



National Foundry Technology Network

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Metalcasting: Technologies and trends

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Department:
Trade, Industry and Competition
REPUBLIC OF SOUTH AFRICA



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The National Foundry Technology Network (NFTN) is an industrial support programme aimed at equipping the South African metal casting industry, delivered by the Council for Scientific Industrial Research (CSIR).

The NFTN is funded by the Department of Trade, Industry and Competition (**the dtic**) to achieve national objectives in this very important sub-sector.



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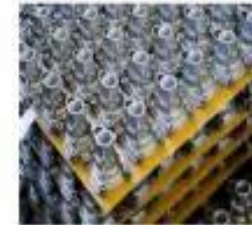
Historical

- The Metalcasting has been serving manufacturing industry for years. from being simple to exceptionally intricate products. The challenges associated with the process have led to many advancements in Metalcasting technologies over time.
- Different cast materials and casting processes have been evolved making it possible to design and manufacture almost any product with high quality.
- It is important to analyse the progress in the past, trends and envisage the future for continuous improvement.

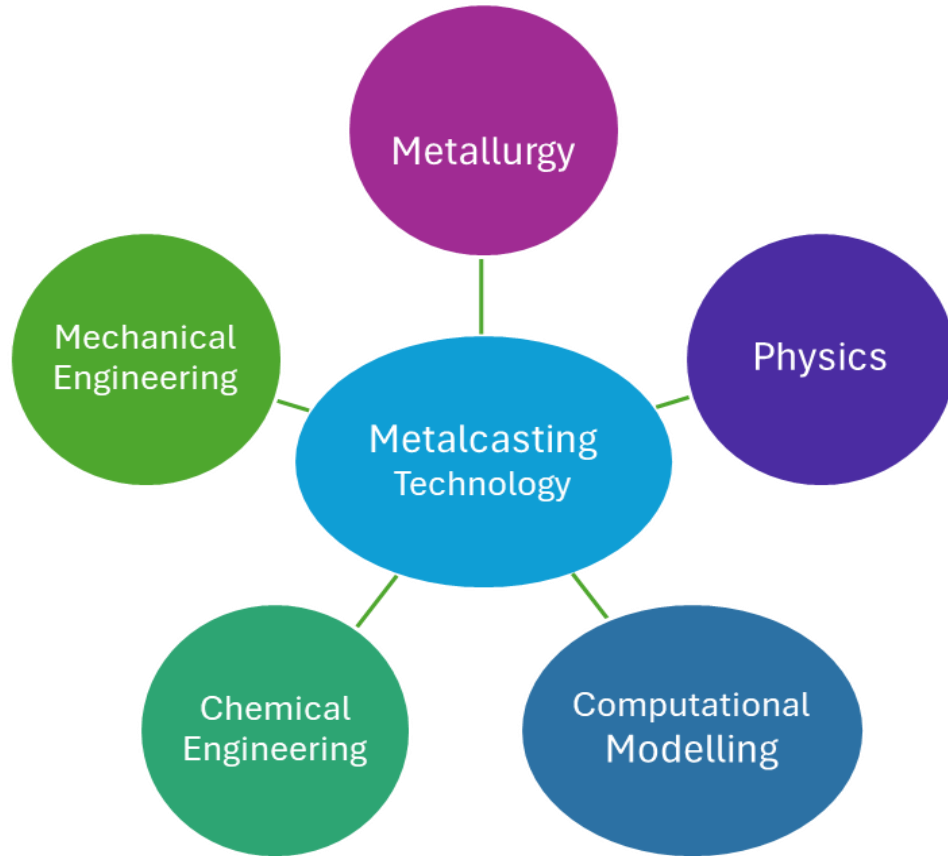


Background

- The Metalcasting Industry is the cornerstone for manufacturing sector with majority of foundries linked with the value chain of most metal related manufacturing processes.
- Approximately 90% of all manufactured items contain at least one casting and for this reason, the Metalcasting industry is identified by the Government as one of the major contributor to the industrialization programme



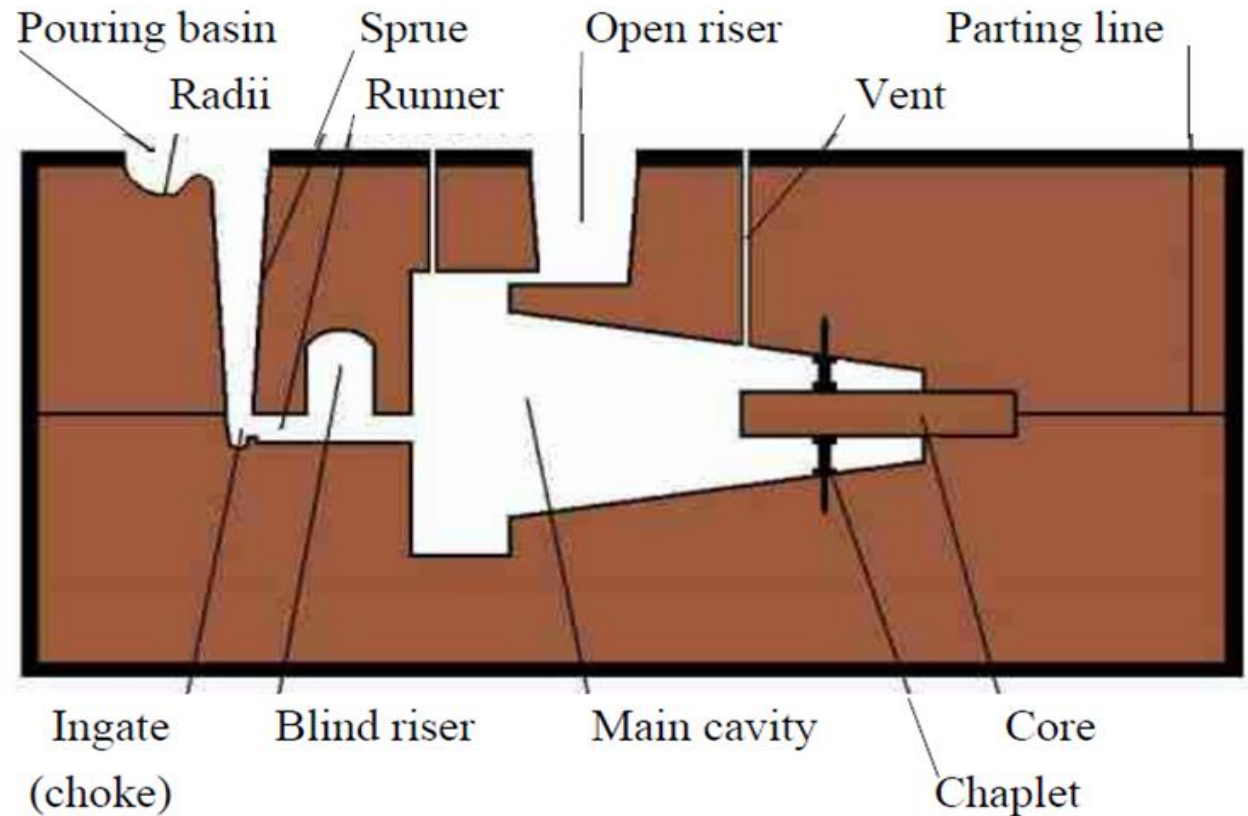
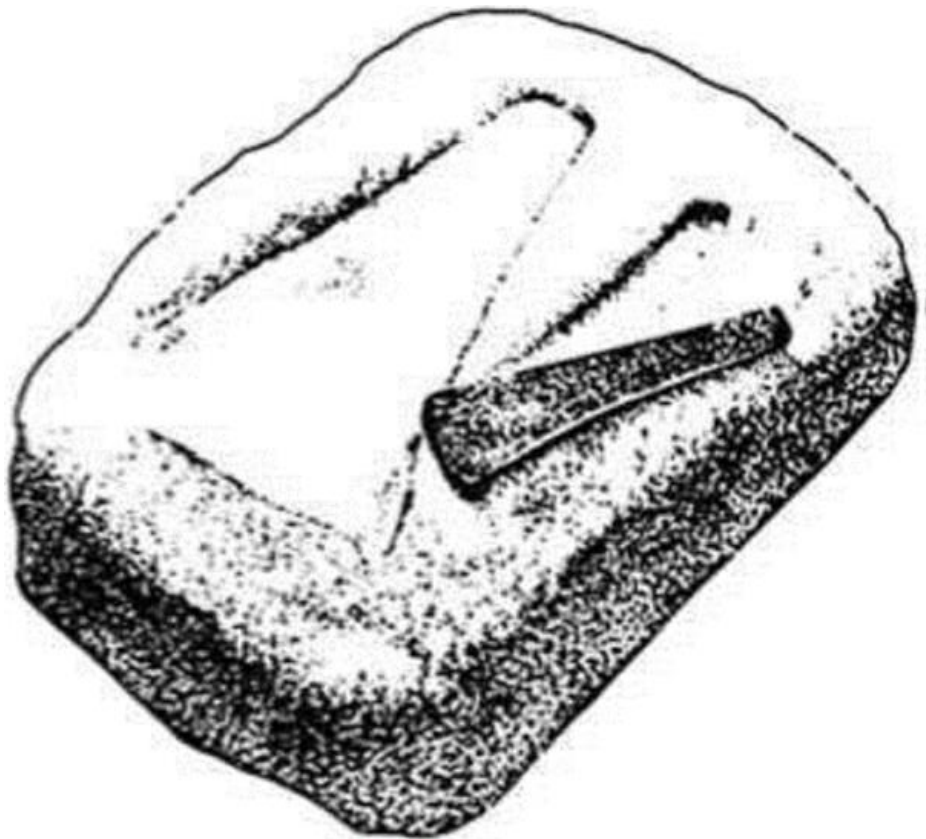
Technologies landscape



- Metallurgy: principles behind grain refinement and heat treatment
- Physics: formation crystal structures, thermodynamic principles as applied to determination of phase diagrams
- Computational modelling: Design of gating risering systems
- Chemical Eng: chemical reaction involved in melting of metals and melt treatment
- Mechanical Eng: premium quality and application

Evolution of Metalcasting technologies

Typical mould: Then/ Open and Now/ closed



Gating system for casting

Evolution of Metalcasting technologies

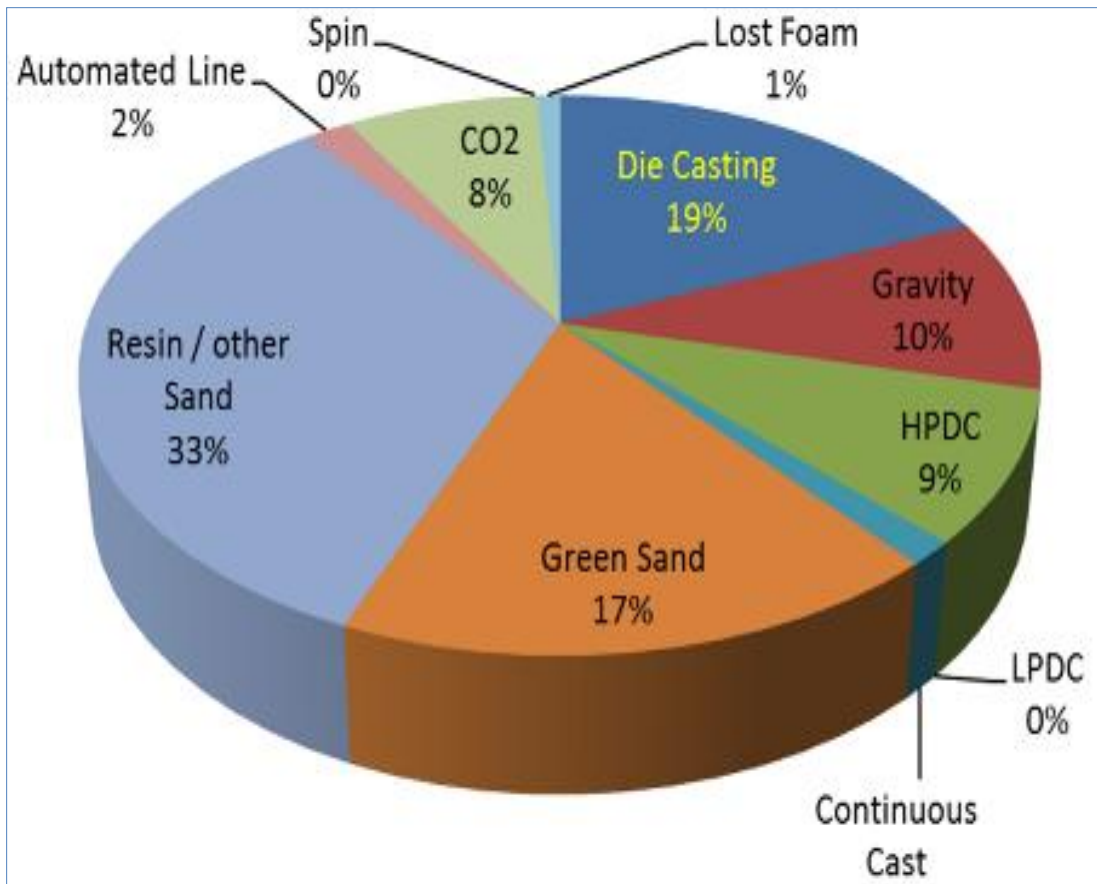
Date	Technological Development	Location
9000 BC- 1800AD	Fire using technologies (Pyro technologies)	Middle East, China, India
	Metalworking (Forging)	
	Metalcasting of Gold for decoration	
1800-1990	Use of investment lost wax for jewelry	Europe: France, England
	Sand molding, cast iron production: expandable mould	
	Development of centrifugal casting	
1990- 2000	Production of cast steel by crucible process	US
	Moulding machine	
	Die Casting machine	
	Rapid prototyping and CAD/ CAM Technologies	
	Microstructure simulation: prediction of filling	
2001-2020	Software development/ accept/reject criteria for castings	US, Europe
	Casting simulation coupled to mechanical performance	

Evolution of Metalcasting technologies

Casting simulation software

Country vendor	Casting Simulation Software
Australia	CastFlow
	Castherm
China	InteCast
Finland	CastCAE
France	ProCast
	QuickCast
	PAM-Cast
	CalcoSo
Germany	MagmaSoft
	WinnCast
India	AutoCast
Japon	JSCast
Russia	Polygon
	LYMFlow
	FlowVision
South Korea	AnyCasting
Spain	Vulcan
Sweden	Nova-Solid/ Flow
UK	MavisFlow
USA	PowerCast
	SolidCast
	CAPCast
	Flow3DCast
	RAPIDCast

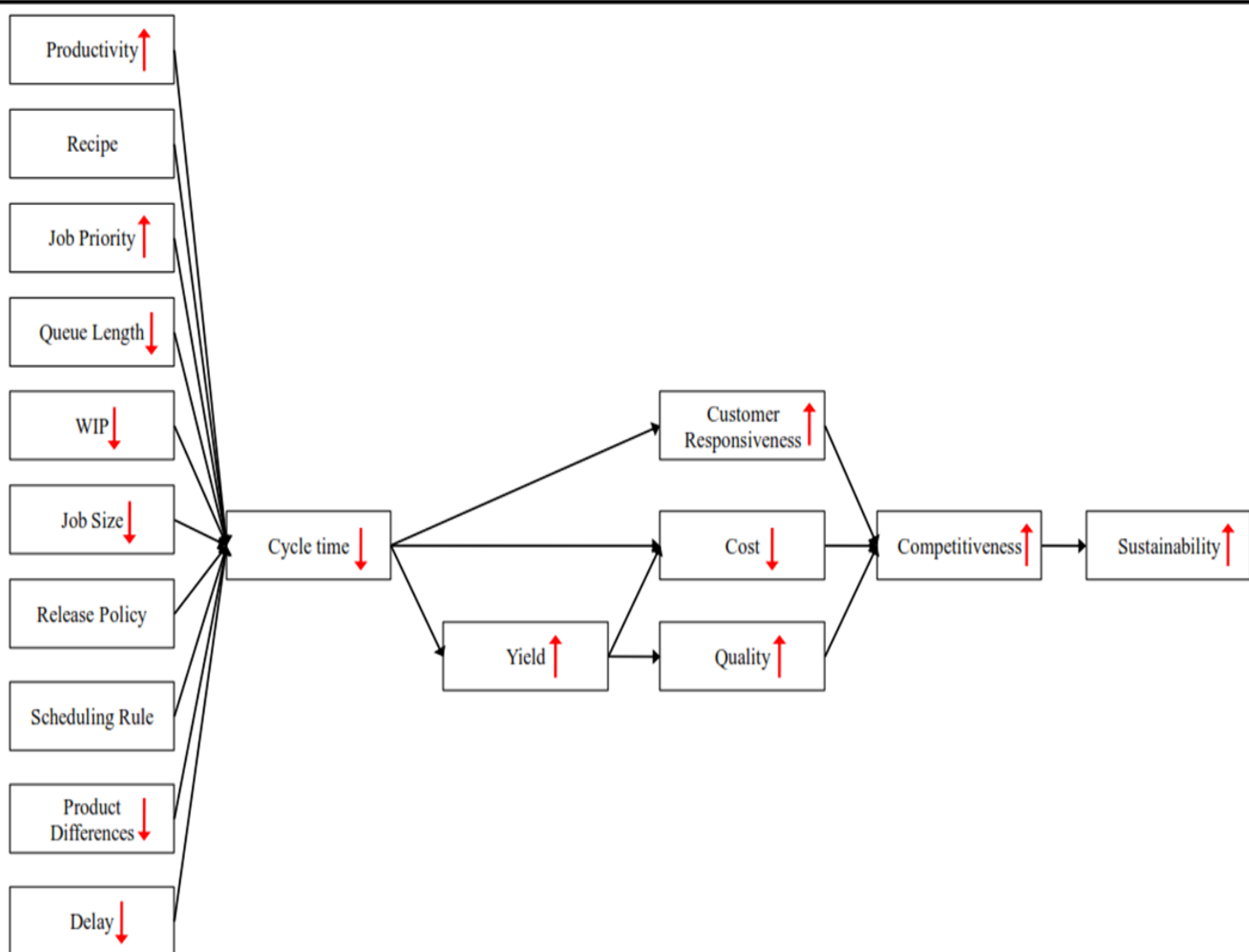
Technologies landscape SA



Drivers of technology advancement

- Metal casting involves melting of metal which is a high energy consuming process. Due to the growing cost of energy, many restrictions are being imposed on the energy-intensive metal casting units in several countries. For example, about 2000 kWh of power is required to produce a ton of finished steel castings.
- Metal casting is still highly labour intensive compared to other processes. The productivity is thereby less than in other automatic processes like rolling.
- The quantum of raw materials required for producing a ton of castings is quite high, needing exhaustive buildings, handling systems, large space and inventory costs. For example, for producing each ton of steel castings about 2,2 tons of metallics, 0,3 ton refractories, 1,2 ton of facing sand, 4 tons of backing sand are needed apart from many other minor materials.
- The time required for the process of making castings starting from receipt of drawing is quite long compared to other processes like machining. On average, a medium-size ferrous casting takes 2 to 4 months for the first casting. Thus, the entire cycle of order execution for castings can take between 3 months to one-and-a-half years depending on size, intricacy, composition, quantity to be cast, etc.
- The working condition in foundries, due to heat, dust, fumes, heaps of scrap, castings, and, slag etc. at different stages, are quite bad compared to other process industries. The environmental pollution is high in metal casting industries. This is leading to closure of foundries in advanced countries like Germany, Switzerland etc., both by governmental legislation
- and by unpopularity as a profession.

Technical aspects in the Metalcasting industry



1. Mechanization and automation: Use of robots to set cores, perform pouring and cleaning treatment
2. 3D sand printing for prototypes and small series of casting production in foundry
3. Enhancement of talents development and independent innovation capacity
4. Improvement of casting quality
5. Energy conservation and emissions reduction
6. Application of computer simulation technology

Metalcasting Artificial intelligence Framework Trends

The most important research directions leading to further development of the Metalcasting industry:

- Development of new technologies and casting alloys,
- Melting and liquid metal preparation,
- Manufacturing of molds and cores,
- Preparation of casting materials and composites,
- Pouring, solidifying and cooling of casting,
- Technological waste management,
- New production systems and quality control,
- Sustainable development of foundry industry,
- Energy and material efficient technologies.



DTIC Fund invests by the NFTN through services

Technology Transfer and Localization portfolio: Opportunities

Productivity improvement and process optimization

- Intervention to address metallurgical process control with the aim to decreasing manufacturing cost and improving quality of castings. Foundries aren't always able to provide real-time intelligence on production metrics to show location of every piece in production, what every operator is doing, ensuring the quality of every casting, what is happening on the plant to meet requirements of each order. Tool such as the Enterprise Resource Planning (ERP Software) is recommended to be applied to improve productivity and optime foundry processes.

Product and tooling development

- Intervention to assist and facilitate the design of foundry technology methoding that optimize casting yields with the use of simulation techniques for the new product local foundries have the market for to develop. Support for critical tools such as patterns, dies could be considered.

Technology improvement

- Technological advancement is a driving force to enhance competitiveness in foundries. Application of new technologies are necessary to respond to environmentally friendly processes and machineries in the foundries are faced with. This intervention covers new applications essential to assist the Metalcasting with high value parameter control such as adaptive thermal analysis system for the melting shop, burner technology for melt supply system etc..



Thank you

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