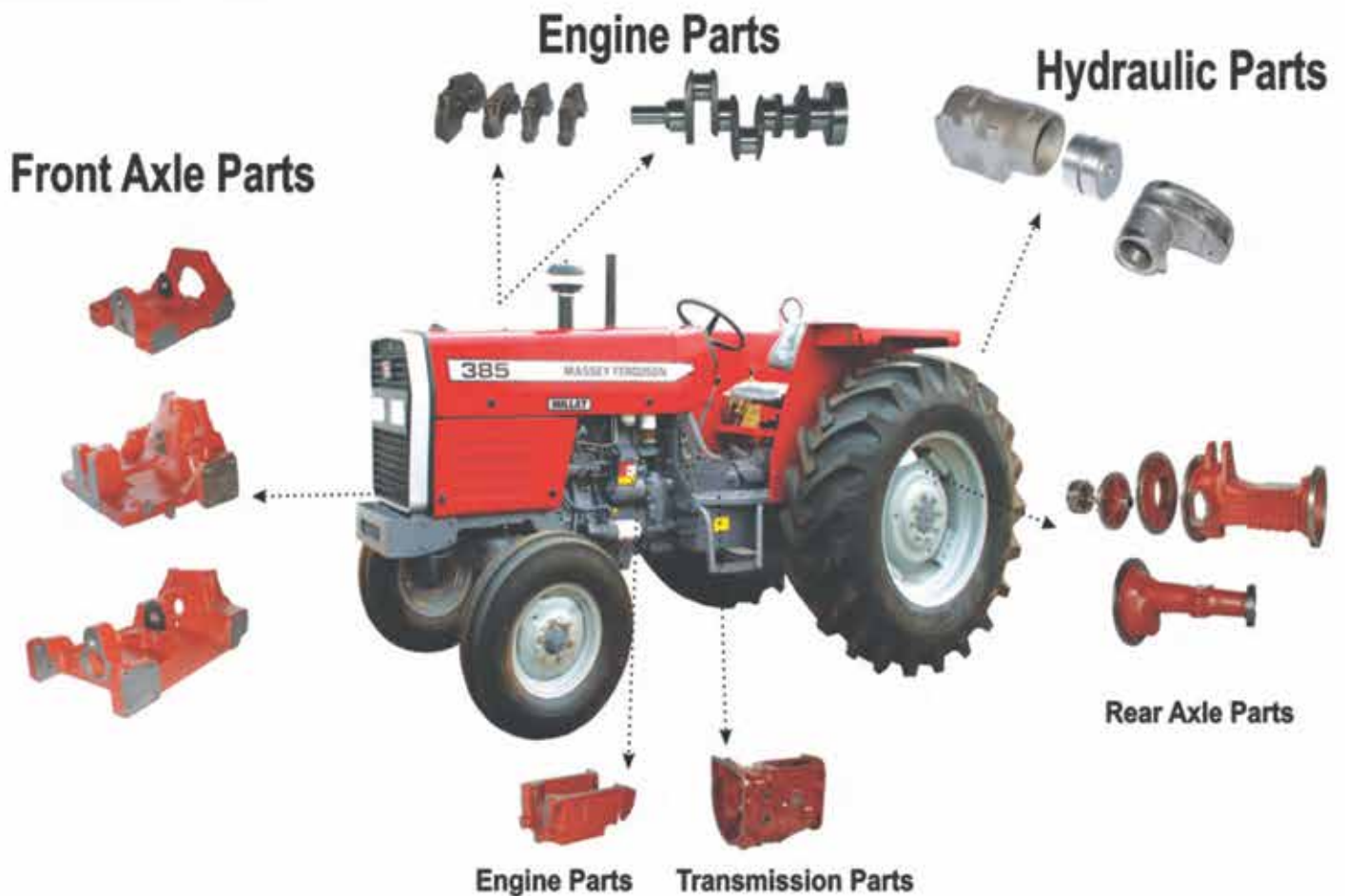
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Casting Evolution by Integrating CAE (Computer Aided Engineering) Methodologies

BY: 3 DIMENSIONS – Digital Manufacturing Solutions, Lahore, Pakistan
Courtesy: Pakistan Foundry Association

Abstract

With the concept of concurrent engineering (CE), today CAD/CAE/CAM integrated systems for casting business is more established, advanced and applied in the initial stages of casting design process. Different platforms for CAD/CAM and simulation softwares are there. These platforms can be integrated and applied successfully in the development of almost any type of casting. The use of casting simulation software is a well-established practice that helps engineers evaluate casting parts with respect to the proposed gating systems and eventually leads to quality casting with improved yield and making business more profitable.

Introduction

In today's competitive environment, where technology is evolving with such a rapid pace, businesses must also evolve in order to survive by incorporating latest technology. Talking about Metal Casting industries, problem solving techniques have evolved tremendously over a last decade. It is the need of the hour for the Metal Casting industries to realise especially small and medium industries to understand the importance of latest technology and to incorporate it into their businesses otherwise they will be left out.

[1]According to Technavio's (Technavio is a global market research firm with industry expertise on hundreds of technologies.) latest market research report on the global casting industries, one of the top emerging market trends driving the global casting market is:

► Simulation-based castings

The simulation-based casting process is used to produce high-precision, cost-effective, and reliable components. Some of the benefits of using this process include an increase in casting yield, reduces shop floor time, ensures easier and accurate fault detection, and helps to analyse and optimize the feed ability of the casting process. Various casting vendors are adopting simulation-based software or out sourcing their casting simulation projects to engineering consultancy firms to cater to the needs of end-user industries such as automotive, aerospace etc. The introduction of this process ensures precision in manufacturing activities in the foundry industry.

According to a lead analyst at Technavio [1]

“The adoption of simulation-based casting in the automotive industry ensures that all parameters such as the exact dimensions related to size, shape, and weight are met and guarantees efficient and defect-free manufacturing. These models are designed to

to reduce wastage and assist in reducing operational costs. The advantages over conventional casting methods will drive the demand for simulation-based casting. As a result, die casting manufacturers need to upgrade their product offerings to sustain the competition in the market.”

Use of casting simulation helps in meeting the demand of achieving high quality casting in cost effective manner within stipulated time frame. It plays an important role not only in the development of new components but also in redesign of existing components. In spite of so much research and development in this field, it is observed that most foundries still use trial and error approach for process development. In order to survive in the market, a systematic workflow is critically required. Figure [1]

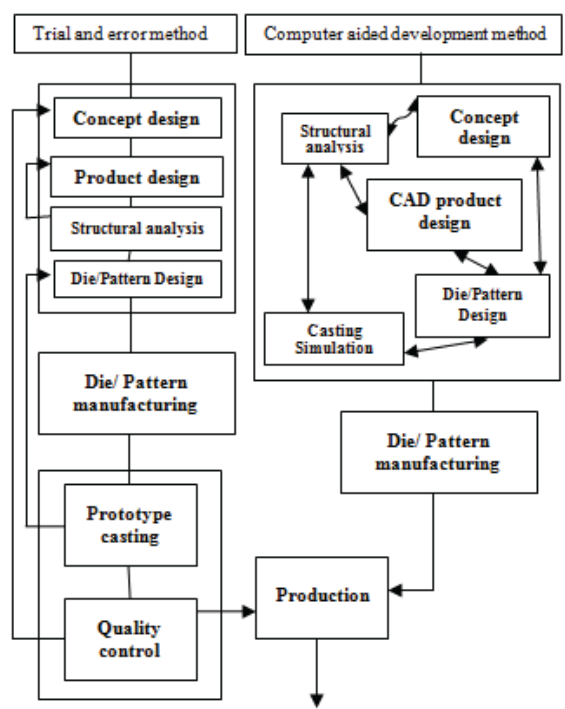


Fig. 1. Difference between trial and error and a systematic approach using CAE methodology

The capability to produce sound casting component of high quality at the same time reducing product costs & development times is the greatest challenge for the foundry today. Elimination of defects is the key for producing sound casting. Few of most common defects found in casting parts are blowholes, shrinkage cavity and porosities.

The study of these defects has led to development of various theories and practices.

[2] Increasing profit margins is primarily a concern for all foundries. But designing a gating system without even knowing the output results is likely to cost them a fortune. Practically it is not feasible to design hundreds or even thousands of gating systems to check which one is more suitable in terms of quality, yield and cost. To tackle this problem, casting process simulation is a practical solid solution that can provide with accurate filling and solidification analysis of casting and optimised gating system.

Cost of Poor Quality

Most foundries are well acquainted with the “visible” costs of poor quality. But these are just the tip of the iceberg compared to the deeper and more intractable “invisible” costs lurking below the waterline. It behoves foundries that value quality leadership to fully understand and account for these hidden costs or risk losing consumer trust, brand reputation and, ultimately, business value. [3]

Foundries that think of quality as only a cost centre enforce the incorrect perception that the quality function is essentially a thumbs up or the bearer of bad news. But actually by embracing a comprehensive view of casting simulation, foundries can limit the visible and hidden impacts of poor quality by incorporating latest CAE methodologies as a true business optimization tool. Figure [2]



Fig. 2. Hidden costs can be up to 4 times the visible cost

Case Study

Following is the brief introduction that highlights the use of casting simulation that helps to achieve defect free casting with increased yield.

Problem

A foundry was facing a problem of micro shrinkage and porosity in the casting of SG iron Axle Hub. After machining the cast part, the internal porosities become visible on the surface. Due to these porosities, the cast part was being rejected by the client. Figure [3]

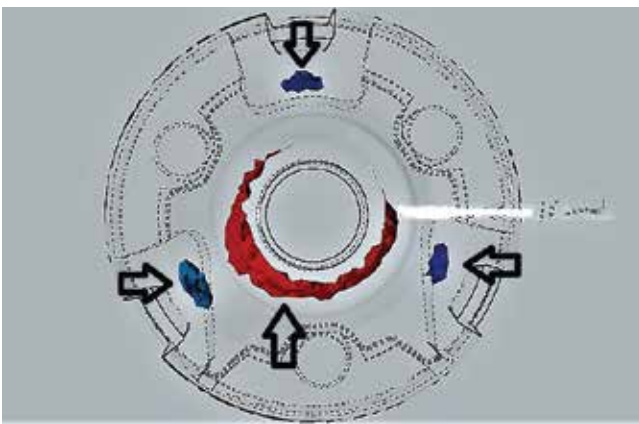


Fig. 3. Casted part with internal porosities

Challenge

A solution to the above problem was required in a manner that overcome the porosity defects and also increase the casting yield.

In order to achieve an optimised gating system, a CAD model of the part was imported into a casting simulation software. After correlating the initial simulation results with the actual nature of the problem, now different geometries with different size combinations of down-sprues, runners and feeders were created. After setting up all the geometries, detailed study was carried out about filling and solidification of the casting with a large design space (approx. 100+ design combinations). After all design iterations, an optimised gating system was proposed that not only covered the porosity defects but also increased the yield to 87%. Figure [4]

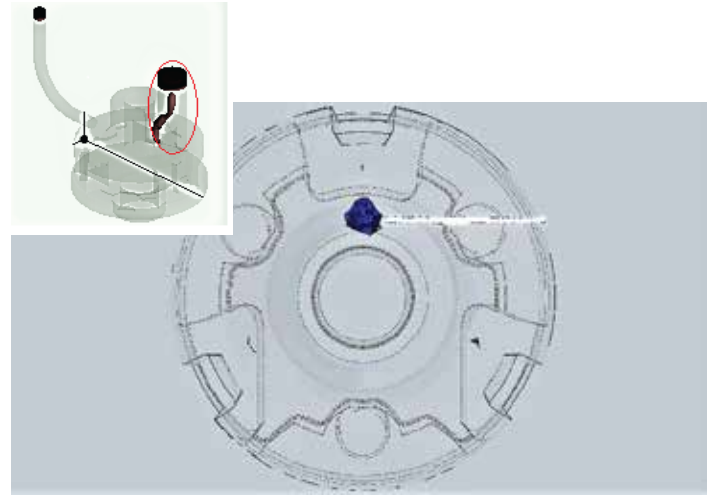


Fig. 4. With optimised gating system

With optimised gating system, a directional solidification was promoted and maximum porosity shifted into the riser geometry.

The above example shows the power of CAE integrated softwares and their positive impact on the business. Use of such softwares is needed to modernize the foundry industry and to reduce the scrap from castings and thus increase the economic profit.

Frequently Asked Questions

Q. What are the costs involved in establishing a casting simulation facility?

Initial costs include benchmarking exercise and evaluation, software license (annual or permanent option), computer hardware, and site preparation (room, furniture, AC). The cost of training and technical support. Major recurring costs include salary of the simulation engineer, and maintenance of software and hardware. [4]

Q. What are the economic benefits from a casting simulation facility?

The most tangible (measurable) benefit is energy saving due to improvement in yield, less scrap and quality, and increased capacity without adding more equipment. New casting development time is usually compressed to one third (from several weeks to few days) which is important for jobbing foundries. Production foundries can reduce their casting rejections. Other (intangible) benefits include higher

customer satisfaction (fewer complaints) and better employee morale (better output and longer retention).

Q. Should we opt for in-house simulation facility or outsource to consultants?

In-house simulation facility is usually preferred by foundries, who continuously need to develop new castings, or improve the quality and yield of many existing castings in regular production. But they must also have adequate qualified human resources to design, simulate and optimize the castings. Remember, simply using the software is not the solution but generating the accurate, feasible and practical solutions also lie with the qualified and trained professionals/or engineers. Other foundries who do not meet the above criteria can opt for simulation services offered by consultants, which is a more feasible solution for them.

Q. In what other ways simulation is useful to OEMs?

Original equipment manufacturers use the simulation results in many ways to improve overall quality assurance. Simulation shows difficult to feed areas (isolated hot spots), which can be either reduced in magnitude, or provided a feed path and feeder boss to ensure directional solidification. Such part design changes, carried out by OEM, can reduce the difference in weight between the designed part and as-cast part, which is often a major point of contention between OEM and casting supplier. The simulation results can also be used to identify critical areas that need careful inspection, and provide useful insights for collaborative solutions through technical discussions. [4]

Conclusion

CAE methodologies is the need of the hour for foundries to flourish. Without their incorporation, it will cost foundries a fortune to meet the upcoming demands. Casting simulation is a powerful, accurate and feasible optimisation tool that can make business more profitable and save from the hassle of trial and error approach.

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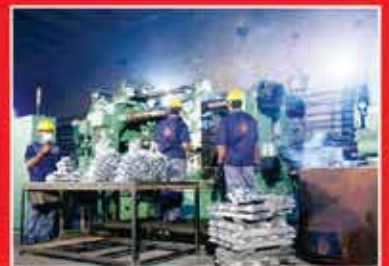


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Foundry- Changing Environment Friendly

N. Visvanathan
Partner & CEO, Ammarun Foundries - Coimbatore

This write-up highlights various such possible measures in a foundry already implemented (Ammarun Foundries, Coimbatore) and thereby attempts to give its experience to fellow foundries.

What is A Clean Foundry?

A clean foundry is one which is well kept on the ground as well as neat and tidy above the ground. This simplified definition when read in between the lines would convey large many things on which actions can be taken in a foundry industry. Essentially, three aspects should be within the grip of the foundry – (i) Air (ii) sound (noise) (iii) water. Sources of polluting elements are centered more or less on the above three factors.

Sources of Air Pollution

- ▶ Melting furnaces (fumes and products of combustion).
- ▶ Moulding operation (from return sand system).
- ▶ Shake-out system.
- ▶ Dust on the floor.
- ▶ Fettling shop (dust from grinding machines).

Possible Counter-measures for Air Pollution

- ▶ Usage of wet scrubber in melting system.
- ▶ Usage of dust collectors with cartridge type filters in the shakeout system.

- ▶ No open conveyors above ground level.
- ▶ Underground return sand system.
- ▶ Using MS pipes for carrying sand from bucket elevator to return sand storage hopper.
- ▶ Using sand conveyors belt only intrenches.
- ▶ Transfer of black castings after shakeout only in metallic conveyors upto shot blasting machine.
- ▶ Grinding machines equipped with dust extraction system.

Sources of Noise Pollution

- ▶ From simultaneous jolt squeeze machines.
- ▶ From grinding machines in the fettling shop.
- ▶ From operations of generators.

Possible Counter-measures for Noise Pollution

- ▶ Technology upgradation on the moulding front - Installation of high pressure moulding lines.

Energy conservation, arresting depletion of natural resources, waste management and in turn a strict vigil on pollution control norms have become absolute necessities in foundries. The state authorities through legislative route have stipulated norms on maintaining the environmental requirements in a metalcasting industry. Till recently, the subject was viewed only with the objective of meeting the pollution control norms. Gradually, when foundries turn inward looking, there could be possibilities of having a grip on the various operations of the foundry from pollution control point of view and also simultaneously make out a clear case for waste elimination and further recycling of the waste itself. Such measures when taken by majority of the foundries will show the way to the concept of foundry industry becoming environment-friendly and gradually, the entire metalcasting segment of the country turning towards this concept getting fulfilled.

- ▶ Drastic reduction on the acoustic levels of noise generation.
- ▶ Grinding machines with mild steel body produces more vibration and more sound. Alternate arrangement being cast iron body producing less vibration and less sound.
- ▶ Soundproof coverage for generators.

Sources of Water Pollution

- ▶ Foundries have no effluents and do not pollute the ground water resource but still the source of pollution is from waste and used water.

Possible Counter-Measures for Water Pollution

- ▶ Sewage water can be treated in sewage treatment plant and reused for irrigation purpose. In case the foundry develops a green belt, then this water can be used to harness the green belt.

- ▶ Waste water from hand wash area can be filtered and reused for again nourishing the green belt.
- ▶ Rain water harvesting; well-guarded open well can be created at suitable locations in the foundry for rain water harvesting and rearing adequate pool of water resources.

Having addressed two aspects in a foundry which are above the ground i.e. air and noise and also the water resources, the concerned foundry will now turn towards the ground level where, substantial handling of raw materials, consumables, movement of materials with respect to each operations of the foundry industry do happen on a continuous basis. Hence, innovation is called for on this area of material handling to justify that as a metalcasting industry, they are changing environment-friendly.

Raw Material Handling

- ▶ Foundries consume large volume of cast iron swarf in combination of steel scrap and pig iron material. While steel scrap and pig iron are in the solid form, the process of unloading does not create the haphazard movement of unloaded material. In the case of cast iron swarf, they are minute chips output from the machine shop and picked out as such from the machine shop. Generally, foundries unload the cast iron swarf manually from the trucks. Here, the scope for improvement being, the cast iron swarf getting unloaded from the truck directly through an electrical mechanism. Through this arrangement, the cast iron swarf is pushed in a uniform fashion and getting unloaded at a particular place instead of manual unloading which could push the material to get scattered. Figure 1 indicates a possible introduction on this aspect.



Fig.1

Silica Sand Unloading Through Electrical System



Fig.2



Fig.3

Similarly, the same electrical system can also unload the fresh silica sand instead of deploying extensive manpower (Figs. 2 and 3).

Similarly, the same electrical system can also unload the fresh silica sand instead of deploying extensive manpower (Figs. 2 and 3).

Materials like Bentonite and pitch powder move in gunny bags within the foundry.

- ▶ These bags are of a smaller size and consume quite a lot of manpower in shifting. Alternatively, if these materials are organised through jumbo bags, then larger quantum of material can be handled with less manpower.
- ▶ Some of the points on the material handling front in the moulding department have been addressed already under air pollution in this write-up. Apart from these factors, there are other possible actions as detailed below:

a. Using pipes from bucket elevator to storage hopper, thereby avoiding the spillage as seen in Fig. 4.



Fig.4

b. Covering the sand mixer top properly through provision of a breather (shown through Fig. 5).



c. Return sand movement in enclosed conveyors. Bentonite and pitch powder material movements only through screw conveyors from storage hoppers to sand-mixers.

d. A simple step like providing a proper discharge door without the scope for sand spillage helps the ground cleanliness. In short, after shake-out, dry sand should not be visible till it gets converted into prepared sand.

Charging Mechanism

- ▶ As pointed out earlier in this article, foundries have to be concerned only when charging the cast iron swarf into the induction furnace, since there is enough scope for creating spillage all over if handled through the conventional mode of manual charging. Here, the possibility exists of conveying the cast iron swarf from the material godown to induction furnaces through conveyor belts. The conveyor belt discharges the swarf through a chute into the induction furnace as can be seen in Fig. 6.



Fig.6

- ▶ Provision of wet scrubber or dry filters with proper hood arrangement over the induction melting furnace as indicated in Fig. 7.



Fig.7

Material Handling in Fettling Shop

- ▶ Generally, foundries transfer the knocked down castings from the shakeout area to fettling area by wheel barrows. This spoils the floor and instead, if metallic conveyors are provided in the layout system, then this transfer of castings would be more efficient.
- ▶ Usage of dust collectors in grinding machines will go a long way in arresting the dust floating around in the fettling shop. Dust extraction system in the fettling shop. (Fig. 8).



Fig.8

Normal Non-Noticed Location of Dust Deposit

Having had a brief look at the spreading of dust during material handling in various operations of the foundry on the ground level, they move onto look at the top. Fair amount of dust emanates from the operations at the ground level, even after providing counter-measures as discussed; still attention has to be paid to arrest the floating dust towards the roof. Here the dust sticks to the galvulum or AC sheets louvers if they are provided with slope (Fig. 9).

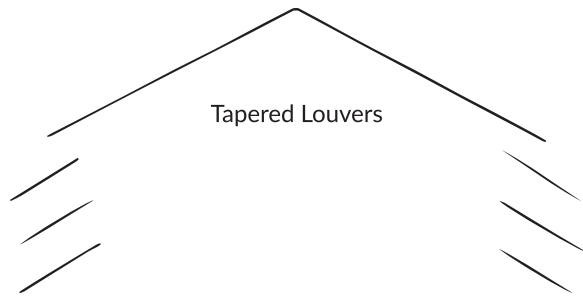


Fig.9

On the other hand, instead of tapered louvers, if we provide vertical louvers (Fig. 10), it would enable avoiding dust getting deposited on the roof sheets. Subsequently, this can be cleaned easily and thus, a way out in capturing the dust above the ground level as well.

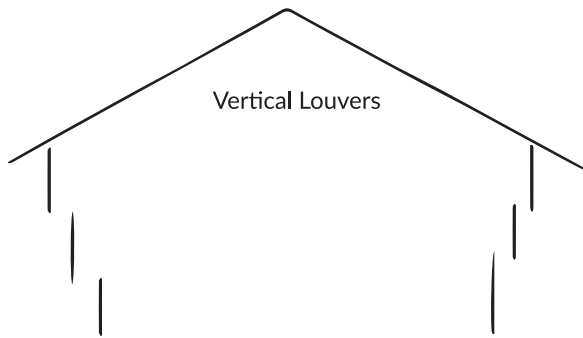


Fig.10

Better Lighting is Also Environment-Friendly

This can be addressed through the provision of transparent sheet on roof for promoting good day light conditions. Transparent roof sheet arrangement (Fig.11).



Fig.11

Also, provision of transparent sheet in vertical louvers also promotes day light and helps in avoiding dust deposits on the roof. A snapshot is given in Fig.12.



Fig.12

Waste Sand Reclamation - Urgent Necessity

Here the subject is quite vast in the sense that as foundry, they deal with various types of sand like chemically bonded sand, CO₂ sodium silicate hardened sand, oil sand and green sand. All these compositions arise from the base silicate sand which is known otherwise foundry sand. Whatever may be the sand system employed in a particular foundry, order of the day is that they align to such a sand system, so that, the sand reclamation is very much a part of that foundry. In Coimbatore foundry hub, they are marching towards putting up a separate company exclusively for the purpose of reclaiming the silica sand from the used CO₂-bonded sodium silicate sand. The project is of a massive size, so that, no foundry in and around Coimbatore employing CO₂-bonded sodium silicate sand will be required to throw or discard the used waste sand from their respective foundries in the near future.

Alternate Usage of Foundry Waste

On the one side, opportunity is there for reclaiming the fresh silica sand from the used CO₂-bonded sodium silicate sand and similarly on the other side, equal opportunities are there to address the melting slag, burnt green sand, etc. Ammarun

Foundries-Coimbatore have successfully developed bricks, pave blocks, fencing post through usage of the foundry waste as stated above. Thus, an alternative road laying material equally comparable with concrete cement is getting developed Making of Pave Blocks and Pave blocks laid flooring. (Figs. 13-14).



Fig.13



Fig.14

Bricks (from foundry waste) used for constructing walls.



Fig.15

Green Belt Within the Foundry

Normally, a lush green spot in an open area away from the industry is seen. The same green outlook, if they try to create within the foundry by planting number of trees along the periphery and at appropriate locations, it improves proximity towards better environment, but still being within the foundry premises where enough scope for creating dust, heat and noise levels are there. The noise level in the foundry industry gets countered through a well-developed green belt system in-house. Snapshot of such developed belt is shown here. Many fruit bearing trees and plants can be grown within the foundry campus.

Conclusion

Not so long ago, the metalcasting industry was viewed with suspicion that the industry is bound to spoil the environment by simply based on the nature of process within the industry. Then came a time, foundries were forced to adhere to the pollution control norms calling for additional investment from their setup amidst their already compelling tight financial situation. The current scenario is changing in the sense, that, foundries can move forward apart from meeting the basic statutory requirements on the pollution front towards contributing to the society by advancing their work on waste reclamation, inventing alternate usage for the foundry waste, attempting preservation of precious materials like sand, etc., and above all, making efforts to create a green belt within the campus. Needless to mention that, all the above efforts are in place after correcting the basic points on air, noise and water polluting aspects as detailed in this write-up. Through combination of actions on all the front as detailed in this paper and through many more inventions at the foundry shop-floor would certainly place the metalcasting as the emerging environment-friendly industry in the years to come and which was not so in the past.

Differential Sub Assembly



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Propeller Shaft



Front Wheel Hub



Die-Casted Wheel Hub



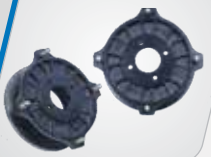
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Five 'S' as the Starting Point of Total Quality Management (TQM) for Making a Digital Foundry+

Author: P K Roy Choudhury

Courtesy: Indian Foundry Journal

Abstract

Foundries today have a challenging task with the stiff marketing environment because customers have abundance of choices in seeking to satisfy their needs and therefore are looking for excellence in quality with value of money while selecting their suppliers. Therefore, the main challenges for foundries are to aim at most competitive and superior offers for profitable performance and for attaining excellence in the market through total transparency. For this, amalgamation of cyber, physical and management systems along with effective work culture is necessary.

These can be obtained by aiming at one Smart/Digital Foundry using internet of operational items and services, together with a number of contemporary automation, information, data management, manufacturing technologies and integrated management systems like TQM, 5'S', Kaizen, Lean Engineering, Quality Circles, etc. Application of TQM with 5'S' as the starting point, can be the right choice for implementing a Smart/Digital Foundry. In fact, Japan is in the top of the world for Quality, only because of their philosophy of TQM and 5'S'. This paper will discuss about 5'S' of housekeeping as the starting point for application of Total Quality Management (TQM), as the changing paradigm of management with application of its theme for systematic operation and maintenance of the foundry and thereby attaining excellence in foundry. The paper starts with chronological development of Foundry Technology. It describes TQM and its aims and benefits. What

is meant by TQM? It describes what is meant by 5'S', why TQM with 5'S' is a powerful tool for productive workplace, and Management of Change for its implementation. Implementation of 5'S' in India helps the whole organisation to live a better life and also the new 5'S' paradigm for TQM.

Keywords: *Transparency, Smart/ Digital foundry, Cyber and physical system, Cloud, Robotics, Sensors, Digital design, Customisation, Community, Data management, Contemporary automation, Cost of quality, Productive workplace, Paradigm towards TQM, Change of Management.*

Introduction

Foundries cannot survive today without doing an excellent job if they are to succeed in the market characterised by fierce competition. One must understand that, knowing the customers and satisfying the customers with competitively superior offers with a transparent pricing is the key to profitable performance, and for attaining excellence in the market. How foundries were chronologically developed has to be seen (Table-1). Main ingredients needed for the 4th stage are – Connections (sensors and networks), Cloud (computing and data on demand), Cyber (mode and memory), Content (meaning and correlation), Community (sharing and collaboration) and Customisation (personalisation and value). It is high time to start with the 4th stage immediately (if not yet done) with a small project and then multiply the projects and

Table - 1: Chronological development of foundries

Stages	Period of Developments	Main Theme	Description
1st Stage	Year 1900 – 1950	Mechanisation	Use of water power, Steam power, Diesel power, Innovations for better machines for increased productivity, better quality and better utilisation of Machines
2nd Stage	Year 1950 - 2000	Mass production	Assembly lines, Developments through use of system analysis, electrics and electronics
3rd Stage	Year 2000 - 2010	Digitisation of manufacturing and services	Technological application of electronics and computers for system analysis and automation in manufacturing processes
4th Stage	2010 Onwards	Amalgamation of cyber, physical and management systems for incremental and continual development	Amalgamation of cyber, physical and management systems, by use of internet of things and services, that together a number of contemporary automation, information and data management, data exchange, manufacturing technologies and integrated management systems like TQM, 5'S', Kaizen, Lean engineering

processes are to be multiplied as required. Various indicators, instrumentation, hardwired logic, PLC's, HMI's, CNC controls, etc., need to be amalgamated with the operating systems, databases, applications, ERP's, Information Systems, Data Clouds, together with the help of management Systems like Five 'S' and Total Quality Management, , to make the coverage with digital design, sensors and robotics. ID scan at all stage of operation can trace the whole history of the casting and thereby its control from receipt of order up to delivery of the product and its customer focus. To do this, the same may be applied effectively in the main steps of foundry, ie, 1) Receipt of order triggering with ascertaining delivery requirements, schedule of production, inventory, equipment, constraints, etc.; 2) Tooling verifications with identification tags for patterns, core boxes, location checks, maintenance, etc; 3) Moulding with respective tag, immediately triggering the recipe, machine parameters, work instructions, quality alerts, etc; 4) Melting – Digital control with continuous monitoring and controlling the input charge, input power and melting parameters, power consumption, melting temperature, robotic sampling, composition control, auto pouring, etc; 5)

Fettling will start with ID tag fixing and recording all information regarding shot blasting and other fettling operations including heat treatment.

ID scan at any stage of operation can trace the whole history of the casting and thereby its control from receipt of order up to delivery of the product and its customer focus. Application of Total Quality Management with Five 'S' of Housekeeping as the starting point can be the right choice for implementing a Digital Foundry with the amalgamation of physical and cyber systems. In fact, Japan is in the top of the world and much above western world, only because of their philosophy of TQM with 5'S'. This paper discusses about Five 'S' of Housekeeping as a starting point for application of TQM as the changing paradigm of management with application of changed management paradigm for systematic and effective operation and maintenance of a foundry and thereby attaining excellence in market environment.

Perception of a Smart Digital Foundry

A Smart Digital Foundry means a spotless clean sunlit foundry with all the equipment systematically arranged with clean air within the factory premises to facilitate safe and healthy environment for each and every work personnel, with sensors and automation everywhere with sand moving through pneumatic pipes or entirely closed conveyors, automated pattern retrieval system, state-of-the-art testing laboratories, real time sand control systems of each mixing batch, with automated moulding system plant, wide cyber system which captures volumes of electronic data on each process control instrument, casting simulation software for minimal rejection and optimum feeding and gating design, closed circuit TV cameras through which each area of the plant can be monitored from individual and centralised system, energy-efficient machineries, rainwater harvesting and solar cells at rooftop to have a factory as aspired for future sustenance. It is something like moving a foundry to “Digital, Dynamic and Different” from “Dirty, Dangerous and Difficult”.

What is TQM?

TQM consists of management systems and procedures to improve the quality of work of all people in the organisation at all levels in all the functional areas, through group activity, participation of everyone, and application of quality control techniques, through activation and perpetualisation of “Quality Wheel” (Fig 1) of continuous improvement, self-development, mutual trust, creativity and quality consciousness.



Total Quality Management (TQM) is an endless journey in pursuit of a delighted customer. It is now something more than the price / performance of a product. The quality improvement movement in general and Total Quality Management in particular have become very popular during the last two decades. The force that generated this movement is the fierce competitiveness of the global market. In fact, for reducing the production cost, as per TQM philosophy, computation of cost of quality is the most important under the following guidelines which are explained in Figs 2-3. Figure 3 also shows that by increasing the investment for cost of conformance, the cost of non-conformance and cost of lost opportunities can be tremendously reduced.



Fig-2

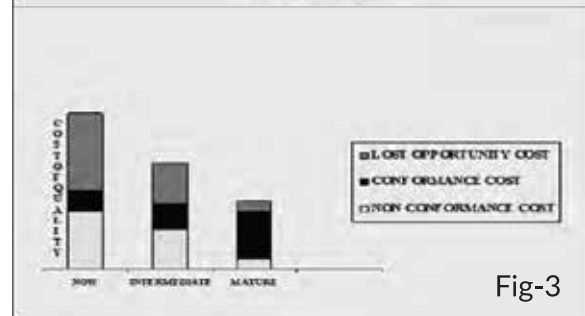


Fig-3

Main aims of TQM and the benefits are as follows

- ▶ Customer satisfaction
- ▶ Organisation culture development as an Institutional function
- ▶ Leadership commitment
- ▶ Dramatic improvement of variability and scrap
- ▶ Easy detection of hidden process personalities
- ▶ Instant reaction to sudden process

► Updating oneself for sustaining and progressing in upcoming decade The objective is to change the philosophy or attitude of the operating people to become proactive rather than being reactive. Operating people are to be motivated to take the charge to get quality. Training should be imparted to each individual to become a quality-man by himself to improve his quality of action, quality of work, quality of operating environment and above all, the quality of life by means of following actions:

- Best and easiest way of doing
- Ensuring preservation of know-how
- Providing guidelines for performance
- Assuring quality, delivery and safety
- Bringing about process improvement
- Ensuring uniformity in work output by different workers / groups
- Basis for training and audit
- Recurrence prevention and control
- Establishment of relation between cause and effect
- Easier and unambiguous communication.

What is Five 'S'?

(Five Japanese Words)

1. SEIRI –English meaning - Structurise (Sort out): To begin with sort out drive. Separate out all that is unnecessary and eliminate it.

2. SEITON - English meaning-Systemise - (Straighten): It talks about organised arrangement. Search time reduction is its predominant role. Those things found to be necessary are put in order so that they lie ready for use when needed and need not be searched.

3. SEISO-English meaning Sanitise - (Shine): Spick and Span, i.e., cleaning with inspection. Cleaning and looking for defects is its main intention. Clean workplace, equipment and prevent defects to get a masterpiece.

4. SEIKETSU (English meaning- Standardise): This is for visible Management and Standardisation. It aims at systems installation and institutionalisation. Standardise, make cleaning and checking a routine.

5. SHITSU KE (English meaning Self-Discipline -Sustain): This is for selfdiscipline for sustenance and habit formation. This has its focus on continuous training and education, discipline and training, personal cleanliness, apply KAIZEN to previous four "S". Five 'S' is the silent informer of company's attitude to quality, workplace management, and people management. The practices of Five'S' reflect Management's general attitude towards work and employees. It should be understood the linkage between the level of Five "S" and the amount of defective products produced, the number of machine breakdowns, inventory level and so on. Therefore, five 'S' should be among the first steps the management should think of and implement for improvement of company's quality standard. Five 'S' is an important aspect of the teamwork. If five 'S' is not done, any work cannot be done effectively. It should never be considered that five 'S' actions are for others to implement. The action speaks louder than the words.



5-S Practice and the aim for Auditing

In order to be able to comment whether 5-S practice is useful, the proprietary 5-S audit has to be done and regular auditing has to be practised. In line with the rule of TQM (i.e., KISS – Keep It Short and Simple), the

check-points for the audit can be detailed in 5'S' Audit worksheet, which has to be developed by the Auditor (external or internal), who will make the audit worksheet based on the type of foundry and data available from the foundry. The guidelines are as follows :

S-1 Work Sheet for the first activity, ie, Sort out to make it Structured

S-2 Work Sheet for the second activity, ie, Systemise or Straighten

S-3: Work Sheet for the third activity, ie, Sanitise or Shine

S-4: Work Sheet for the fourth activity, ie, Standardise

S-5: Work Sheet for the fifth activity, i.e., Self-discipline for Sustenance

Why TQM with 5 'S' is a Powerful Tool for a Productive Workplace?

- ▶ It simplifies the workplace.
- ▶ It removes the root causes for insufficient, unsafe and indisciplined Workplace, like slippery oil floor that often causes accidents, broken ceilings, waterlogged areas, unlabelled and unidentified materials that create confusion.
- ▶ It reduces the chance of using wrong chemicals for testing and drinking DM water because it looks like potable water, fall of helmet and safety boots in hot well of the water circulation system, blockage of the flow of water in pipelines, accidents due to fall of wires and use of faulty cables with improper sockets.
- ▶ It increases the ease for identification and traceability of anything preventing loss of time.
- ▶ Things arranged in proper order create more space and reflects the white spaces (spaces allocated for things but not used) for better utilisation of space. This can accelerate the process of getting things done in a proactive and planned manner.
- ▶ Enhances the motivation level of employees due to good and organised surroundings that acts as a hygienic factor (proper light, air and arrangement) for productivity.

- ▶ Reduces the touch time (time needed for acting) for any activity.
- ▶ Things arranged in proper manner helps in handling emergencies like fire and other accidents.
- ▶ It is not the person located for getting the tools; rather just getting it from the predefined places. The best process approach for converting TQM with 5'S' for productive workplace, is PDCA cycle.



First action is PLAN properly for application of TQM together with 5'S'. Proper planning can be made by using 5-W and 1-H, ie, what? Where? Why? Who? When? How? (Fig 5) Planning should directly be linked to 5'S' and productivity. To create a productive workplace, 5- star supermarket arrangements are required, ie, "Everything in place, self-revealing, price-tagged, easily accessible, well-protected, saves energy and time.

Second action is DOING – Things in workplace are to be arranged according to their importance, value and frequency of use. It becomes a powerful tool. If this job is done by heart, then customer service effectiveness will always be the best. Every man/woman in the organisation needs to be involved to do their bit to make 5'S' as a powerful tool for enhancing the productivity. Quality Circles (QC) or lean QC can be the part of the TQM movement.

Third action is CHECK. Carrying out audit is a must for TQM implementation very often in initial stage till it comes to a steady state, because before auditing all don'ts remain hidden and needs exposure to the participants to show how it is helping them to improve their performance by the help of 5'S'. In some organisations 5'S' coordinators take

snaps of before and after the 5'S' application and spreads the message to all connected. Making 5'S' as a powerful tool needs daily checks with the mental list to see whether everything is in order and everything has been kept in a pre-assigned locations so that the next person who is coming for the work, also finds everything in order and place. Self-checking will create a healthy 5'S' atmosphere and a good productive workplace.

Fourth and Final action is Act. Five 'S' must be considered at par with production process and not as a separate issue. It can be considered as an organisational value. If in the childhood, in the prayer class children promised in school that they would keep themselves neat and tidy, cut their nails and keep their corridors clean, then why as an adult, people can't do the same for their workplace where they are paid for everything they do for them and their family. If 5'S' is done by all in the workplace as a team, then there is no need for certification and workers will be the role model for 5'S' for any organisation. Do the PDCA cycle for 5'S' in a cyclic manner, and reengineer it as per the requirement of the environment for sustaining in the fast advancing industrial atmosphere.

Management of change for implementation

Change is part of daily life, how can people drive it under control rather than being driven off by itself? Change in organisation would, in the long run, lead to change in the organisational culture. A typical example is the learning organisation, where people are excited in trying out new ideas and recognise that failure is an important part in the path of success. Traditional way was:

Vision ==> Mission ==> Behaviour
==> Action ==> Culture

A new paradigm is:

Action ==> Behaviour ==> Mission
==> Vision ==> Culture

The new idea here is that action leads to behaviour change of the employees. This arises from the learning process, "There is no learning without action and no action without learning." If learning has been taken successfully, the organisational behaviour will be lifted to a dynamic and challenges-seeking level. This will

influence the top management in defining their mission. By then they are confident that the mission, spin off from the better organisation behaviour, will take off once it is announced. The chief executive will then be in a position to develop the corporate vision which will take the organisation through to world-class against competition. Built on firm foundations, the new vision will establish a new culture within the organisation. One best known example of this new culture is 'Kaizen', the Japanese word for continuous improvement. Being action-oriented, TQM is a powerful quality tool for everyone to get involved in the improvement process. Therefore, it is a very effective way to implement the new management paradigm. By formalising the technique, the Japanese established the framework which enabled them to successfully convey the message across the organisation, achieve total participation and systematically implement the practice. The TQM has become the way of doing businesses. In order to be able to comment whether 5-S practice is useful, the proprietary 5-S Audit system has to be developed with an aim for systematic auditing. Regular and systematic auditing is the key route for the success of Five "S" in conjunction with TQM to make a digital foundry.

Implementation of 5-S campaign in India

In order to promote the 5-S practice in India, it is important that a massive promotional campaign be launched together with an easily accessible training programme. In each training programme delegates will be given a copy of the 5-S write-up and attend at least two half-day sessions in consecutive weekends. In between the two Saturdays, the delegates had to do the 5-S Audit at their own organisation. Ten photos had to be taken, one each for the good and bad examples of 5-S. Moreover, the training programme has to be organised by suitable Training and Development Institute, or a suitable person with adequate knowledge of Five 'S' along with auditing knowledge of ISO 9000, ISO 14000 and OSHAS 18000. In most cases, respondents find all elements (resource, time, cooperation, top management support and subordinate's participation) as relevant. Amongst these, top management support and sub-ordinates'

participation are most crucial. Regarding benefits of 5-S implementation, most respondents find that all 10 elements relevant to each 'S' can be achieved with substantial benefits. Amongst these, safety, quality, productivity and image are more important to them. One interesting finding is that, for those respondents knowing about ISO 9000, ISO 14000 and OHSAS 18001, agreed that 5-S is useful as a stepping stone for their development to increase productivity, improve quality and reduce cost of production. The major difference is that the 5-S manual is very thin. For those who are certified, they find it very effective to motivate everyone to get involved; hence the word 'totality' of TQM is easily achieved.

New 5-S Paradigm towards TQM

It has been observed and identified that the 5-S practice can be adopted as the step number one for a TQM programme. Being action-oriented, 5-S is an important step towards process improvement, the key to ISO 9000, ISO 14000 and OHSAS 18001. When added with the check points of the 5-S element, the quality, environment and safety management systems can be steered towards TQM as shown in the flow diagram below:

5-S» ISO 9000/ISO14000/OHSAS 1800 » TQM

Many organisations including a few construction companies are doing a longitudinal research towards TQM based on the above new 5-S paradigm. Since the reputed construction companies in India required certification in all three management systems by their major clients, they are experimenting how 5-S can be used as an integrating tool for this "Change Management". It has now been widely recognised policy for most of the construction companies to operate and master, with zero accident, minimum quality problem, high productivity and meeting the target completion date effectively without any cost overrun. More accurate comparative data before and after changes are being collected in order to show more significant statistical results and analysis based on different conditions.

Conclusions

The 5-S practice is a well-recognised methodology used by the Japanese for improving the work environment. It was found to be the key to quality and productivity. This paper details the proprietary 5-S methodology and reports on how it has to be adopted in the existing complex business environment through intensive training programme and effective management system. The 5-S practice is useful because it helps everyone in the organisation to live a better life. It is the starting point of a TQM programme. In fact, many organisations, in east or west, have already included some aspects of the 5-S in their routines without being aware of its existence as a formalised technique. Some Institutions like Quality Circle Forum of India are fully committed to promoting the 5-S practice in order to help industries to improve their competitiveness. It is therefore hoped that this paper will serve as a seed and promote the foundrymen to consider it as an effective and important techniques for taking India to the top of the world.

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Braving the Storm

A look at COVID's effect on Asian foundries

Courtesy: Metal Casting Magazine

The COVID-19 pandemic has inflicted enormous burden on the economy, as well as disrupting manufacturing systems around the world – and the foundry industry is not immune. However, as Sam Charlwood discovers, the metal casting sector is forging on in its own resourceful fashion.

From the beginning

If you read the reports, it started fairly innocuously. December 1, 2019, is commonly referred to as the source date of the coronavirus pandemic. From its relatively humble origins in China, it took two months for the World Health Organisation to declare coronavirus as a public health emergency, and more than three months for the word 'pandemic' to officially surface.

Yet, as we find ourselves well into the second half of 2020, COVID-19 (as it has become known) has inflicted unequivocal damage to manufacturing and the global economy. Already, some analysts say the coronavirus pandemic looms as the worst financial crisis since the Great Depression of the 1930s, and many believe it has eclipsed the Global Financial Crisis of 2008.

The casting industry is not immune, and it too has been a vulnerable passenger during these turbulent and unprecedented times; albeit one willing to do its bit to help with efforts in curbing the spread of the virus. In this Metal Casting Technologies special feature, we speak to key global stakeholders from the metal casting industry to see how the pandemic has affected foundries and what is being done to sustain and even strengthen

one of the world's most important manufacturing businesses.

Shock factor

Even before it breached China's borders, news of the coronavirus pandemic initially appeared bleak for foundries and the broader supply chain. It wasn't long before those fears were warranted. It is estimated that 60 percent of global castings are developed for the automotive industry – a sector, like so many others, that was forced to shut operations overnight, imposing a brutal flow-on effect for foundries of all sizes.

"Initially, there were two main concerns from the Chinese casting association," explains Gopal Padki, a metal casting industry analyst based in China. "One was the European market was a little delayed with their COVID-19 infection – in China it started in December but in Europe it didn't materialise until February or March. Prior to that it was Christmas, so the accumulative effect of all those elements, along with the Chinese New Year, meant China couldn't deliver export orders for three months. "There was a huge inventory build-up in multiple industries where China exports a lot of castings. The real impact of the market we will only know by October because some of the data has not been seen.

“The second concern was the physical impact on the metal casting industry in China, because 80 to 90 per cent of China’s work was gone for those three months. Many labourers have been asked to go, there have been retrenchments and some companies have gone bankrupt. The foundry industries that have been affected are the government-owned ones, their output is much lower.”



The global metal casting industry is forging ahead despite the COVID-19 pandemic.



Baptism of fire: global foundries have been forced to alter their approach to manufacturing in the face of unprecedented times.

Top of form

If China’s story was any guide, then the global metal casting economy was bound to have some rough days ahead. In the succeeding months, many foundries have been forced to close, and the global consensus is an approximate 20 percent reduction of the foundry workforce – a broad reflection of what originally took place in China.

But with that said, the general secretary of The World Foundry Organisation, Andrew Turner, says the pandemic has also

reemphasised the critical role metal casting plays in the global economy.

“It has been really interesting because lots of the sectors have not been affected without any real change. A lot of the infrastructure foundries are continuing as normal – in fact there’s some growth in some instances,” Turner says, pointing to respective governments stimulating the industry with major infrastructure projects. “Clearly the biggest issue is that over 60 percent of castings produced around the world are for automotive, and automotive has been decimated.”

Breaking down the damage

As part of a recent global analysis, the World Foundry Organisation (WFO) surveyed 12 of its member countries to see how each had fared through the opening months of the pandemic. The overarching theme was that Korea had been hit hardest due to its reliance on automotive castings, while Indonesia reported a relatively soft 10 percent dip in outputs that was expected to be remedied within three months.

“I would hazard a guess that we’re going to see a 10 to 15 percent reduction in the global output of castings in 2020 against 2019,” reports Turner on the global metal castings picture. The WFO is also predicting changes to the global supply chain along with more efficient work flows for foundries. For many foundries, it’s a case of wait and see.

“Part of the difficulty is investment, which has been put on hold purely because of the uncertainty of all of this at the moment,” says Turner. “Transportation and air travel is on its absolute bumpers at the moment, a lot of the big companies supplying that – people like Rolls-Royce who are a major casting user in engines, their income comes from renting engines out. Their income is based on planes flying.

“We can’t just wait for this to go away, because it’s going to be difficult. Certainly within the whole range

“We can’t just wait for this to go away, because it’s going to be difficult. Certainly within the whole range of the sectors, so not just customers of the foundries, but the suppliers of equipment and consumables – hey’re all finding it difficult at the moment, particularly the capital goods market that supplies the foundry industry.

“The foundries have just put on hold all of their investment, they’re not likely to be installing a new melting furnace or a new molding line at the moment because they just can’t see where this thing’s going to end.”

Many experts agree the true extent of the coronavirus on the metal casting industry won’t be known for some months, when China’s regular output cycle has resumed, infrastructure stimulus packages have slowed and government furlough schemes have begun dissipating. In any case, there is a broad view that foundries will be central to major infrastructure projects used to stimulate global economies. “Internal infrastructure projects are critical, as are the foundries involved in those projects,” says Turner. “Many governments have supported their economies with furlough schemes where they’ve picked up the cost of people who would otherwise be laid off.”

Already, governments across the Asia Pacific have injected money into future infrastructure packages. There have also been major job assistance packages offered to employers in a bid to retain the workforce throughout the pandemic. “The big change will be getting people back into work, because many of these furlough schemes are just delaying the inevitable in my opinion,” says Turner. “I think there will still be a significant amount of job losses – and everyone is talking in Europe and the Americas about stimulus of infrastructure development, so pushing money into house building, rail infrastructure, general infrastructure, because that’s going to benefit people now and the people that are going to have to pay for it, our children, and they’ll also get the benefit.”



Rethinking the game

Countless trends and technologies have dictated the direction of the global metal casting economy in recent years, but one unshakeable feature of the current marketplace is that of globalisation. The rise of China, with its cheap labour, bullish uptake of technology and hard-nosed ambition, often to the detriment of traditionally strong casting nations such as Australia and New Zealand, has been documented in these pages many times before.

China’s success has underlined the global environment in which metal casting operates. However, with travel restrictions, ongoing export bans and uncertainty over how to conduct sales digitally, there has been a slight change in tack across the global supply chain, officials report. “Surprisingly, the one thing that our affiliates have found difficult is the inability to travel,” says Turner. “The one thing that came from virtually every country is the nature of selling castings and the nature of selling technically advanced castings relies on face-to-face detail. It relies on being able to visit people, so restrictions on travel was the most common statement out of all of the countries that we surveyed. “The other elements were the supply chain of materials; certain countries rely heavily on the importation of materials such as coke, scrap and some of the alloying elements. Effects on the supply of those was significant.” With those aforementioned challenges has come opportunity, particularly for affiliates outside of China.



The metal casting industry has introduced strict hygiene and social distancing protocols to ensure a safe COVID-19 working environment.



The metal casting industry has rallied around efforts to curb the coronavirus, supplying face masks, breathing apparatus and more to medical efforts.

China effectively turned off its casting production for three months this year, experts say many suppliers discovered they didn't have a "plan B". Chinese analyst Gopal Padki points to Vietnam, Taiwan, India and Malaysia as immediate beneficiaries from COVID-19, especially for supply chains looking to import outside of China.

"Those countries are like China 15 or 20 years ago," he explains. "Castings are a long haul, but for those buying readymade accessories like the fashion industry, medical equipment and medical industries, other countries will benefit – especially Taiwan."

In Australia, the shake-up from COVID-19 has been favourable for many local foundries who have won work back from suppliers previously sourcing abroad. It is hoped the breakthrough will be augmented by incoming reforms to power prices for industrial users. "We are seeing a general downturn in business, though many foundries are getting enquiries from companies who have previously sourced castings out of China and are now looking to reshore those castings," says Australian Foundry Institute national president Alan Cooke.

"The uncertainty around supply chains has been heightened with the COVID-19 concerns, but also I still strongly believe Australian foundries – although we generally don't compete on high volume parts – are very competitive on the small- to medium-sized casting volumes. Plus we can differentiate on quality – we've got to do our

best to capitalise." Over the ditch in New Zealand, officials say major infrastructure projects along with the increased localisation of castings has contributed to more quote requests and a broad return to pre-COVID casting manufacturing.

"We have heard that some foundries are getting back some work previously lost to China. However the fear is that once things settle down customers will go back to looking at price as the driver for making purchases," say industry representatives from Casting Technology New Zealand, the national body.

"This pandemic reaffirms the importance of manufacturing in this country [New Zealand]. If our castings were supplied from overseas, schedule and production planning would be very difficult to meet deadlines."

With respect to Pakistan, foundries are also pressing ahead, buoyed by low interest bank loans and government subsidisation offered to companies that commit to retaining all their employees.

A Pakistan Foundry Industry spokesman said the disrupted supply chain initially inflated the prices of castings locally, though there is continued optimism for foundries.

"Initially, the exports were affected badly, but now the exports are getting better with the passage of time. Since trade restrictions have been gradually eased by most countries, there are better prospects for Pakistan Foundry Industry to penetrate in the European and Middle East markets," says Mohammad Shiraz, a spokesman for Pakistan foundries.

"Export-oriented foundries with modern technologies and reduced cost of production will have better prospects to survive in the highly competitive and qualitative environment." Ultimately, the World Foundry Organisation believes COVID-19 will not overturn China's dominance within the global casting economy. While China produces more than 50 percent of the 110 million tonnes outputted each year, it is estimated 90 percent of that is for internal demand

(including for products eventually exported in whole). Therefore, even with a potential dip in export numbers, China's strength as a global manufacturing superpower is big enough to survive the coronavirus. "I think people will continue to buy," Turner says. There's going to be some reshoring without question, but in the long-term, as much as we all moralise and say we won't do it again, money talks. If you can buy something 20 percent cheaper out of China, then you're going to buy something 20 percent cheaper.

"You might keep 10 percent of your requirements being made locally, just so you can tick over should this ever happen again. I think people who have blindly gone into supply chains with only Plan A, will now start to run their purchasing policies with a Plan B." Veteran industry analyst Dr John Pearce, based in Thailand, says the full ramifications of COVID-19 will not be known until later this year. He agrees the pandemic will be the catalyst for new opportunities, but also for the accelerated uptake of technology where there is a means to do so.

"After COVID-19 I think that manufacturing companies that can afford to invest will accelerate their moves towards automation and robotics and that there will be an even greater demand for skills in mechatronics," he says.

Preparing for the future

Though the fight against coronavirus is far from over, optimism abounds from within the global metal casting network. To begin with, the World Foundry Organisation has focussed its energy into developing a generic set of guidelines for foundries – covering everything required in terms of social distancing, cleanliness and making sure work spaces are cleaned regularly, staggering of break times, phasing of people in and out of businesses, and toilet areas.

In the short term, the global body is also throwing its weight behind foundries making a difference in the medical treatment and logistical management of coronavirus.

"One of the other positive things that has come out of this – if you want to put it that way – is just the way people have come together. How people have reacted and dealt with the pandemic," says Turner. "There were companies in the UK that were literally making car seats on Friday afternoon and returned on Monday morning making parts for ventilators for hospitals. Then there's the 3D printing companies that suddenly started printing 3D headbands for the protective visors used in hospitals. It warms your heart."

More broadly, it is believed infrastructure projects will be key in resuscitating the foundry network, with most citing six to nine months as the best estimate of recovery – though those estimates are contingent on minimal spikes and no second waves of COVID-19 in the future.

At the same time, the global casting industry is confronted by myriad challenges and opportunities outside of the coronavirus pandemic. These are delivered in both large-scale applications, like environmental challenges, growing wages and fluctuating currencies and the sourcing of raw materials, or are market-specific, like the US-China trade tensions or the UK's Brexit tribulations. At the ground level, experts are tipping a reduced take-up of new technologies as foundries simply work to cover their costs while the pandemic is in effect.

"Investment will be slowed down, especially the automation work that many foundries had started three or four years ago, that will take a back seat now," says Chinese analyst Gopal Padki.

Australian Foundry Institute national president Alan Cooke believes the gradual resumption of trade also allow foundries to revisit their operational policies and workflow, especially within Australia. "We're nimble compared to the big foundries overseas that make just two or three parts but output millions of them, our foundries can make many different products from different grades of metal – and do it in a nimble way. That's a big advantage," Cooke says.



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“More and more, we’re embracing the technologies and the simulation in foundries, we can be a lot smarter about what we do. That’s not to say other countries aren’t doing the same, but I think there are a few instances that Australian foundries are doing it better right now.” Irrespective of the situation across Asia Pacific foundries, officials are adamant the metal casting industry will brave the unprecedented storms of 2020. And it is well geared to continue to do so in the future. “The industry has been going now for over 5000 years. We have been at the forefront of making things better for humanity – whether it’s making cast iron cooking pots or the development of castings for the automotive and transportation structures, whether it’s healthcare and artificial knees or hips,” says Turner, of the WFO. “That’s not going to stop and however you look at it – yes there has been significant changes in terms of the geographical production, China makes 50 percent of the castings in the world – but there isn’t a country that doesn’t have some form of casting industry.

“The industry has grown year-on-year for as long as I can remember, so I don’t see the industry falling apart. In short, we are simply too important.”

Metal Casting Technologies magazine sought comment from all Asia Pacific affiliates when compiling this feature story.



The coronavirus pandemic has posed huge hurdles for foundries and manufacturing in general, but in the face of those challenges, production largely continues.

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