"2020" VALUE CHAIN & CHALLENGES OF THE FOUNDRY INDUSTRY IN CHINA

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Courtesy: Taihang Engine.

The Chinese foundry industry has to move up the value chain to conserve environment, energy and resources. The key diving factor for this is the government commitment in 2011-2015 -12th five year plan aiming to move away from absolute economic growth to social and quality of life improvement yardsticks!

Globally, today, nearly 100 million tonnes of castings are being cast and consumed. This is expected to grow to 150 million tonnes over next eight to ten year period. Of this nearly 50% of the growth is expected from the internally driven demand for continued improvement in the Chinese life style that will in turn bring about changes from being a commodity type volume supplier to a value added business partner for both domestic and overseas consumers. This migration towards value chain with sustainable natural resources is all about 2020 green foundry and new concepts for foundrymen in China to consider and invest smartly for innovative growth driven by cleaner working conditions.

China takes a mammoth share of the global output:

One third of global computers & refrigerators,

Half of the global textiles and apparels.

Two thirds of air conditioners ,DVDs, microwave ovens and copy machines

The global ranking of salt lake brine lithium reserves and lithium ore reserves of China is the 3rd and 4th respectively.

China is the third largest country to produce lithium carbonate an excellent input for future electric vehicles –green energy driven autos!

The above man made machines and related utilities especially iron and steel, aluminium, cement, glass and plastic manufacturing industries consume disproportionately high volumes of natural resources per every dollar GDP value creation. Nearly 60% of China's energy is consumed by industrial drive systems: electric motors, pumps, compressors and fans which are the first basis output of

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growing foundry industry in China. Today nearly 130MT, 400MT and even 600 MT weighing single unit castings are being successfully manufactured and sold. The Chinese casting industry has surpassed all global records in tonnage and machine creation. ***The key for future is sustainable green foundries with value creation as the main objective and not volume growth!***

At present, domestic steel and foundry enterprises are mainly focused on acquiring mineral resources abroad, but that would become more difficult given global commodity price hikes fueled by a market volatilities and environmental concerns. The costs of energy, raw materials, shipping and rising trade protectionism and pressure for China to appreciate its currency would pose challenges for Chinese exporters.

Water and clean energy are depleting faster than the GDP growth. The time for us as foundrymen is to efficiently utilize both water and energy. In this context before reaching 2020 a combined strength of vision, technology, management and perseverance will help us achieve sustainable castings. In about 15 to 20 years in future the need for electricity, natural gas and water resources will be determined by lifestyle, buildings, machines and devices that do not exist as yet. The construction industry as a part of urban and rural infrastructure will lead the value path in metal processing and casting industries.

Top 10 Construction Markets in 2009 and 2020

Country	Market Size in 2009 (USD bn)	World Market Share in 2009	Predicted Top 10 in 2020
US	1,132	17.4%	China
China	1,034	13.7%	US
Japan	592	7.9%	India
Germany	303	4%	Japan
Spain	292	3.9%	South Korea
France	270	3.6%	Germany
Italy	262	3.5%	Spain
S. Korea	248	3.3%	Russia
India	247	3.3%	UK
UK	243	3.2%	Canada

Source: Global Construction 2020 Report

This overview of the Chinese foundry industry therefore attempts to enlist the current challenges in the foundry industry given the existing landscape with respect to water and energy resources, government and its industry initiatives, some new concepts for alloys, castings type and the castings processes for debate and possible development for the ultimate and overall success of the Chinese castings and foundrymen with equally important mitigation targets for global climate degradation. Only Green and energy efficient foundries will sustain future competition for natural resources and value creation!

1.0 China Foundry –the Spread and the Depth.

The foundry industry is the mother of all industrialized economies driven by motor, rail ship, air or engineered components for life inputs such as food, medicine, leisure, sports and so on. The Chinese economic miracle witnessed by the world today is also driven by the same factors. The past two decades of transformation of the mindset from the planned economy to the current WTO ruled market economy with an unprecedented GDP growth per year in excess of 9 + % and the FDI investment of US$ 40-60 billion of which nearly 70% consumed by the manufacturing sector has resulted in a robust economic performance similar to what Japan witnessed during the initial phase of the 80s.

Direct foreign investment with capital, technology, and training followed by Chinese entrepreneurial & scientific skills, work discipline and government support to the castings industry has further catalyzed the mindset change. The recent trend in Japanese, Taiwanese, Korean, American, European and Australian foundry investments in China is a factual reflection of the inherent strengths of the local manufacturing industry and its relevance to global OEM markets. Evolution towards value chain is in early phase today but it is already nucleating in terms of benchmarking with western standards for costs, quality, resources, government subsidy for export and imports, IP, HSE and last but not least the quality of life. The purpose of this paper is to capture these developments in a changing landscape with some specific real-time data and concepts for ***moving up the Value Chain initiatives and the relative challenges*** for various foundries in China.

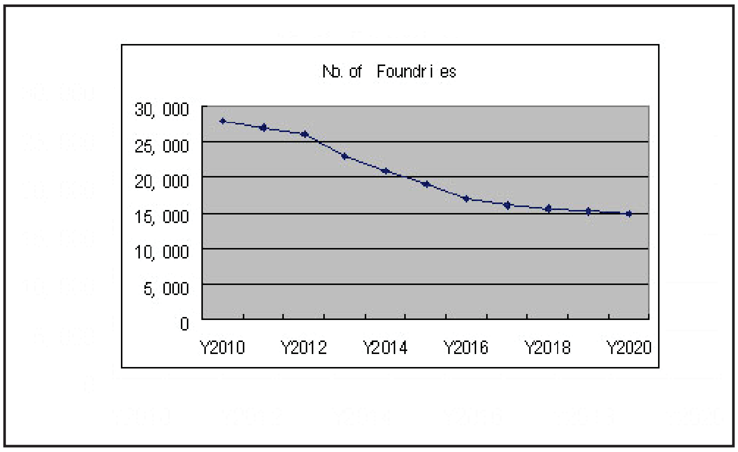
2. Market and Social Challenges:

The rapid industrialization and economic growth priorities at every micro & macro government levels have resulted in faster depletion of natural resources and severe and questionable degradation of water, air quality standards. The rewards also have come with a cost of growing concerns of sanitation and municipal amenities burden in urban cities and the growing unrest due to rural unemployment. Nearly 400 million people are jobless at rural China, of which ony 150 million people or so are adequate to till the land, the challenge is to create industrial and service jobs far away from cities for the rest. This may offer continued cheaper labour force but the challenge ahead is for creation of sustainable economic transformation away from traditional coastal strong growth centers which are already overburdened.

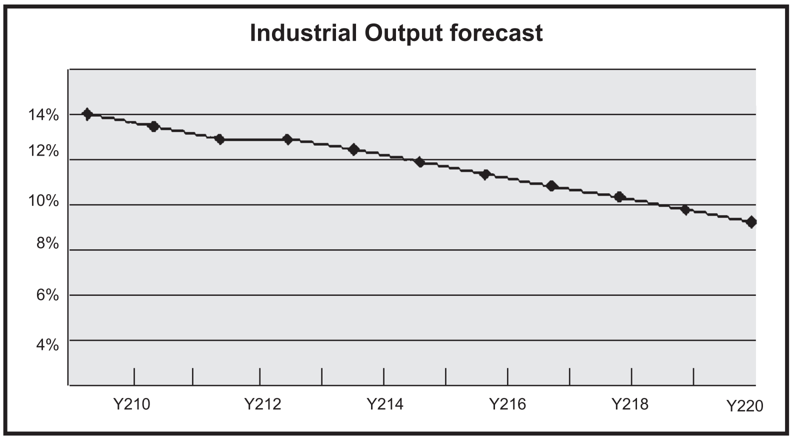
- At about 40 m tonnes of castings a year and with a 600 + million tonnes of crude steel output, China is one of the highest producers of energy and the consumer also in the global industrial world. China, today, is estimated to produce about 1.8 billion tonnes of standard coal, and consume lump sum energy equivalent to about 2.0 b tonnes of standard coal. Reduction of SO2 emissions and emphasis for cleaner, renewable energies are the major tasks. This will increase future costs for capital investments and also increase the cost of operations for both the existing and newer business enterprises.
- Oil price and its availability.
- Power supply and its cost through national grid integration
- Waste water treatment -facility and local government and the entrepreneur's attitude. Even in well governed cities of Shanghai and Jiangsu regions there are a number of industries that ought to be fined, a few to be closed for causing severe damage to the local air and water qualities, unfortunately these enterprises are also models for paying high taxes and some of them are good source for employment among local businesses.
- Iron ore source and its costs and therefore its impact on pig iron.
- Copper, zinc and nickel source and unchecked price hikes. China consumes about 5 million tonnes of copper still growing, the biggest in the world.
- Sand quality and its source limitations owing to costs and inland transport constraints.
- Deforestation and cost increases for good quality wooden pattern material.
- Younger and better-educated talent shying away from employment from hot metal processing and casting industries. Increased job opportunities in IT, service legal, management and professional jobs in banks, insurance, fashion and trading sectors will further make it difficult for foundries.

3.0 The Restructuring of foundries is a must:

The castings growth will not be dramatic, as the future mix will experience consolidation of the market, closure of small scale, energy inefficient and polluting foundries. The existing regional imbalances particularly in the State Owned foundries will reduce, as the business model will change from captive type castings consumption to independent profit driven enterprises with grater emphasis on environment and natural resource conservation. This will lead to actual number of casting foundries reduction thereby leading to mergers and joint management of key strategic groups under government bodies for automotive, energy-turbine, diesel, railway, tractor, mining and pipe industries.



Whilst the government will continue to attract FDIs in manufacturing industries so will be the resultant inflow of investments in the foundry sectors –already multinational and homegrown castings groups have invested in green field sites for tonnage matching the western economy of scales-120 to 200 K tonnes per year. This large scale tonnage itself heralds a shift in productivity and manufacturing scale efficiencies. Industrial output may stabilize and restructure but the drive will be towards economy of scale, efficiencies and environment protection. Safety will be the priority.



Of the total US$ 210+ billion foreign direct investment in 2007-2009 nearly 70% of the cash went into the manufacturing sector. This trend is expected to remain unchanged in the coming years but with a deliberate shift in value, energy efficient process development .Some examples being the R&D notable projects include –Japanese –Tsinguha university for Mg alloy smelting and castings, Rolls-Royce aircraft parts development, Microsoft, ICI, DuPont R&D centers, the plans from Toyota, Honda –engine development centers, Airbus collaboration with China Aircraft industry for regional jet engine development, Kawasaki/Mitsubishi investments in steel making research, casting simulation, pattern materials and high efficiency induction furnace melting equipment development. Inductotherm Asiapacifc R&D centered in Shanghai, Siemens, Mistsui and Fuji, GE investments in motors and parts of lower friction and therefore lowers energy losses. Motor industry design, parts and the related accessories will revolutionize the way we will develop future machines for human comforts, sports, leisure and healthcare industries.

4.0 How China may work towards green and energy driven metal casting and moulding technologies- future foundries?

The casting industry evolution in China is on a progressive path which is positively moulded with combined strengths of ambitious multinational corporations, local and global entrepreneurs, local skill sets, disciplined labour and highly enthusiastic support from the Chinese government. ¡¡

Castings

Although China's government is making efforts to curb emissions, as evidenced by renewable and energy targets in its most recent five years plans, it has not yet demonstrated that it can meet the targets. It is estimated that by Year 2030 the total emissions in China will reach 9,600 million tonnes of CO2, 22% shred by the industry and 59% by power generation sectors.

China accounts for:

One third of the global crude steel output where the energy consumed is 20% more than the global average. The energy consumption is even more challenging in industrial goods. In this context we foundrymen will be much more crucial in delivering innovative components and machines that are smooth to run with less nice, less wear, less weight and cleaner castings.

Half of the global cement and glass production. Recycle ,reuse as much as foundry and steel mill wastes as raw material inputs for these industries

Half of the urban building being built globally. The need is to build greener buildings that consume less heat to keep buildings warm during winter and take less energy to keep cool during summers. These requirements will revolutionize materials and process development of cast components for compressors, motors, pumps and couplings.

China's annual per capital water supply is 25% below global average. By 2030 per capita supply is expected to fall from 2200 cu.m to less than 1,700 cu.m. In the northern region where the foundry and steel mill density is even higher high the water availability will be even more challenging at about 750 cu.M only. Therefore again for us, the Foundrymen, the need of the hour is to develop casting processes and water management systems those conserve water.

Given the above factual challenges the author has made an attempt to list a few concepts for mitigation of the risks and for possible move towards value chain targets for foundry industry in china.

4.1 Business Innovation:

The actual installed capacity already far exceeds the actual demand. Therefore avoid any new investments. Castings of similar type foundries may merge or collaborate for economies of scale and share and spread specific skill sets. Hence the author is forecasting the actual reduction of number of foundries. Need upgrade in economy of scale and value chain investment.

Redesign office and workshops to conserve energy.

Rain harvesting and landscaping of foundries.

4.2 Foundry Practice:

3 Rs: Reduce, Reuse and Recycle: A typical foundry layout and our possible conservation areas.

Foundry residuals will achieve the same status as that of foundry metal scrap in future.-valuable and a must for recycle.

Application of inorganic binders systems for cores and moulds in place of organic/resin systems. Related sand reclaims systems for silicate binders processes.

Ecologically intelligent and economically smart slag and metal separating systems in iron and steel foundries.

Avoid coatings where feasible and if they have to be used to impart good surface finish to the castings, use water based carriers. This will provide impetus for innovative hand held solar/infrared torches for surface drying of water based coatings. The convective heat from melting shops and pouring areas maybe channeled in a drying system that can be applied for mould/core drying.

Pattern fewer castings where feasible.

Thin walled and bimetallic castings.

Vacuum and plasma technologies for high end castings.

Complicated castings and components surface finish using laser welding technologies.

Use light weight and insulating ladles. Where feasible one shot clean ladles lined with disposable boards. No preheating and no oxide dirt.

Improve HSE conditions to reduce accidents and also improve general happiness. Reduce noise, but do play light music for better moods.

4.3 Tools and Instruments:

Advanced computers for simulation-scrap mix, melting time, refining and pouring conditions including mould and core management.

Measuring instruments having virtually no human intervention.

Recorder and analyzers with no human intervention.

Sensors based on solar energy.

Artificial intelligence.

Use of solar thermal heaters/coolers for sand heating/cooling processes.

Core drying tunnels based on solar thermal stoves/ovens operating at 200 deg C.

4.4 Equipment & Systems for future viability:

Melting furnaces, ladle refiners, moulding lines, pouring systems, mixers, sand reclaim machines ,shot blasting machines, fettling tools and so on will undergo radical change in terms of having lower inertia materials, high strength, minimal moving parts. And those that must will have significantly reduced friction. The objective will be to reduce energy consumption in various unwanted drives.

Use of composite and nano technology materials in addition to the inbuilt materials of very high tolerance for thermal shocks will be developed.

4.5 Metallurgical properties/alloys.

Castings having metallurgical properties which will need no heat treatment or reduced annealing cycle time.

Deliberately included inclusions and oxides that will enhance strength of consumer choice.

Food grade and antibacterial surface properties within alloy matrix. Need no external and additional coatings.

Scratch free and corrosion resistant metal components and machine exteriors that will need no additional paints.

Alloy melts compositions that will have least shrinkage after solidification.

Lighter and stronger alloys with equal emphasis on safety on impact.

4.6 Revolution in skill-set: Interdisciplinary talent inputs:

Future foundry layouts and operations will attract talent from fashion, architecture, IT, telecommunication and art institutions in addition to the core team of metallurgists, material engineers, scientists, and mechanical, electrical and civil engineering specialists. The future training needs will therefore be cross discipline and multi collaborative type.

5. The Conclusions

By 2020, the nation's GDP will reach US$4.7 trillion, or US$3,200 per capita income. The local governments have already invested more than US$ 34 billion in 2009 already up 52% against 2008 spent for innovative technologies for local industries for greenhouse emission reductions. Going green, clean and energy efficient is an economic wisdom that future casting foundries will compete and benefit by switching to innovative practices that conserve water, electricity, reduce pollution, safeguard employees and consumers health to sustain long term viability of the said business.

Future castings will be differentiated and sold based not only on metallurgical properties, dimensional accuracy, and surface finish factors but also on how much impact will they have on reducing friction, noise and electrical energy consumptions. **This is all about Moving up the Value Chain ladder in the context of current and future perceived challenges**!

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