

OUTCOME DOCUMENT

THE NEW AGE OF GLOBALIZATION DIGITAL MANUFACTURING OPPORTUNITIES FOR INDIA

29TH APRIL 2021



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SECTION I

AGENDA – TIMELINE – BIO OF PANELISTS

In March 2021, the World Economic Forum (WEF) announced the addition of 15 manufacturing facilities to the prestigious [Global Lighthouse Network](#). Two Indian companies were on the list – the Tata Steel facility in Jamshedpur, and the ReNew Power facility in Hubli. This is twice the number of Indian companies on the list: till last year, the Tata Steel facility in Kalinganagar had alone been holding aloft the Indian flag in the Lighthouse network. Many more Indian companies and facilities will likely be added to the WEF list, as several are in the preparation to graduate their manufacturing businesses to becoming new age Industry 4.0-capable.

This is good news for India, as it begins to build its manufacturing capacity, encouraged by global trends and the various [Aatmanirbhar Bharat](#) incentives available. It's also good news globally, as supply chains begin to diversify away from single-source options like China, bringing India, with its lower costs and high-tech capabilities into competitive trading systems. Most importantly, it promises to create new jobs and products while boosting productivity.

The complex array of processes that make this possible – including 3D printing, computer-aided design, data analytics, artificial intelligence, simulation, virtual reality, sophisticated process management and more – are collectively known as Digital Manufacturing.

In India, digital manufacturing has begun in parallel with global efforts. Its most obvious mode of entry has been through multinational companies that are transferring updated technology to their India operations. Schneider, Siemens, ABB and Rockwell are some of the leaders. Their parent companies are among the 69 entities on the WEF's Global Lighthouse Network for effectively integrating digital technologies to enhance manufacturing processes. These companies have long been at the forefront of industrial transformation. China is a clear leader in this pack with 20 facilities.

But Indian multinationals like Tata Steel and Piramal Glass, as also small and medium companies and software start-ups catering to the new manufacturing systems globally, are gaining traction. An ecosystem is being put in place in India, with government-recognised centres assisting MSMEs, the creation of standards and certifications and education. Significantly, India runs the only academic degree course in the world on digital manufacturing, at the Birla Institute for Technology in Pilani, Rajasthan.

This webcast will discuss the potential of Digital Manufacturing in India leading to a new age globalisation of manufacturing, and developing resilient, transparent and trusted supply chains. It will detail the role of MNCs, start-ups and government in accelerating digital adoption, and how it will draw India into the emerging global trading system.

AGENDA

The webinar will focus on the following issues

INDIA ACCELERATING DIGITAL ADOPTION

Objective:

A report by the [United Nations Industrial Development Organization \(UNIDO\)](#), *Industrializing in the digital age* identifies India alongside U.S., U.K, Japan, Singapore, Canada and Australia, as potential pioneers of Advanced Digital Production (ADP) technologies (Industry 4.0). India's strength lies in its diverse business landscape, skilled workforce, low labour costs, young demographics, broad base of English-speakers, robust IT industry and high consumption levels.

The ongoing pandemic has further accelerated digital transformation trends in India and are helping maintain operational continuity across value chains, providing domestic manufacturers wider access to global markets and supply chains. A number of government initiatives aimed at scaling up the Gross Value Added (GVA) contribution of manufacturing to 25% of GDP from the existing 16% are helping. These include, [Make in India](#), [Digital India](#), [Production Linked Incentive scheme](#), and [Smart Advanced Manufacturing and Rapid Transformation Hub \(SAMARTH\)](#).

India's manufacturing sector is a mix of advanced manufacturing MNCs which use high-end automation and a large number of MNCs and SMEs operating at the periphery of Industry 3.0. How can Industry 4.0 help Indian manufacturing leapfrog and insert itself in the global trading system?

GLOBALISED MANUFACTURING & RESILIENCE

Objective:

The on-going trade war between U.S. and China and the pandemic have both reemphasised the urgency for building resilient and agile manufacturing supply chains. Companies that saw digital transformation as an option, now understand it as a business imperative. Digital manufacturing now has the potential not only to create opportunities for a select few but for the entire breadth and depth of the manufacturing sector leading to rapid globalisation of manufacturing that has largely remained China-centric over the past two decades. In response to geo-political headwinds and the adverse impact of highly concentrated supply chains, many countries have recalibrated their strategies. On 25 January, the Biden administration signed an executive order [mandating procurement](#) of *Made in America* goods and services by the government and another on 24 February 2021, ordering a [100 day supply chain review](#).

India too announced the [Aatmanirbhar Bharat](#) aimed at transforming India from being just a passive market to an active manufacturing hub at the heart of global value chains. In April 2020, Japan [set aside ¥ 243.5 billion](#) to help manufacturers shift production out of China. China itself announced a [Dual Circulation](#) policy to boost economic recovery based on domestic consumption. Japan, Australia, India and ASEAN are also promoting cooperation on sharing production data of key industries such as cars and electronics, as the supply chains for such industries are expanding into many countries and regions.

Can digital manufacturing lead the new age globalisation, tied together by resilient, transparent and trusted supply chains? How can MNCs, start-ups and governments leverage digital manufacturing to de-risk supply chains?

FLOW OF WEBCAST

Date: 29 April 2021

Time: 1 hour 10 minutes (5:30pmIST to 6:40pm IST)

OPENING REMARKS

Time: 5:30pm – 5:36pm

Welcome remarks from Gateway House (3 mins)	Manjeet Kripalani , Executive Director and Co-founder, Gateway House
Opening remarks from KAS (3 mins)	Peter Rimmele , Resident Representative to India, Konrad-Adenauer-Stiftung

MODERATED PARTICIPANTS DISCUSSION

Time: 5:36pm – 6:19pm

Moderator	Manjeet Kripalani , Executive Director and Co-founder, Gateway House
Panellists	Sunil Mathur , MD & CEO, Siemens, India Michael Mandel , Chief Economic Strategist at Progressive Policy Institute Rajat Gupta , Senior Partner, McKinsey & Co., Mumbai

AUDIENCE Q&A

Time: 6:19pm – 6:34pm

Moderator	Manjeet Kripalani , Executive Director and Co-founder, Gateway House
Panellists	Sunil Mathur , MD & CEO, Siemens, India Michael Mandel , Chief Economic Strategist at Progressive Policy Institute Rajat Gupta , Senior Partner, McKinsey & Co., Mumbai

CLOSING COMMENTS BY PANELISTS

Time: 6:34pm – 6:37pm

SUMMATION OF DISCUSSION & CLOSING REMARKS

Time: 6:37pm – 6:40pm

Closing remarks from Gateway House	Manjeet Kripalani , Executive Director and Co-founder, Gateway House
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HOUSE RULES AND INTERVENTION GUIDELINES

FLOW OF DISCUSSION

Time: 1 hour 10 minutes

Welcome remarks	3 mins	Welcome remarks by Manjeet Kripalani, Gateway House. Moderator informs participants about flow of the session and house rules
Opening remarks	3 mins	Opening Remarks by Peter Rimmele, Konrad-Adenauer-Stiftung
Moderated discussion	43 mins	Moderator informs participants about flow of the session and house rules. Discussion begins; questions asked to each of the experts on the subject by the Chair
Q&A	15 mins	Audience Q&A
Closing Comment by each panellist	3 mins	Panellists
Closing Remarks	3 mins	Closing remarks by Manjeet Kripalani, Gateway House.

Note:

- Time will be strictly adhered to.
- No Power Point slides, audio or videos permitted.
- Bios will be shared in advance. There will be no formal introductions.

SPEAKING GUIDELINES

Participants in each session must address the policy question presented for discussion. It helps keep the discussion focused and facilitates documenting specific assessments and policy recommendations.

- Designated speakers: Responsible for giving introductory remarks to launch the discussion
- All session participants and delegates: Encouraged to participate during the roundtable discussion.
- We encourage evidence-based interventions.
- We discourage generalized assessments and repetition of facts that are already well-known.
- Please use the raise hand option on Zoom when seeking the Chair's attention to make an intervention.

INFORMATION DISCLOSURE POLICY

This meeting is open to the public.

PARTICIPANTS

Manjeet Kripalani

Executive Director and Co-founder, Gateway House



Manjeet Kripalani was India bureau chief of *Businessweek* magazine from 1996 to 2009. She holds two bachelor's degrees – in law, and English and history – from Bombay University and a master's degree in international affairs from Columbia University, New York. Her political career includes being deputy press secretary to Steve Forbes during his first run in 1995-1996 as Republican candidate for U.S. President in New Jersey and press secretary for independent candidate Meera Sanyal's Lok Sabha election campaign in 2008 and 2014 in Mumbai. She is currently a member of the Center for American Progress' U.S.-India Task Force, a member of the Asian advisory board of the International Centre for Journalists and the Overseas Press Club, and sits on the executive board of Gateway House, the Indian Liberal Group and Emancipation, all non-profit organisations.

Dr. Michael Mandel

Chief Economic Strategist, Progressive Policy Institute, Washington DC



Dr. Michael Mandel is chief economic strategist at the Progressive Policy Institute in Washington DC, senior fellow at the Wharton School (UPenn), and fellow at the Manufacturing Policy Initiative at Indiana University. He was chief economist at BusinessWeek prior to its purchase by Bloomberg. With experience spanning policy, academics, and business, Dr. Mandel has helped lead the public conversation about the economic and business impact of technology for the past two decades. Mandel's seminal analysis showing how ecommerce creates jobs and reduces inequality was featured by the Wall Street Journal, New York Times, Washington Post, Boston Globe, and Financial Times, among others. Mandel argues that Americans suffer from too little innovation, rather than too much. More innovation, especially in "physical" industries such as manufacturing, agriculture, and healthcare, will raise wages and create more good jobs. His current work focuses on the economic benefits of digital manufacturing; job

creation by ecommerce and 5G; pharmaceutical pricing and innovation; and regulation of cross-border data flows. He spearheads PPI's "Investment Heroes" annual report, and tracks App Economy jobs around the world. Mandel has written four books, including the optimistic *Rational Exuberance*. His economics textbook, *Economics: The Basics*, is in its fourth edition. He received a PhD in economics from Harvard University, and taught at NYU's Stern School of Business.

Sunil Mathur

Managing Director and Chief Executive Officer, Siemens Limited



Sunil Mathur is the Managing Director and Chief Executive Officer of Siemens Limited, India since 2014. In this role he is responsible for Siemens in South Asia represented mainly by Bangladesh, Sri Lanka, Nepal & Bhutan. He is currently a Member of the Global Leadership Team of Siemens; a Member of the Board of Siemens Healthcare Private Limited in India and Chairman of Siemens Gamesa Renewable Power Private Ltd in India. He has been with Siemens for over 30 years, holding several Senior Management positions in Germany, where he worked in the Power Generation Division as also as Chief Financial Officer of a Global Business Unit in the Industrial Automation Division of the Company. Sunil Mathur is on the National Councils of the Confederation of Indian Industry (CII) & Federation of Indian Chambers of Commerce & Industry (FICCI), and is Chairman of the CII Smart Manufacturing Council & past Chairman of CII Western Region. He is also past President of Indo-German Chamber of Commerce and Bombay Chamber of Commerce & Industry.

Peter Rimmele

Resident Representative to India, Konrad-Adenauer-Stiftung



Peter Max Rimmele is currently the Resident Representative of Konrad Adenauer-Stiftung Office, India. He has a First Law Degree from Freiburg University, as well as a Second Law Degree from the Ministry of Justice Baden-Württemberg, Germany and a M.A. in Geography. After working as a jurist, judge and lecturer, he took public office as Ministerialrat, Head of Division at the State Ministry of the Interior in Saxony, Germany, from November 1991 on until 2000. There he first served in the Police and Security and later in the Local Government Department. On behalf of the German Foreign Ministry he served in East Timor as Registrar General, Head of Civil Registry and Notary Services (UNTAET), and became later the principal Advisor for Governance Reform for GIZ (German International Cooperation) to the Ministry of Administrative Reform and the Anti-Corruption-Commission of the Republic of Indonesia, where he served for 7 years. He then moved to Rwanda, also as Principal Advisor Good Governance/Justice Program. Earlier he was Resident Representative Lebanon, Director of Rule of Law Program Middle East North Africa, Konrad-Adenauer Stiftung.

Rajat Gupta

Senior Partner, McKinsey & Co., Mumbai



Rajat is a leader in McKinsey's global energy and materials sector. Since joining McKinsey, Rajat has lived on three continents and served clients in 15 countries, including China, India, Indonesia, the Netherlands, South Africa, Thailand, the United Kingdom, and the United States. He leads McKinsey's energy and materials work in Asia, helping companies in emerging markets transform their performance, achieve breakout growth, and become global leaders. He leads McKinsey's relationships with two of India's top five conglomerates, serving them across the globe. Rajat also leads the firm's work with the central government, working across multiple ministries—such as those for aviation, railways, roads, and shipping—on major programs and transformations. He brings particular expertise in operational transformations and change programs, leveraging digital tools in these areas. He is on the board of the Indian think tank CSTEP and the governing

board of the Childline India Foundation. Rajat leads McKinsey's social-responsibility efforts through Generation, the world's largest demand-driven skilling initiative, and is a member of the McKinsey Global Institute advisory council.

OBSERVERS

- Pankaj Madan, Deputy Head - India Office, Konrad-Adenauer-Stiftung
- Neha Aneja, Executive Assistant to Representative to India, Konrad-Adenauer-Stiftung
- Simran Dhingra, Research Officer, Konrad-Adenauer-Stiftung
- Ashish Gupta, Research Officer, Konrad-Adenauer-Stiftung
- Prableen Kaur, Accounts Officer, Konrad-Adenauer-Stiftung
- Kripal Singh Rawat, Accounts Officer, Konrad-Adenauer-Stiftung
- Cdr. Amrut Godbole, Indian Navy Fellow, Gateway House
- Sameer Patil, Fellow, International Security Studies, Gateway House
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- Arun D'Souza – Administration, Gateway House
- Kunal Thakkar, Researcher, Gateway House
- Kartik Astha, Researcher, Gateway House
- Saloni Rao, Intern, Gateway House
- Saeed Faridi, Intern, Gateway House

SECTION II

KEY FINDINGS

- ❖ **Pandemic and digital adoption:** Digital manufacturing has the potential to revive the pandemic-ridden economies in India and across the world. The pandemic has accelerated digital transformation of the manufacturing sector in India. It is not deep, as it is in the West or China, but is developing breadth and depth. Digital connectivity, especially in manufacturing, is helping in overcoming supply chain constraints, adding resilience to operations.

- ❖ **Compulsion for Digital Co-operation:** Co-operation between like-minded nations like India and Germany in Digital Manufacturing can cushion many of the problems that most Western countries face – like ageing work force and loss of institutional knowledge. The West will need to collaborate to transfer most recent technologies to local Indian operations, and avoid monopolization of supply chains. China invested \$13 billion in EU countries, mostly in mergers and acquisitions, while minimal new infrastructure was created. These M&As are designed to support the *Made in China 2025* strategy to become a superpower in smart manufacturing, digitisation and emerging technologies, leaving foreign competitors behind.

- ❖ **Technology for the factory floor:** The simultaneous maturation of a range of technologies and their affordability is driving digitization of factory floors. Artificial intelligence, machine learning, additive manufacturing and 3D, digital twins, e-commerce and GPS tracking – these accelerate decision-making, prototyping, maintenance support, safety, logistics and market access. Accelerated digital adoption provides flexibility in operations, better asset utilization and cost savings as well as higher quality and productivity.

- ❖ **Starting right:** Only 1/6th of the manufacturers that embark on digital transformation, succeed. The key is to identify the correct starting point.
 - (i) **Go Micro.** Breakdown the manufacturing process into smaller stacks ([building the new manufacturing stack](#)). This makes problem-solving manageable and easier.

 - (ii) **Focus on Value Creation.** Create value in business transformation. For instance, an Indian steel-maker improved yields from 80% to 99.5% in six weeks through data-driven digital intelligence, a time-consuming job for the in-house process engineer. In the Siemens' Amberg facility in Germany, productivity improved 1400% over 10 years using the same process.

 - (iii) **Leverage existing digital infrastructure.** Manufacturers must leverage existing digital infrastructure and integrate it with new digital tools to improve decision-making and control over the factory floor. This will generate confidence for scaling up digital transformation.

 - (iv) **Build capabilities.** “For every dollar invested in technology, a dollar must be invested in upgrading capability.” No outsourcing to tech experts: In-house engineers are best, invested in organizational success and their contribution to it, backed by sound process expertise. Short classroom training on data science combined with extensive on-the-job learnings is key to capability building.

 - (v) **Scale-up.** Escape pilot purgatory and scale-up by devoting adequate resources, use cases and management focus to enhance the company's digital transformation vision and journey.

 - (vi) **The Micro-factory.** Big factories are “a thing of the past” and can be replaced by a central platform, with tailor-made micro factories in regions where consumers are.

❖ **Opportunities for Indian manufacturing.** India wants to increase manufacturing from 16% to 25% of GDP. This translates into an additional consumption of \$800 billion of manufactured goods requiring capital expenditure of \$1.5 trillion in the next five to seven years. Not too many countries in the world are looking at this volume of capital expenditure. India can attract foreign manufacturers to serve the local market, drive exports and help local job creation (as Amazon did). The Productivity Linked Incentive schemes will help. Indian industry, reticent about digital adoption two years ago, now sees it as an imperative, including the SMEs.

❖ **Challenges for Indian manufacturing.** Indian manufactured goods have a 5%-15% cost disadvantage, mostly due to high costs of logistics, infrastructure, power, productivity of labour and land availability. Digital adoption can bridge the cost disadvantage – in three years, process manufacturing can be 6%-7% more competitive.

❖ **Recommendations**

(i) India's near-term advantage in software skills will not last long; imperative to overcome issues of logistics, land, labour and affordable power for long-term competitiveness.

(ii) Foreign MNCs must follow the example of Siemens in bringing in new technology to their local manufacturing operations.

(iii) Resilience is necessary, through policy intervention. India must work with like-minded countries to evolve strategic manufacturing policies and supply chains backed by digital technology.

❖ **The future of Industrial Revolution** Industry 4.0 will further expand to: -

(i) Bio-science, bio-genetics and healthcare;

(ii) Agriculture;

(iii) Decarbonisation;

(iv) Digital inclusivity and equality.

SECTION III

WEBINAR TRANSCRIPT

Introduction:

Manjeet Kripalani:

- Good evening and welcome to the seventh Gateway House-KAS webcast. In all the gloom of COVID-19 around us, I have the pleasure of introducing a panel of experts to discuss a very optimistic and successful trend taking place in India of digital manufacturing.
- Some of you may remember the Deming Prize that all Indian companies vied to get. The 21st century equivalent is being part of the Lighthouse Network, a recognition from the World Economic Forum, for companies that have successfully digitized their manufacturing and are prepared for the future. There are 69 such companies around the world, and this month, India doubled its count from one to three.
- To discuss this, we have an excellent group of experts. Sunil Mathur, the CEO of Siemens India, which has transformed a brownfield facility into a digitized one; Rajat Gupta, McKinsey, who has led some of these transformative Industry 4.0 initiatives and Michael Mandel, of the Progressive Policy Institute in Washington D.C., who led the global research on digital manufacturing and created the manufacturing stack, which explains how this all works.
- We will run the discussion for about 40 minutes, followed by 15 minutes of audience Q&A. Please send in your questions in the chat box and I request you to mute yourselves during the discussion. Gentlemen, I look forward to our discussion but before that I request Peter Rimmele, the Resident Representative of the Konrad Adenauer Foundation to India to make opening remarks.

Opening Remarks:

Peter Rimmele:

- Thank you. In the current times of crisis, nobody will doubt that many have described globalization as moving in slow motion. However, I would rather argue that globalization has moved towards digital inclusion, and has actually even accelerated in the midst of this new digital revolution.
- We are currently witnessing ever-increasing numbers of digital interventions and tools, allowing people from all corners of the world to connect and communicate quickly, easily, and efficiently from the comfort of their homes, providing us with the opportunity for deeper and stronger collaboration than at any other time in human history.
- For every obstacle to globalisation, it seems there is a catalyst for a new kind of connectivity. Companies need to understand and adapt swiftly to these new realities if they are to remain competitive in the global marketplace, instead of being left in the dust.
- If this global crisis has shown us one thing, it is that digital is no longer optional. Recent global supply chain disruptions and the subsequent realization of the necessity for greater supply chain diversification are driving an acute need for quantitative and qualitative growth amid shifts in supply, demand and customer expectations for digital first experiences.
- An excellent example of what companies can accomplish is what Siemens Germany is doing on the innovation front. I'm certain that Mr. Mathur, who is here with us today, will be able to provide us with many more valuable, in-depth insights on this. In 2010 the company started digitizing its own manufacturing plant in Hamburg in Germany, Bavaria. Over the next decade, the factory evolved from 25% digital to 75%. During this relatively short period of time, productivity improved by an astonishing 1400 percent. Before embarking towards digitization, the factory could produce five products only. 12 months after its increased digitization, the

factory was able to produce 1300 different products, with a capacity to produce 9000 in total. So that is just an example.

- Siemens is also a textbook example of the need to collaborate and share know-how with other companies, operating within like-minded democracies. I consider the cooperation between Germany and India in the digital manufacturing sector even more of an imperative as the subcontinent can cushion many of the problems that most Western countries face, such as an aging workforce. To prevent the brain drain and the loss of institutional knowledge as large parts of the workforce will soon be retiring, manufacturers in Europe and the U.S. will need to step up cooperation with partners located in countries with a younger demographic structure such as India and continue on an even larger scale to transfer their most-recent technologies to local Indian operations.
- Moreover, this devastating pandemic has reminded us that we need to diversify our global supply chains away from monopolies that have already formed especially in China, and that we must prevent the formation of such monopolies from occurring in the times that lie ahead. Last year, Chinese companies invested 13 billion dollars in European Union countries, most of which went into mergers and acquisitions, with only a minimal amount going into the creation of new companies. Today's investments and acquisitions continue in this mode and are often part of China's 'Made in China 2025' strategy, through which China plans to become, by hook or by crook, a superpower in smart manufacturing, digitization and emerging technologies, leaving foreign competitors behind.
- Isolationist policies are not the right remedy to effectively challenge the Red Dragon's vision of solely dominating the digital manufacturing sector. Only through cohesive merger and acquisition policies and intensified, as well as more resilient cooperation between democratic nations, will we be able to effectively thwart this perilous dynamic.
- Lastly, let me conclude by reminding you that this new technological revolution will possibly render millions of jobs obsolete, but equally carries the power to create millions of new opportunities and jobs. To quote Adam Neumann, "As the world becomes a more digital place we cannot forget about the human connection." We therefore also have to shoulder the immense moral responsibility to reflect on how this new digital revolution can firstly benefit the majority of humanity and secondly be made sustainable in the long run.
- As the Resident Representative to India of the Konrad Adenauer foundation, and in the spirit of our core value of solidarity, I firmly believe that we must never neglect this social component. However, the experiences of the last year and the current dynamics in the realm of digital manufacturing have me feeling abundantly confident that we can do justice to this responsibility and the challenges that accompany it. One part is certain, and I'm sure we all agree on it: if implemented properly, the digital manufacturing Industry 4.0 could revitalize our pandemic ridden economies and thus, represent a watershed moment towards greater prosperity and equality in India and the rest of the terra firma. After all, John F. Kennedy did say that, "change is the law of life and those who look only to the past or present are certain to miss the future."
- Manjeet will be moderating today's panel discussion which is once again filled to the brim with insightful experts who will broaden our horizons and explore new exciting and innovative ideas and thoughts about the future of India's digital manufacturing sector. Thank you.

Panel Discussion:

Manjeet Kripalani to Sunil Mathur:

- The first question is to you. As Peter said, companies that view digital adoption as an option in the pre-COVID era have now made it a business imperative. What are the lasting changes that you see as a result of this transition in the Indian manufacturing sector? Is this the Sputnik moment for Indian manufacturing?

Sunil Mathur:

- Thank you. That's a very broad question and I think one issue that has really become clear through the pandemic over the last one and a half years is how critical digitalization is not only for manufacturing but the way it's taken over our lives, from an Indian perspective.
- There have been three major focuses that most manufacturing companies, particularly small and medium enterprises, have actually been looking out for. One is flexibility, with the changes that are happening every day, every week, manufacturing organizations will need to be more flexible. Flexibility is one, the other is saving costs, saving capex and saving cash. When you put that all together and underlay it with quality, you get a complete picture really of what digitalization can do.
- India is really at the threshold right now. When you look at the way Indian manufacturing is growing, or is intended to grow through all the different programs, there will be a couple of trends that we will see.
- Collaboration across the entire business chain is the norm now, starting from design right through to delivery and the entire process in between. The silo organizations will disappear and you will have one standard platform. There will be a demand for high-speed secured wireless networks that can really handle high volumes and high velocity of data.
- There has been a very clear feeling of what remote monitoring of operations can actually do: how digital twins on the manufacturing can really make a difference, particularly at a time like this, how remote support from the original equipment will help manufacturers improve the availability of assets, how robotic process automation can really strengthen and take care of areas which were earlier labour-intensive. Artificial intelligence in blockchain technologies will lead to a faster decision making, better accountability, quality and traceability. All of this will be happening at the back end, and this is really India's forte. We've got the software capabilities, and these are things that we are really good at.
- Logistics having a completely different meaning and performance-based logistics will become very critical. In the new world, businesses have learned how critical it is to build the risk and really look at on-shoring versus off-shoring.
- Maybe the size of factories will get much smaller, warehousing strategies are having to change. Out of the experiences we have, I predict issues of additive manufacturing. We are seeing the demand for new parts to be produced really on demand because you can't predict long term anymore. So rapid prototyping-customization and the ability to manufacture small batches of products is going to become critical.
- Cyber security is going to be central to the entire digital story that India is putting together. India is really thinking about all these issues right now. If you look at what a microbe has done in the real world to us, think about what it can do, what havoc it can do if it is pushed into the industrial networks.

Manjeet Kripalani to Michael Mandel:

- Michael, geopolitical issues with China and the ongoing pandemic have made many countries take a closer look at their manufacturing capabilities, as pointed out by Sunil. The U.S., under the Biden administration, is also looking at this. It has announced the "Build Back Better", India has the "Aatmanirbhar" initiative, China has a dual-circulation policy and Japan has incentivized reshoring. Clearly the new era of manufacturing has dawned. What role will digital manufacturing play?

Michael Mandel:

- This is of course a striking time everywhere. As the pandemic gets worse in India, it improves in other parts of the globe, and we grapple simultaneously with increasing production capacity for vaccines while at the same time, as the pandemic ebbs in some parts of the world, seeing a great increase in demand for goods.

- We have not yet finished learning the lessons from this pandemic about what we need to do about supply chains. When I look at the Biden administration's proposal, what is striking is that he proposes to put lots of money into manufacturing in the U.S., but does not actually mention digital manufacturing, which is a surprise to me, at least in the top line of his proposal, which is what we've got so far.
- You know right at this moment people are still grappling with the question of just "how big" and "how much". As Sunil and Peter said, this is an amazing period of transformation. I think we're going to have to learn how to separate out different parts of the production process. We'll talk about this when I talk about the manufacturing stack.
- Design, costs of manufacturing, where you want to do it, the ability to produce materials and goods within your own border has become much more essential. Sunil referred to that as de-risking, which is a great word. It means an awful lot, but in this case, it means that if something really bad happens that you have manufacturing product capabilities of boosting your own manufacturing production very quickly. On the other hand, you don't want to use this as an excuse for isolationism.
- How do you balance out the ability to work hand-in-hand with countries like India, while at the same time having the flexibility to move production from one country to another very quickly? This requires breaking down the production process, the design process, the operation process into pieces that can be shifted very quickly.
- This brings us to the whole China question which is that you don't want to be in a situation where you are held captive to Chinese manufacturers, whether or not that's for consumer goods or for semiconductors or for pharmaceuticals.
- That's really the interesting place where we are at this point, which is that Biden plan looks at creating an office in the U.S. government that talks about essential manufacturing. We have to think about what we mean by essential manufacturing in the digital context without actually going isolationist. That's going to be the key point going forward.

Manjeet Kripalani to Rajat Gupta:

- The World Economic Forum's Global Lighthouse Network has identified 69 manufacturing facilities in China and in the world, and in this, China is a clear leader. India now has three facilities on the list. How have these companies adopted digital and what's different relative to others that have tried but not been as successful?

Rajat Gupta:

- My experience on digitization in manufacturing has been very much in the resource-based process industries or heavy industrial areas like metals, mining, chemicals, refining.
- My own experience on digital at McKinsey: we used to talk about digital and data for 15 years but I saw the impact of this just about four or five years ago where a client of mine had a problem of yield being at 80% for a high value product which means that 20% of the product that was being put in the machine was being wasted.
- Building capability. So, it's not as much about the technology because the technology often is already there. It may be in the next generation as technology changes, but it is about the capability to use that technology and this capability has to be built in-house by companies. It can't be outsourced.
- One, to see if there's enough data. Two, go after the business problem. Three, build capability and four, do it at scale in a programmatic way.

Sunil Mathur:

- Completely agree with Rajat's stance on data. Data is only good if you can interpret it. This is where you really need people who understand how to interpret data.

Manjeet Kripalani to Michael Mandel:

- Can you tell us a little bit about your manufacturing stack? What made you create it? What were you thinking and how did it happen? Where does it stand today?

Michael Mandel:

- We're all familiar with the network stack, which is the ability to think about different layers of the network, whether it's the physical layer, the transport layer or the application layer. This division enables us to divide and conquer in terms of having different companies attack different levels of the stack, make our problems simpler much easier to solve. So, rather than having to deal with the problems of getting bits and bytes from one place to another, we can assume that that problem has been solved and just work on the application layer.
- The same thing is true for manufacturing. When I think about the different layers of manufacturing- you've got the design layer, you've got the cost of manufacturability layer, where you decide how much it's going to cost and where and what can be manufactured, you've got the actual production layer and you can get the logistics layer.
- Part of the reason why the digital journey is so difficult is that companies are having to deal with all these layers at the same time. If we could break it down, it becomes much easier. So, I think that this is a way of thinking about the digital manufacturing problem that will make it easier for Indian companies to join in with the global manufacturing network without having to tackle so many different problems at once.

Manjeet Kripalani to Rajat Gupta:

- You stated “we need to build capabilities and skills too.” Can you describe that a little bit more and how will countries like India actually make that happen?

Rajat Gupta:

- At a micro level, What I have found the most effective in building capabilities is actually a little bit of classroom training.
- My own experience has been that hiring from the outside has not worked right- people will come they won't enjoy it; they won't integrate really well; they will leave. These people who are insiders, they really feel like the companies and corporations have invested in them. That's how I believe capabilities will get made.

Manjeet Kripalani to Sunil Mathur:

- India has announced several PLR production-linked incentive schemes to encourage manufacturing. How can our domestic and international manufacturers in India leverage digital technologies for economies of scale and maximize the benefits so that these government incentives can actually work?

Sunil Mathur:

- The Indian government has stated a very clear objective of growing the share of manufacturing to GDP from roughly 15% to 25%. Now what does that exactly mean? It means effectively, a capex (capital expenditure) investment over the next five to seven years of close to one and a half billion dollars right now, if we are looking at those kinds of volumes.
- The capex that India operates with is not going to be adequate to support as a business plan, to support only the consumption in India. We're going to have to export. When we start exporting, who are the competition that we are dealing with? All the international players. What are they doing? Digitalization of manufacturing. So what's happening over there is that we are slowly, whether we like it or not, we will have to go for digitalization in the manufacturing process.

- That's why the move of the PLI (Production Linked Incentive) system of the government is a very strategic move, to slowly start incentivizing Indian industry to start thinking about manufacturing.
- We are going to have to start improving the infrastructure.
- This is where industry 4.0 and digitalization becomes so central and so critical to the overall plan of achieving the target or the vision of the government of going from 15% of GDP to 25% of GDP.
- The PLI scheme is a good initiative from the government but industry is going to have to do a lot more to step up and digitalization is going to be the centre of that of that initiative.

Manjeet Kripalani to Rajat Gupta:

- Is the Industry cognizant and getting prepared for what Sunil just states?

Rajat Gupta:

- The Industries in the last two years have become much more receptive. They have seen the benefits of digitalization. Costs can be reduced tremendously - this is what Indian industry and particularly small and medium enterprises are slowly beginning to realize.
- Until yesterday digitalization was only for the big boys and now small and medium enterprises are beginning to ask the question, how can I save cash? How can I save costs? How can I save capex?

Manjeet Kripalani to Michael Mandel:

- There's the common perception that industry 4.0 will lead to loss of jobs. What can India and other developing countries, even the United States do to create well-paying jobs?

Michael Mandel:

- When you expand markets, you expand jobs, a country that moves share of manufacturing from 15 percent to 25 of GDP is going to create more jobs.
- I've actually written papers about the distributed manufacturing creating jobs around the world in places that did not have them before. In terms of manufacturing, now the proof point for this in the U.S. is actually Amazon and logistics, which is that Amazon roboticized the distribution process and was actually able to create demand and create jobs which weren't there before.
- Customized Manufacturing can create jobs that were not there before, because people are getting products that they could not get before. If you ask yourself the question, "what do you not have because it's too expensive?", and the flip side of that is, what jobs can be created by making things cheaper that are not available now.
- I'm actually firmly of the view that as digitization moves into the physical industries, we're actually seeing job creation as opposed to job destruction in terms of what the ultimate end is going to be. At this point now, there's no evidence against that. We don't have a shortage of jobs in the U.S., in fact right now we're seeing a shortage of workers.

Manjeet Kripalani:

- A question to all. We are now at the fourth industrial revolution and we haven't even quite got there. What is on the horizon for the fifth?

Michael Mandel:

- We're moving into a biotech boom globally.
- India has the opportunity of being a full participant in the coming biotech revolution that has been delayed for 20 years for a variety of reasons.
- What I consider is not simply digitization in the context of steel or in the process of heavy machinery, but digitization in the process of biotech products of various sorts where India clearly has the opportunity to be a leader.

- The U.S. needs to do more to help India at this point in terms of opening up the India supply chains, opening up some of the production processes, buying out some patents is absolutely essential.
- Going for digitization, Industry 5.0 is the bio revolution. There's still a lot of resistance in the U.S., on the patents side with the transition from Trump to Biden.
- The Progressive Policy Institute has come out in favour of patent buyouts, which is one way to get from here to there.

Sunil Mathur:

- I wouldn't like to move towards the fifth-grade revolution at this point in time, because the fourth revolution is going to open up avenues that don't exist today.
- The fifth revolution will emerge as we get halfway through the fourth revolution bringing a whole lot of new avenues and a completely different horizon.
- Biogenetics is a whole new area building up as well and the issue of healthcare will be entirely different. Issues of decarbonisation will play a much greater role, issues of healthcare affordability are going to play a completely different role.

Rajat Gupta:

- As Sunil said, one of the major trends that will rule the world in the next 20 or 30 years is going to be decarbonisation.
- There will be a whole host of industries that will come in place like solar industries emerged in the last 10 years.

Manjeet Kripalani:

- Sunil, can the PLI scheme be extended more to sectors like services in which India is strong?

Sunil Mathur:

- India has announced that it wants to be a manufacturing hub. The PLI scheme is basically promoting that intent as far as services are concerned. We are also a very significant player in the global arena and therefore incentivizing that further may not necessarily make sense.
- I do believe we have the capability to be the front office of the world in in the area of services.
- The PLI scheme is not the ideal scheme for that but there possibly needs to be some kind of a scheme, perhaps even a central scheme.

Manjeet Kripalani:

- Thank you all. This has been a terrific discussion, we thought we learned something about digital manufacturing from our paper but we've learned so much more in this discussion with all of you.