Role of the Welding Industry in the Growth of Indian Economy

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Abstract

With the declared target of the Indian government to become a USD 5 Trillion economy by 2024, the role that the Welding Industry ought to play in the growth of the Indian Economy has been discussed. Manufacturing industry while identified as a key contributor to the economy contributes only 16% to the economy against the 25% target laid by the National manufacturing policy. Welding as an enabling technology for manufacturing can play a significant role towards achieving the desired growth target. Developments in the last 50 years in welding technology and industries where welding technology plays a key role are delineated. Technical competence in welding industry is reviewed and recommendations to overcome the challenges to Indian welding industry are spelt out.

Keywords: Welding; GDP; Indian economy; manufacturing; welding industry; technical competency.

1.0 Introduction

It is an honour to deliver the Jaeger Memorial Lecture at the IC-2020, the Fifth International Conference in my home town, Mumbai. Mumbai is the city that gave refuge to my parents and our family who migrated after partition of India during August 1947.

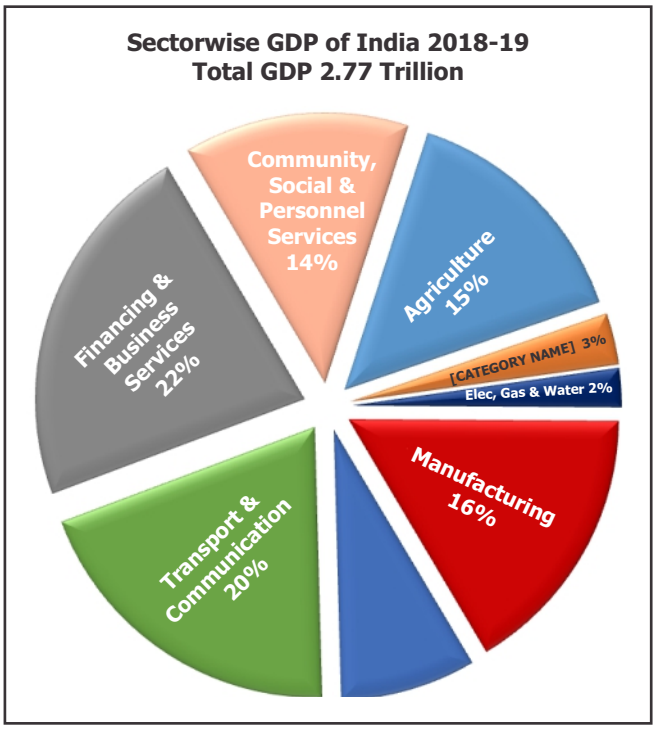
My interest in welding technology developed way back in seventies when I was working with the Power Projects Engineering Division at the Department of Atomic Energy. The close interaction with Canadian consultants who helped us in developing reactor components indigenously inspired me to pursue welding technology.

The topic – "Role of the Welding Industry in the growth of the Indian Economy" assumes importance with the prime minister citing intentions of the Government to be one of the leading economies of the world by doubling the Indian economy in a span of five years i.e. by F.Y. 2024-25. This will make India a USD 5 Trillion economy from the existing figure of USD 2.77 Trillion. We, the welding engineers too should accept this challenge by contributing our best to economy.

2.0 GDP – A Measure of Economy

Any discussion on economy automatically connects it to the 'GDP'. We all know that GDP is the total market value of all final goods and services produced in a given time period. It is an output-based measure of the economic activity commonly referred to as value added to the economy and is a measure of its capacity to produce goods and services. The ten-year average annual GDP growth has been 6.4%.

Manufacturing is a key contributor to the economy of a nation, adding jobs as well as increasing self-reliance. National manufacturing policy of India prepared in year 2016 envisaged 25% share in the economy and creating 100 million jobs by end of 2024. The current contribution of manufacturing sector is only 16%. The filling up of this gap is a challenge for welding industry. Please refer to the chart shown below. The chart gives a comparative contribution to the economy of the major sectors.



To have a robust and thriving economy the contribution of manufacturing sector needs to increase. Since Welding is a major enabling technology for manufacturing, we have ample opportunity to contribute.

3.0 Development of welding technology in the last 50 years

Over the last 50 years, welding technology has undergone much change. The changes are attributable to a combination of information, research and use of technology. It has led to automation of processes yielding higher productivity, consistent quality, safety and improvements of work environment. This progress has led to:

3.1. Process Development - Application of advance processes, such as electron beam, plasma arc, friction stir, explosion and laser hybrid welding resulting in increase in the range of materials that can be welded. High speed ESW for weld overlay is now much in use. Most of these processes are fully automated making them highly productive.

Welding power sources are upgraded/modified for specific purposes / advantages e.g. Flexibility - AC/DC combined, RMD/CMT technique for root pass welding, hot wire TIG/twin wire, TIG for higher productivity, K-TIG single pass welding for thin metals, etc.; Higher productive processes e.g. industrial robots and computer-controlled systems are used today to improve both quality and productivity.

3.2. Advances in Weld Design - capability - Analytical ability for structures, seismic design, finite element analysis and residual stress analysis is now available.

3.3. Advances in Material Science - The developments in materials and understanding their properties have improved. This led to better design and operation of fabricated equipment and systems.

3.4. Advances in NDT Techniques - Real time examination and monitoring techniques, use of simulation techniques, machine learning and data analytics for reliable predictability have advanced significantly.

3.5. Digital Technology – has led to adaptation of 3D printing for manufacturing of complex components on a large scale and use of IOT is helping in raising productivity and quality.

Let us ask ourselves –

Are we in India making use of these developments?

The answer is "NOT FULLY". Adoption of advanced/ improved welding technologies is limited to large companies. Unfortunately, small and medium scale companies are still dependent on conventional technology due to lack of technical knowledge, shortage of skilled manpower and the capital needed for upgradation. Welding industry as a whole need to put efforts in increasing awareness about advanced technologies and making them available at affordable price through indigenization.

4.0 Industries where welding is important

Desired growth of economy is possible by laying greater focus on industrial manufacturing. This translates into growth in steel, power, infrastructure/ transportation, and petroleum industries among others.

In this presentation, I will cover the contributions that welding makes in some of these industrial sectors:

1) General Construction & Engineering (includes infrastructure)
2) Heavy Engineering / Capital goods Fabrication
3) Ship Building
4) Automotive Industry
5) Civil/ Defence Aviation
6) Aero Space Industry

4.1. General Construction & Engineering (includes Infrastructure activity)

Infrastructure activities connected with welding are construction of roads, bridges, dams, stadiums, pipelines, tanks and other engineering construction that uses special

metallic material and varying degree of welding. This segment constitutes a large number of small and medium welding fabrication facilities carrying out jobs from a fixed location or mobilise to sites where these jobs are to be carried out. Growth of this segment is linked to growth of general economy of the country and vice-versa. The firms connected with this segment are often referred as EPC contractors. Automation is gaining momentum to reduce overall project completion time besides other linked advantages.

General welded fabrication can be classified into two groups, those dealing with thinner sections having lower weight of construction and others constructed with heavier sections having larger weight.

Presently, most of these fabricators use welding processes of a wide array to achieve high productivity such as Tandem wire MAG welding, laser- MAG hybrid process, SAW, Robotics for subassemblies. Laser and plasma cutting help in fast and accurate cutting of large panels.

The infrastructure spend by our Government is growing at a CAGR of 10.5 per cent annually and is expected to reach USD 215 billion in 2020. India is witnessing significant interest from international investors in the infrastructure space. Government has recently announced sanction of the world's longest LPG pipeline (2757 km) from Kandla (Gujarat) to Gorakhpur (UP) at an estimated cost of USD 1.5 billion. This project is expected to use high strength steel with good fracture toughness. We need to develop necessary consumables and infrastructure facility to handle the challenges associated with such a large project.

Another area of large investment in infrastructure in the next five years in India is in the power sector. India is investing in Advanced Ultra Super Critical and the Ultra Super Critical technology to boost fuel efficiency. It is planned to increase current installed capacity from 192GW to 330GW by year 2031

On the nuclear power front, which currently has only 3% share, Government plans addition of 21 nuclear reactors by year 2031 using different technologies. An estimated USD 35 Billion is the proposed budget. This big boost in energy is the need of our country.

Welding will play a key role in this sector. We need to develop necessary welding consumable and infrastructure to handle the challenges associated with large projects.

4.2. Heavy Engineering / Capital Goods Fabrication

Heavy Engineering Fabrication is often connected with capital goods requirements from industries such as Power, Petrochemical, Refineries, and Process Plants, requiring reliable and assured long life of the products supplied. This segment employs high end of Welding Technology and is a major source of employment. Automation becomes often necessary to predict, control and ensure final properties in line with the expectations.

All the common arc welding processes used are mostly in their automated form and some have even introduced the latest IOT compliant systems to centrally integrate and operate for maximum efficiency.

4.3. Ship Building

Historically, we may say that welding started with ship and barge building involving several kilometres long welding and cutting of varying materials and thicknesses. It should be pointed out that skills needed for the repair services are of a different kind. We will not go into those details.

Soon after gaining independence, India had commenced shipbuilding activity for naval use including submarines. Today there are many agencies for fabrication of ship, barge, container and other related activities.

The Indian shipbuilding industry may be classified as welding intensive and benefits immensely from the availability of skilled labour. All methods rendering fast weld deposits with minimal distortion have helped introduce automation augmented by jigs and fixtures for pre-setting the components to offset the eventual distortion in many ways. The advantages leveraged are high speed one-side welding, multi-electrode fillet welding and overhead welding robotics for bottom shell welding. Historically, shipbuilding has helped growth of FCAW and aluminium welding, both requiring different kinds of facilities and skill set. Cutting by plasma, instead of gas cutting is useful for higher speeds and improved accuracy. All this will help in improving delivery schedule and also make Indian shipbuilding industry more competitive.

4.4. Automotive Industry

Automobile industry is one of the major contributors to GDP (7%) during FY 2018-19. Welding forms a core activity of this industry segment employing smaller thicknesses of material requiring significant investment in automation and robotics. High productive welding processes such as laser welding and robotic arc welding are employed to weld a large variety of materials to keep the weight of a vehicle low with improved performance features. GMAW and Resistance welding processes have come a long way in delivering faster production, lesser rejections and ensuring consistent performance. Some of the new introductions are:

- Welding of high strength steels and coated materials
- Online monitoring of process and quality
- Autogenous GTAW, Laser and Electron Beam welding

Railway coach and wagon manufacturing extensively use welding of carbon, stainless and Corten steel for their fabrication and India has the distinction of using locally

manufactured units since inception. Metro rail, a new emerging segment, will also gain the advantages rendered by new joining technologies.

4.5. Civil/ Defence Aviation

This segment of industry addresses the needs of the rapidly growing demands of the global market. The Indian government accords top priority to expanding the defense and aero-space industry. The measured steps that the Indian government has taken in moving towards the open sky policy, increase in military, civil and business aircraft fleet in the country, the growing preference for air travel by India's largely under-served middle class, and the focus by industry to optimize cost of aircraft operations, provides a strong foundation for the Indian maintenance, repair and overhaul (MRO) industry to strengthen its capability to meet global standards of excellence.

India is projected to become a strong domestic base for manufacturing sub-assemblies and components in the years to come. The cost advantages, availability of well-educated talent pool, the ability to leverage IT competitiveness and a liberal SEZ law, attractive fiscal benefits are drivers to investment in this sector.

MRO being a support service to the aviation industry is also expected to grow proportionately. Our competitive manpower cost, the availability of talent, locational advantages and the presence of specialist capabilities combine to give India a competitive edge. Though large-scale welding is not involved in MRO activities, the job requires specialized knowledge and skills that we in the welding industry are best suited to provide.

4.6 Aero Space Industry

India is one of the six countries in the world that has carried out space odyssey. The Indian Space Research Organization (ISRO) is engaged in development of satellites, launch vehicles and ground systems, with the objective of rapid development of mass communications, remote education, remote sensing, survey and management of the country's natural resources.

Welding technology is a major contributor to success of this program. GTAW/EB/Friction welding are extensively used to weld the various grades of Nickel Alloys, Al alloys and PH grade steels that are used in the space program.

If we are to meet the demands of the civil aviation and defense and aero-space industry, we will need access to critical technology, and develop raw material and certification processes by adopting international standards. Our maintenance standards ought to be the best in the world.

5.0 Challenges to Welding Industry in India (An Overview of Technical Competence)

It will be appropriate to have an overview of the size, its status and the depth of technology it employs. It may give some idea of its impact on the economy. Technology Information, Forecasting and Assessment Council (TIFAC), a think tank set up under the Ministry of Science & Technology, has brought out TECHNOVISION-2035 to assess overall technological progress in India. It has used the metaphor of horse gaits, Gallop, Canter, Trot and Walk, as an analogy for how India has progressed. It is presented in the following pictorial depiction.

TECHNOLOGY VISION 2020 – Horse Gait Analogy

GALLOPING INDIA

Successfully Deployed

Space & Nuclear Technologies

- India has emerged as a significant player in building & launching satellites to both polar and geo-synchronous transfer space orbits.
- Leads with advanced nuclear technology, improvising and indigenising PHWR and PFBR.

Missile Technologies

India has become reasonably self-reliant in missile technology with successful completion of Integrated Guided Missile Development Programme.

CANTERING INDIA

Pilot Plant Stage

Civil Aviation

Although ninth civil aviation market in the world, still no indigenous aircraft manufacturing capability. Recently, there have been a few international collaborations, but a long way to go.

Road Transportation

Notable progress in road infrastructure, but economic losses due to inadequate planning, poor handling of congestion.

TROTTING INDIA

Being developed

Engineering - India's export has risen in last ten years, its manufacturing as percentage share in GDP has (more-or-less remained constant) not kept pace with exports. There is considerable scope for improvement

Materials & Processing
- rising in sectors like Steel, Titanium, Nickel. Magnesium through breakthrough technologies being adopted.

WALKING INDIA

Needs greater Focus

Advanced Sensors for Automation
Low indigenization, banking solely on import, leading to costly products. Significantly affecting productivity and automation of all industries.

Waterways
- Less than 1% share of cargo. Big shortfall of ports, terminals, navigation aids and fleets.

The chart shows a mixed picture of achievements and missed targets. While we have made quantitative leaps, the concomitant qualitative technological improvement is still only a desire.

The reasons for India's progress or lack of it in the last two decades could be attributed to a number of factors. Coverage on this subject is limited to welding technology only.

6.0 Way forward for Welding Industry in India

To proceed further, a discussion on summary of overall needs and challenges faced by Indian welding industry and way forward will be appropriate. Refer adjacent table.

Needs & Challenges	Way Forward
1. Scale Up	- Invest capital to increase production volume and reduce cost. - Use AI, IOT tools and advanced power sources to achieve higher productivity and consistent quality
2. Educate	- Need to spend on education, skill development on top priority - Health and safety awareness of the welders must be emphasised
3. Innovate	- Need to encourage the spirit of innovation - Private sector in their own interest should encourage R&D - Need to support students and faculty in their R&D efforts and in commercialisation - Government in partnership with Industry to work on incentives to augment research activities, promote innovation and improve academic industry interaction
4. Standardise	- Use, promote standards for design, production and quality control - Promote international welding standard ISO 3834 which is designed exclusively for welding operations
5. Form apex regulatory body	- IIW-India should take proactive action for upgradation of welding technology competence. - Form a multi-disciplinary think tank which will periodically assess / report and make forecast of our competence level and recommend steps for continuous improvement. - Coordinate and synchronise R&D activities with the Govt. and private sector units to avoid duplication of efforts and reduce cost.

7.0 Role of Welding Technology in National Economy

It is important to have a vibrant welding sector since it has significant impact on cost, quality and delivery schedule of various manufacturing industries which in turn will affect the economy. Determining the contribution of welding to the economy directly is not feasible and can only be done indirectly.

Contribution of welding to economy is mainly through the following:

7.1. Welding Intensive Industries – where the output is a welded product as in fabrication industry

7.2. Complementary goods – necessary only for welding such as welding consumables, welding machines etc.

7.3. Auxiliary products – goods also used by other industries besides welding such as gas, gloves etc.

7.4. Employment – direct and indirect

7.5. User industries – which uses welding technology as a support technology say for maintenance.

The total Indian welding market size is estimated to be USD750 Million. The breakup of consumables and equipment is 80:20 ratio. The quantity of Welding consumables used by India is approx. 450k Tonnes per annum.

The market survey reveals that use of SMAW process still exists to a large extent though high productivity processes too are gaining market share. Welding consumable industry is dependent on import of many raw materials including core wires particularly in the high-end segment (approx. 20%). However, dependence of equipment industry on import is much higher – 40-45%. This is an area of concern as it consumes precious foreign exchange and therefore should encourage indigenous developments.

8.0 Conclusion

- It is evident that in order to achieve targeted GDP of 5 trillion USD we have to increase share of manufacturing sector to 25%. Welding productivity coupled with enhanced quality will play a major role in achieving the same.
- We need to give top priority to education and skill development in order to innovate processes and increase productivity.
- We have reasonable level of competence in welding technology. However, these are limited to large and organized sectors of our country. We need to spread this knowledge to MSME sector, academics and R&D organizations to achieve a 'critical mass'.

8.0 Suggestions

- Promote pro-manufacturing policies - Professional Associations like IIW-India should play active role in advocating policy changes to the Government.
- Promote "Make in India" products and enforce quality standards. This will create a healthy image of welding for the youth.
- Create a regulatory body / think tank of multi-disciplinary background for conducting tech audit, study 'successes' and 'gaps' and propose suitable corrective measures.

How the world views India's Technology Development

"Mancur Lloyd Olson, a well-known economist from USA has explained the problem with Technology Development in India as one of cultural inhibitions and not lack of resources- Material, Human, Financial- not even Technological ones. Once the country nurtures and retains its abundant talent, and does so by encouraging innovation and enterprise it becomes technological world power"

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