AM INTERNATIONAL HOLDINGS PRIVATE LIMITED

Businesses trusted by society

Coming of Age with Technology

An Insight into Technology Integration in **Traditional Industries**

Whitepaper II

Traditional industries have prevailed since the settlement of civilizations. However, it is important to acknowledge that the ability of conventional businesses to modernize themselves is the key to their survival.

Consequently, this segment has witnessed repeated metamorphoses, especially at the beginning of every new epoch in human history.

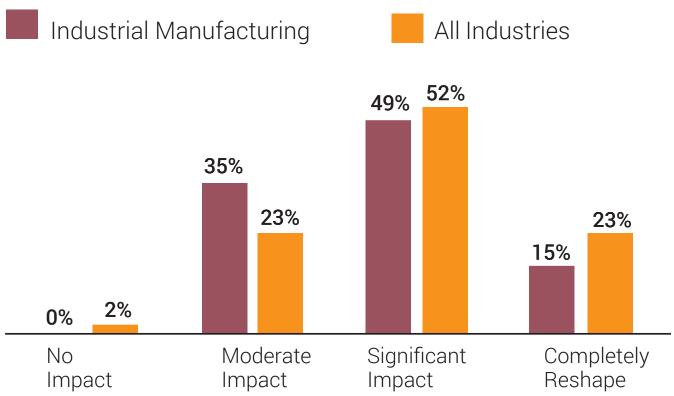
From steam power to IT systems, traditional manufacturers have readily adopted technology to enhance their capabilities. Technology is the driving force in today's world and permeates every aspect of our life today.

In this whitepaper, we examine the need and impact of technology in traditional industries. On one hand, technology can enhance the resourcefulness of businesses through digitalization, leading us to an industry 4.0 On the other hand, it can prove to be a nemesis for players unwilling to adapt.

The world will be home to 9.7 billion people by 2050[1]. Its inhabitants will need to be protected, clothed and fed. Their well-being will require more infrastructure and greater number of consumer products. Mobility of people and goods will increase. Increased life expectancy will demand better healthcare facilities.

Chart I: Impact of Technology on Industrial Manufacturing[4]

To what extent do CEOs think technology will change competition in their industry over the next 5 years?



Given that the basic demands remain unchanged, most of these needs will continue to be catered to by traditional industries. The scope for traditional industries, hence, will remain unparalleled. This also means that conventional players need to integrate technology in their processes to efficiently cater to the rapidly increasing demand. To cite an example, food demand is expected to increase between 59% to 98% by 2050[2].

Since land availability is limited, agriculturists will have to enhance productivity and yields. The fertilizer industry will undeniably play an important role in making this happen.

Conventional players need to integrate technology in their processes to efficiently cater to the rapidly increasing demand.

Presently the fertilizer industry is largely commodity-driven, relying on products that were innovated more than three decades ago3.

The need of the hour is to innovate and improve the uptake of vital nutrients such as nitrogen and phosphorus whilst minimizing run-offs of excessive quantities. Technology will evidently play an important role in accomplishing these goals (refer Chart 1: Impact of Technology on Industrial Manufacturing[4]).

Evolution Demands Progress

Civilization implies advancement; in fact, human evolution is driven by striving towards better living. Conversely, the same progress can cause unprecedented destruction of the natural ecosystem. Fortunately, technology has the ability to stop such obliteration and rein the course of evolution to encompass large-scale betterment. For instance, the application of technology in manufacturing reduced our dependence on natural resources for survival and in fact, led to increased socio-economic prosperity.

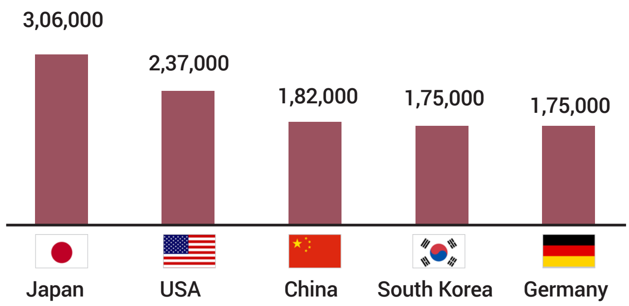
From the use of steam power for mechanization in 1700s to the comprehensive integration of technologies through the use of cyber-physical systems, industrialization has come a long way (refer image 1: Industrial Revolutions[5]). The world today is at the cusp of Industry 4.0 – a German government sponsored vision for advanced manufacturing[6]. In this age of smart production, information and communication technologies (ICT)-based machines, systems and networks

1. http://stats.unctad.org/Dgff2016/DGFF2016.pdf
2. http://onlinelibrary.wiley.com/doi/10.1111/agec.12089/abstract
3. http://gpcafertilizers.com/2015/wp-content/uploads/2015/08/Interview-with-Dr.-Amit-Roy.pdf
4. http://www.pwc.com/gx/en/ceo-agenda/ceosurvey/2017/gx/data-explorer.html?1F000w
5. https://www.strategyand.pwc.com/trends/2016-manufacturing-trends
6. https://industrie4.0.gtai.de/INDUSTRIE40/Navigation/EN/Topics/industrie-4-0.html

Image I: Industrial Revolutions

1800 Industry 1.0	1900 Industry 2.0	1970s Industry 3.0	*Today* 2015+ Industry 4.0	2030+ Digital ecosystem
The invention of mechanical production powered by water and steam started the first industrial revolution	Mass production, with machines powered by electricity and combustion engines Introduction of assembly line	Electronics, IT, and Industrial robotics for advanced automation of production processes Electronics and IT (such as computers) and the internet constitute the beginning of the infromation age	**Digital supply chain** **Smart manufacturing** **Digital products, services and business models** **Data anailytics and action as a core competency**	Flexible and integrated value chain networks Virtualized processes Virtualized customer interface Industry collaboration as a key value driver

Chart 2: Country-wise use of Industrial Robots (Number)



will independently manage industrial production processes by exchanging and responding to information. Keeping with this trend, the number of industrial robots is increasing as are their abilities to perform complex tasks. Between 2013 and 2017, there has been a 58% increase in the application of robotics for manufacturing worldwide (refer Chart 2: Country-wise Use of Industrial Robots). From 1.2 million industrial robots in in 2013, the number is expected to increase to 1.9 million by this year-end[7].

When Technology Meets Tradition

The convergence of technology and traditional industries is inevitable. In fact, the answer to the challenges of the new world lies in technology integration. Traditional industries such as fertilizer manufacturing, petrochemical production, automotive production etc. are known to cause serious environmental concerns. With the application of technology, the manufacturing processes of these essential commodities can be made more efficient and sustainable. Here is an example to understand the correlation better:

Invented in the early 20th century, synthetic nitrogen (N) fertilizer has played a key role in enhancing global food production and in a way, is responsible for the survival of half the world population. However, it is also a leading environmental pollutant and reducing N emission is a central ecological challenge. China is the world's largest producer and consumer of N fertilizers with related-emissions constituting about 7% of the greenhouse gas (GHG) emissions from the entire Chinese economy.

By application of mitigation technological strategies including methane recovery during coal mining, enhancing energy efficiency in fertilizer manufacturing and minimizing N over use in field-level crop rotation, this can be controlled significantly. Research indicates that a combination of these advanced technologies could cut N fertilizer-related emissions by 20-63% and decrease China's GHG emissions by 2-6%[8].

Ensuring Sustainable Relevance

Threats such as global warming and greenhouse effects are attributed to the emission of carbon dioxide (CO2). Manufacturing industries are infamous for emitting huge amounts of CO2 world over. Technology used for carbon capture and utilization can significantly reduce this risk and in fact, contribute to the catering of our growing energy needs. According to research, by 2030 as much as three gigatons of

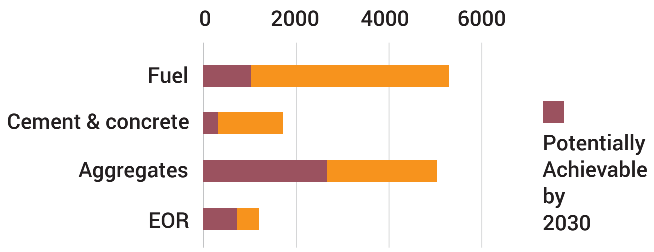
7. https://www.brookings.edu/blog/techtank/2016/06/02/how-technology-is-changing-manufacturing/

8. https://www.ncbi.nlm.nih.gov/pubmed/23671096

CO2 could be consumed by commercial industries such as chemicals, materials and fuels.

This amount is a significant 10% of the global energy-related emissions. Given the potential, the CO2 based product market is expected to grow by 10X times during the period, representing a USD 1 trillion opportunity[9] (refer image 2: Estimated Potential CO2 Use).

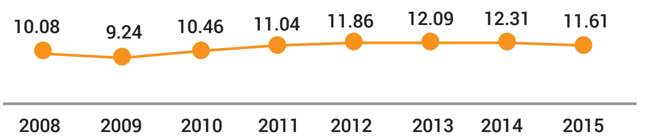
Image 2: Estimated potential CO2 use (Million tons per year)



Source: CO_2 Sciences

Evidently, the integration of technology can help in preserving the relevance of traditional industries and redefining their approach to cater to new-age challenges. In fact, industrial technology is the reason for the resurgence of the manufacturing sector. (refer chart 3: World Manufacturing Output by Value[10]).

Chart 3: World Manufacturing Output by Value (USD Trillion)



Fuelling the Economy by Sweating Existing Assets

One of the driving forces of increased technological integration in traditional industries is the goal of deriving greater value from existing assets and industrial investments. In Germany, for instance, over the next five to ten years, the manufacturing segment is expected to witness a boost in productivity by €90 billion to €150 billion, on the back of large-scale integration of Industry 4.0[11] (refer Image 3: Productivity Gains through Industry 4.0 in Germany). Productivity gains are just an early

Image 3: Productivity Gains through Industry 4.0 in Germany

Sources: Federal Statistical Office of Germany; expert interviews; BCG analysis.

Note: Conversion cost = manufacturing cost excluding material.
[1]Construction of wind parks is included in mechanical engineering (including technical components, tower, and nacelle).
[2]Additional net effect for manufacturing industries, including investments, supplementary to conventional productivity increases.

9. http://www.carboncleansolutions.com/applications/co2-capture-and-utilization
10. 10 https://data.worldbank.org/indicator/NV.IND.MANF.CD
11. https://www.bcgperspectives.com/content/articles/engineered_products_project_business_industry_40_future_productivity_growth_manufacturing_industries/?chapter=3

Image 4: Benefits of Smart Production

benefit of smart production. The processes are also expected to positively affect manufacturing flexibility, product quality and the speed of execution (refer Image 4: Benefits of Smart Production[12]).

In addition, there is bound to be an enhancement of the overall manufacturing environment. To elaborate, automation will enhance occupational safety standards, increase collaborative efficiencies across production networks, optimize the use of limited resources and increase innovative capabilities.

Enhancing the Lifespan of Assets

Technological integration takes various forms. Automation, artificial intelligence, digitalization, robotics, additive manufacturing are all different elements of new-age manufacturing units. To remain competitive in this era of hyper-automation, conventional industries need to up their technological abilities and derive greater benefits from existing assets. Simultaneously, constant innovation in recovery techniques is enabling industrialists to extend the lifespan of old assets. For example, primary and secondary recovery processes applied in conventional oil reserves usually extract only 30% - 35% of the oil in a reservoir, leaving a significant reserve unextracted.

The petrochemical industry has made great advancements in recent times to recover more oil from existing fields through the application of advanced technologies. These techniques can help in extracting an additional 5%-20% of the oil. In fact, with sustained efforts, it may be possible to increase the levels to 50% - 75% and more[13]. Thus, the lifespan of mature fields can witness considerable extension and help in averting the impending energy crisis. While maximizing the productivity of existing assets is important, it is equally vital to assess the operating integrity and safety of the resource. In fact, the approach to assess and ascertain the integrity of ageing assets must develop alongside the lifespan extension technologies.

12. https://www.i-scoop.eu/industry-4-0/

13. http://www.offshore-technology.com/features/featurerecovery-techniques-lifespan-mature-oilfields-shell-engineering-production-assets-integrity-lance-cook-hydrocarbons-wireline-technology/

Shaping the New Economy and Education Systems

Evidently, as technology and manufacturing converge, there is bound to be a spill over on the labour markets. Data from 2010 to 2016 reveals that manufacturing has seen 10% to 20% increase in output, but only a 2% to 5% increase in jobs. According to research, robots and automation have led to tremendous labour cost savings in various industrialized nations. While the average savings hover around ~16%, countries such as South Korea and Japan have reported savings to the tune of 33% and 25% respectively[14]. Evidently, robotics has arrived in true sense of the word and is here to transform the global way of working and manufacturing in profound and inevitable ways.

Over the last three industrial revolutions, we have seen that humans have a tremendous ability to adapt to modernization. For instance, the number of Americans ploughing agricultural fields has dwindled by 31% over the last century (from 33% to 2%) owing to large-scale mechanization of the agronomy. However, during the same period countless unforeseen opportunities and new occupations have materialized owing to the same technological advancements[15].

The current situation is no different – if robots are replacing humans in manufacturing, we will find effective replacements using natural ingenuity. To quote Vijay Kumar, dean of University of Pennsylvania School of Engineering and Applied Science, "The implication that jobs will disappear and not be replaced is, I think, completely false[16]." However, this also means that the curricula in our schools needs to be upgraded and made more practical to cater to the demands of the new economy. Economists need to conduct strategic workforce planning and introduce vocational training, with specific focus on IT, to gear up workers to function efficiently in an automated environment. We cannot possibly resolve the challenges of the new age through old-school strategies.

Technological integration provides tremendous opportunities for progress of individuals, companies and overall economies.

Laggards will be Losers

Technological integration provides tremendous opportunities for progress of individuals, companies and overall economies. However, laggards are likely to be threatened by the pace of progress. Hence, it is very important to adopt a unified approach through the collaboration of industry, educationists, policymakers and socio-economic strategists.

Ultimately, the motive should be to enable the entire stakeholder value-chain to benefit from the advances of technology in industrial manufacturing.

14. https://www.brookings.edu/blog/techtank/2016/06/02/how-technology-is-changing-manufacturing/
15. http://harvardpolitics.com/online/rise-robotic-workforce/
16. http://harvardpolitics.com/online/rise-robotic-workforce/