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Tel: 0124 - 4822222
Fax: 0124 – 2380694

BENGALURU
205-207, Sree Complex
(Opposite RBANMS Ground)
#73, St John's Road,
Bangalore – 560 042
Tel: +91 (80) 4341 2000,
Fax: +91 (80) 2350 7971

MUMBAI
404, Trade Square,
Mehra Industries
Compound Safed Pool,
Sakinaka, Andheri East,
Mumbai – 400072
Mobile: +91 9969424024

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Shubhendu Parth

Healthtech startups need **a helping hand – from government**

Technology has good news for those with movement-related physical disability. Researchers have improved neural control of robotic prosthetics and wearable exoskeleton. This is a big achievement because, despite the promise of powered limb prostheses, the controllers were not able to assist the users in several activities that required continuous control of prosthetic joints according to human states and environments.

Researchers from North Carolina State University and University of North Carolina were able to use the direct, continuous electromyographic (dEMG) signals to control a powered prosthetic ankle of a person with his thoughts. This was the first attempt to demonstrate the feasibility and potential for dEMG control of a powered prosthetic ankle, combined with PT-guided training, to enhance standing postural control across various contexts and tasks.

In another study, a number of medical research institutions in Texas, led by a team at the University of Houston, have developed a system that combines a brain-computer interface (BCI) and a robotic arm that responds to the intentions of treated patients. The system showed an impressive ability to improve arm and hand movements in patients who have stopped seeing benefits from conventional stroke rehab therapy.

In a similar breakthrough in healthtech, the US Food and Drug Administration (FDA) granted De Novo market authorization to US-based Neurolutions for its upper extremity rehabilitation system IpsiHand System. The system has been cleared for use in chronic stroke patients to facilitate muscle re-education through its BCI platform.

A ResearchAndMarkets report indicates that the global wearable robotic exoskeleton market will grow at 32.68% (by value) and 34.01% (by volume) during 2021-31. Every fifth of the 2,68,14,994 people with disabilities in India have movement problems, according to the annual report of the Department of Empowerment of Persons with Disabilities. By successfully hooking up robotic exoskeleton to neural interface for both upper and lower limb controls, researchers have not just brought in smile for these 54 lakh people, but have also opened up the possibility of similar research by deeptech and healthtech startups in India. Unfortunately, the annual report talks more about grant-in-aids and has no mention of any support to any such research programmes.

Now is the time for behaviourial correction by the government; India has both tech prowess and the need for it.

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Pratima Harigunani
maildqindia@cybermedia.co.in

THE TECHNOLOGY BROOM FOR CARBON DUST

There is a famous saying: 'Actions speak louder than words'. Carbon accounting software is the 'action' companies need to take to reduce their carbon footprint

Have you ever come across a hawk in a five-star beach resort that had the hotel's badge? Have you ever passed by a liveried monkey while climbing towards the gates of a boarding school? The sight may appear strange at first, but once you get to know the reason behind choosing this unusual staff, it will all make sense. Who better than a sharp hawk to shoo away the seagulls! Who would save the kids' food from the mischievous hands of rowdy monkeys if not a monkey on guard, appointed and trained by the school itself!

At the risk of comparing technology to animals, let us think about how far we have come on the same lane. Science, tools and tech-enabled innovations have fuelled the rise of capitalism and industrial growth. But they have also endangered the future and safety of this world by adding the weight of carbon emissions on this already-crumbling planet – and through every big and small business activity. But how can one measure the impact of activities that cross the line somewhere? And how can one get a grip on the extent to which a company affects the environment as well as its capacity to help? Well, of course, the answer is technology!

The perpetrator can be the saviour again.

That should explain why carbon accounting software is not an odd word to hear these days. It is beyond lip service or some greenwashing advertisement. It is actual money backing a company's intent to control its carbon impact. After all, software has been helping companies to measure and manage data of all stripes – from supply chains to customer sentiments, refinery value, machine downtime, accident risks and oil leakage. It can, then, measure carbon emission data too, right!

And surely much more.

THE BEST WAY TO STUB OUT THAT CIGARETTE – TRACK IT

A good carbon accounting intervention is designed to achieve the maximum of these four aims – measuring how much company harms or can harm the planet, reporting the emissions to regulators and stakeholders, managing these emissions over a well-laid-out map, and converting the mitigation efforts into tangible numbers through trading in carbon offsets.

For instance, if you are a player in the real estate market, you can choose good accounting software to accurately monitor each building's energy use – and also track onsite and offsite energy areas. You can report this data to compliance authorities. You can find out best ways to reduce or control energy where the tendency of wastage is high or the scope of savings is possible. One can start using this information to manage one's environmental footprint and impact. And this data can also be used for business – in the form of buying or selling carbon offsets.

> I THINK IT [REASON FOR SPEND ON CARBON ACCOUNTING] BOILS DOWN TO BRANDING, WHETHER A COMPANY WANTS TO BE SEEN AS PART OF THE SOLUTION VS. PART OF THE PROBLEM.
>
> — **Tani Colbert-Sangree**, Program Officer, GHG Management Institute

Similarly, in almost every kind of industry, the use of carbon accounting solutions can help in accurate and real-time identification of emission spots. One can also convert data into insights that can translate well for risk maps and energy-control decisions. The solutions can further assess one's sustainability stance from a pragmatic and on-ground angle, and businesses can devise and manage better-informed efforts on sustainability – with stakeholders across the value chain. The use of carbon accounting software can be highly useful in maintaining compliance with regard to reporting and disclosures. Furthermore, it can support in engagement in ROI through data for trading in carbon offsets.

According to CleanTechnica, the corporate carbon accounting market is emitting a lot of growth signals, especially as voluntary standards such as Carbon Disclosure Project (CDP) and metrics guidelines such as Sustainability Accounting Standards Board (SASB) gain higher and higher adoption curves. It looks like many leading companies have opted to embrace environmental performance transparency. As many as 42% of the companies above USD 10 billion market cap are already disclosing some climate-relevant information.

No wonder the space is growing at a tremendous pace. By Mordor Intelligence's reckoning, the carbon management system market stood at about USD 10.93 billion in 2020 and is expected to touch USD 21.70 billion by 2026. This can be pegged to many factors but the chief ones are not so hard to guess. There is now a big need to reduce wastage and utilise resources efficiently, no matter why you want to do it – whether for compliance or a profitable business model. Additionally, as governments across the globe keep tightening regulations on carbon emission norms for businesses, the need for continuous monitoring of carbon management would keep exploding.

Another report from MarketsandMarkets shows that the global carbon footprint management market size could easily be seen billowing from USD 9.0 billion in 2020 to USD 12.2 billion in 2025. This is primarily due to the adoption of carbon footprint management software across verticals, emanating from the basic need of adhering to carbon emission compliances. In fact, the report also points to how an increasing span of government initiatives across the world could further provide an impetus to this carbon footprint management market. For instance, look at how the UK has begun the countdown requiring all companies to disclose the climate change impacts of their business by 2025.

Recently, there was some noteworthy buzz in the US on how environmental, social, and governance (ESG) issues are becoming central to the mission of the US Securities and Exchange Commission (SEC), outlining the distinction between 'what is good' and 'what is profitable'. In the near future, rigour could be expected in standardised reporting and mandatory climate disclosures.

Players such as Salesforce, SAP, IBM, ClearTrace, Watershed, Sinai Carbon Footprint, Schneider Electric, Trinity Consultants, Dakota Software, Enviance, ProcessMAP, NativeEnergy, EnergyCAP, Locus Technologies, Ecotrack, and FigBytes have started emerging as the top names on the carbon accounting radar. Similarly the other big names include Accuvio (UK), Envizi (Australia), ENGIE and Enablon (France), IsoMetrix (South Africa), Envirosoft and Intelex (Canada), and Carbon EMS (New Zealand). Their customers reflect a wide

WITHIN END-USER ORGANISATIONS, REDUCING CARBON FOOTPRINT WAS INITIALLY ONLY CHAMPIONED BY MNCS. HOWEVER, THIS IS GETTING PICKED UP BY DOMESTIC COMPANIES TOO.

— DD Mishra, Senior Director Analyst, Gartner

spectrum of companies from IT to financial behemoths to heavy-legacy firms like Babcock International, Microsoft, West Fraser, Brookfield Renewable, JPMorgan Chase, ArcelorMittal, Accenture, CBRE, Cushman & Wakefield, Akamai and Taylor Farms.

Tani Colbert-Sangree, Program Officer, GHG Management Institute, explains what is driving this market. "The Science Based Targets initiative (SBTi) explains many reasons, but, in general, I would say companies have many different drivers – certainly for compliance, as well as for reasons beyond it (such as data for carbon offset market or better branding or building customer trust or cost-reduction mandates). I think it boils down to branding generally, whether a company wants to be seen as part of the solution vs. part of the problem."

Many enterprises invest in carbon accounting software for compliance reasons, argues Dr. Rajesh Kumar Singh, Senior Director, Sphera India. "However, the reasons for enterprises vary according to their maturity in their sustainability strategy and adoption, reaching from reducing risks and costs, increasing brand value to becoming a market leader."

Dr. Singh further adds that the role of carbon accounting is changing as it is the foundational element towards fighting climate change. "Companies cannot only offset their carbon emission (which is the final step in the carbon accounting process). With the increased interest of investors, rating agencies and financial institutions, carbon management as part of the overall ESG data has become an important consideration for the C-level, as it will influence a company's overall rating and access to capital (e.g. BlackRock announcements, especially for Asia Pacific)."

He reasons that to demonstrate leadership and build customer trust, one needs a comprehensive carbon management approach. "Collect and manage data, set targets and run scenario analysis on carbon mitigation, reduce carbon emission by analysing Scope 1-3 emissions, and finally offset what cannot be reduced or avoided. A carbon accounting software offers standardisation, hotspot identification, monitoring and review through intuitive dashboards, and flexibility to respond to various frameworks/standards."

So how much of this possibility or promise is transpiring into action?

NO-SMOKING ROOM, PLEASE!

How much adoption has taken place and how much can we expect in the next two years? And has the technology matured enough for enterprise-grade needs? "Yes, certainly," says Colbert-Sangree. "The largest companies in the world are engaged in carbon accounting. Organisations worth citing here include SBTi, CDP, TCR, and the various initiatives led by CERES and many others."

However, increased adoption due to regulations vary between countries and industries, points out Dr. Singh. "In addition, with the increased interest of investors and one of the key carbon disclosure requirements through CDP, the board level has understood that actions need to be taken and carbon management strategies need to be implemented across the company's operations and divisions." That said, he maintains that sustainability (including carbon accounting) software adoption is on the rise, not just by a few companies, and the mass of the market has advanced in maturity. "It is currently the phase

> USING HYBRID BLOCKCHAIN ENABLES USERS TO SECURE THE IMMUTABILITY OF THE DATA IN THE ENTIRE SUPPLY CHAIN FOR BOTH PRIVATE (CONFIDENTIAL) DATA AND PUBLIC DATA.
>
> **— Antony Welfare,** Executive Director (Enterprise), NEM Software

DID THE PANDEMIC SLOW DOWN CLIMATE CHANGE?

It is interesting to note that contrary to common perception, the planet warmed instead of cooling down during the period of lockdowns and reduced societal activity due to the COVID-19 pandemic for several months last year.

Temperatures over parts of Earth's land surface last spring were about 0.2-0.5 degree Fahrenheit (0.1-0.3 degree Celsius) warmer than what might be expected in the prevailing weather conditions. This effect was high in regions that normally are associated with substantial emissions of aerosols, with the warming reaching about 0.7 degree F (0.37 degree C) over much of the United States and Russia.

This unfolds the complex and often conflicting nature of influences of different types of emissions from power plants, motor vehicles, industrial facilities, and other sources. While aerosols brighten clouds and reflect heat from the Sun back into space, carbon dioxide and other greenhouse gases trap heat near the planet's surface and elevate temperatures.

So while the long-term impact of the pandemic could be to slow down climate change, the immediate impact may be different – due to factors such as aerosols.

Source: A study by the National Center for Atmospheric Research (NCAR)

of 'wild west': more standardisation is likely to happen with increasing importance."

Ron Robins, Founder and Analyst, Investing for the Soul also feels that shareholders, stakeholders and regulators are increasingly requiring companies to track their carbon emissions. "Since most large companies are either reporting or planning to report on their carbon emissions, I can only assume that such software is the way they'll likely handle it."

IS INDIA READY TO TAKE THE SMOKE TEST?

How can India stay behind in this imperative expedition of carbon accounting? And why should it, especially, when we are talking about helping the world and helping businesses in the long-term here.

Sustainability is gaining importance within the global business landscape, surmises DD Mishra, Senior Director Analyst at Gartner. "The way the conversations shape into actions globally will certainly have an impact on Indian businesses. Multinationals will implement the policies globally and demand for sustainable practices will increase. They will look for sustainable suppliers and Indian companies cannot ignore their competitiveness by not being part of it. The time is right for sustainability to take a centre stage in India – this will be beneficial for Indian organisations to stay ahead of these shifts."

Indian enterprises have also started to become cognizant that IT processes (including data centre operations, delivery operations, travel, and electricity consumption) have an impact on carbon footprint. They have initiated steps to track and measure the impact by using various types of digital carbon calculators, illustrates Nisheeth Srivastava, CTIO – India, Capgemini.

> IT IS A GOOD IDEA TO ALREADY HAVE A BLOCKCHAIN-BASED SOLUTION IN PLACE, EVEN IF IN THE FIRST STEP A CENTRALISED SOLUTION IS IMPLEMENTED.
>
> — **Ingo Rübe,** Founder and CEO, KILT Protocol

"At Capgemini, we have developed our own carbon calculator. When a new client engagement commences, based on the configuration of the delivery organisation and corresponding carbon factors, carbon emission estimates are calculated for all the activities, and consolidated carbon emission value estimation reports are generated."

Many large Indian IT services companies are realising sustainability as an opportunity as well as a threat, Mishra echoes. "From a compliance perspective, they cannot choose to ignore it. Many organisations have consciously made sustainability a part of their vision. Within end-user organisations, the focus on reducing carbon footprint was initially only championed by global MNCs. However, this is getting picked up by domestic organisations too. Data centres are one of the key focus areas now. The boundaries between information technology and operations technology are diminishing."

Regarding the outlook on the Indian market and its appetite, Srivastava is quite affirmative. "Organisations, mostly corporates, are keen on getting started on carbon accounting for a variety of reasons including potential cost-cutting implications, alignment with new incoming regulatory requirements, alignment as a supplier to its clients' net-zero requirements, and the opportunity to showcase environmental leadership." He explains how Indian entrepreneurs have started recognising the significance of carbon accounting – undertaking and reporting it in various public forums such as CDP and 'sustainability reports'. The number of organisations formally reporting on climate-change mitigation strategy, emission risk hedging, and carbon accounting has increased every year over the last decade.

ROI VS. RONI: THE RISK OF NOT INVESTING

- A business-as-usual scenario would lead to CO2 levels surpassing four times the pre-industrial levels by 2100. The cost to the US economy of waiting 10 more years before passing policies to reach net-zero emissions by 2050 is huge– based on the calculation of annual costs of replacing fossil fuels with clean energy for transportation, electrification, industry, and building in the US.
- If action begins in 2030, the cost of transitioning to a clean energy economy could be 75 per cent higher than taking action this year – roughly USD 750 billion each year in the 2030 scenario (for a total of about USD 8 trillion). The peak costs amount to USD 320 billion per year if early action is taken (for a total of USD 4.5 trillion).
- If we delay climate policies until 2030, it would mean building nine times more renewable energy capacity per year by the mid-2030s.
- About USD 90 trillion of investment is required to finance sustainable infrastructure and cities in the US. Also, after 2024, fines totalling as much as USD 1-1.5 trillion will be paid in order to meet enforcement of climate standards for emissions reduction.

Source: Energy Innovation Group study; and KPMG's 2020 Study on Climate Accounting

CARBON ACCOUNTING SOFTWARE IS BEYOND LIP SERVICE OR SOME GREENWASHING ADVERTISEMENT. IT IS ACTUAL MONEY BACKING A COMPANY'S INTENT TO CONTROL ITS CARBON IMPACT

CARBON ACCOUNTING RUNGS

SCOPE 1: Direct emissions from owned or controlled sources –apt for O&G majors and industrial companies with direct emissions from production

SCOPE 2: Indirect emissions from the generation of purchased electricity, steam, heating and cooling consumed by the reporting company – relevant mostly for software companies

Scope 3: Indirect emitters with considerable value chains

BLOCKCHAIN, THE UNEXPECTED SENSOR NOSE

There is one more question that needs to be exhaled well here. Are these accounting solutions as good as their siblings in the IT domain? Are they matching up to enterprise-grade needs?

Dr. Singh explains that some technologies are purpose-built and can cover only one use case.

"There are only a few vendors that provide the sustainability knowledge and insights behind the software in order to give an enterprise-grade solution that can help move in the maturity journey from compliance to performance, which will become a differentiating factor in the future." But what is notable here is that mature enterprise solutions address current and evolving reporting requirements and are flexible to scale up and expand to cover additional complexities and scope of emerging metrics. "Such solutions have strong methodological foundations, analytic rigour and reliable verification."

That also leads to another idea or cue – how about using blockchain? After all, injecting more real-time data, decentralisation and transparency would be just the stuff that this space would love. From a quick scan, it looks like there are already players addressing this possibility. There is GreenH2chain, which aims to help customers verify and visualise the entire green hydrogen value chain in real-time. Then there is FlexiDAO, another blockchain platform to track renewable energy generation. Similarly, ClearTrace provides an immutable ledger to measure energy supplies at their source.

Colbert-Sangree avers that carbon accounting solutions can certainly be adapted to use blockchain. "I know of a few companies using blockchain to trade carbon, e.g. Nori." Dr. Singh points out that the blockchain hype has decreased somewhat for the sustainability market, as to begin with, organisations need to take the first steps and have appropriate software solutions in place to cover the more initial functionality. "However, mature software providers today have created additional value propositions in terms of benchmarking against peers, target setting, forecasting, scenario planning, maintaining best practices libraries, etc."

He suggests that due to increasing complexity of environmental impacts and increasing regulation, and growing data volume and investor interest, companies should consider consulting projects to evaluate their starting point and scope of sustainability strategy. "There should be an emerging consensus on including non-financial metrics in mainstream reports such as annual financial report with the same discipline and rigour as financial reporting."

Ingo Rübe, founder and CEO, KILT Protocol explains both the scenarios where blockchain can and cannot be useful. "If a country operates a central entity for measuring and accounting carbon emissions of companies, then the

THERE IS A BIG NEED TO REDUCE WASTAGE AND UTILISE RESOURCES EFFICIENTLY, NO MATTER WHY YOU WANT TO DO IT, WHETHER FOR COMPLIANCE OR A PROFITABLE BUSINESS MODEL

companies have no choice but to trust this central entity. In such a case, it is highly recommended to use a central database for accounting. It is much easier and cheaper to operate than blockchain."

But on a more pragmatic side and the other end of the pendulum, Rübe says that using blockchain generally makes sense when you want to hold or exchange data or value in a trustless environment.

"If a country's concept involves tradable carbon certificates or interaction with other countries, then it might be impossible or very cumbersome to agree on a trusted entity. In such a case, blockchain can replace the trust from an entity with mathematical truth. Governments could issue carbon certificates in limited amounts to companies, which they could trade in a regulated way in a free market, with no central entity involved. Also, cross-border certificates could be issued, allowing carbon measurement and accounting on an international level, without the need for trust between the governments involved."

Antony Welfare, Executive Director (Enterprise), NEM Software points out that using blockchain for carbon accounting is an effective way to ensure trust in the carbon data being used. "Using a hybrid blockchain enables users to secure the immutability of the data in the entire supply chain for both private (confidential) data and public data."

Rübe advises that if a country has plans to open its carbon strategy for certificate trading, or strives to offer its system for an international decentralised roll-out with neighbouring countries, it is surely a good idea to already have a blockchain-based solution in place, even if in the first step a centralised solution is implemented. This prevents from replacing a centralised solution with a decentralised solution during the project.

Yessin Schiegg, CFO, NEAR Foundation, shares a different perspective on the impact side of the blockchain industry. "Even though we are a highly scalable blockchain, those building it are still human, living at the threshold of environmental deterioration/climate change. So we took a proactive step towards environment-friendly, sustainable blockchain development. We partnered with South Pole, a carbon offsetting company headquartered in Zurich, Switzerland, to assess our carbon footprint, advise us on reducing it where possible, and fully compensate the remaining emissions with CO2 offsetting projects going forward." The company has also invested in reforestation efforts in regions such as Colombia and Zimbabwe.

Other than blockchain, AI and data science can also play a key role to help scale such solutions to the next level. AI's ability to deliver deep insights into multiple aspects of a company's carbon footprint offers a promising route for accelerating sustainable transformation and reducing expenses. According to Capgemini Research Institute, AI will likely reduce greenhouse gas (GHG) emissions by 16 per cent and assist industries to fulfil up to 45 per cent of the Paris Agreement targets by 2030.

All in all, the contours of this space can change a lot from the 'how' of the software to the 'why' of these investments. Maybe in just a year or two, we will see more evidence of how carbon accounting is not just an expense but also an investment. After all, there is a huge carbon offset and insurance market that could be a game-changer for companies who are early movers in the field of sustainability.

If not anything else, just feeling responsible, alert and accountable for environmental impact can make a contribution – now that is getting a big monkey off one's back.

Shubhendu Parth
shubhendup@cybermedia.co.in

How Indian football scored a goal, with OKR kicking in

India's sports bodies are not tech-savvy, but AIFF is a trend-setter as it adopts the OKR platform to take football in the country to the next level

If Intel, Google, Microsoft, Uber and Twitter can do it, so can the drivers of football in India. Surprised? We will come to the whole story, but let us take first things first.

The All India Football Federation (AIFF) – the national governing body for the sport that is affiliated to the Asian Football Confederation (AFC) and FIFA, the world governing body for football – governs and runs football from the grassroots to elite football and national teams in the country. In 2013, AIFF decided to adopt modern management practices to create a robust structure for its development programmes and bring in more professional approach to game management and improve India's FIFA ranking.

The result caught the attention of many: the Indian national team improved its ranking from 154 to 97, India qualified for the AFC Asian Cup 2019 in the most emphatic manner by topping its group, it successfully hosted the U-17 World Cup that saw a massive 1.34 million participation, and launched IWL – the professional league for women. Following the success of its four-year strategic plan (2014-17), AIFF decided to launch its second four-year strategic plan in March 2019.

While rolling out the new plan, the federation also analysed the data from the last two and a half years (post digitisation) to identify key success factors and improve the quality of delivery of the development programmes in future. The analysis indicated that even though the first strategic plan had helped AIFF bring about some major changes and new initiatives, there was a lack of alignment since the organisation did not have a proper mechanism of monitoring or tracking the objectives. In fact, the organisation was using MS Word and Excel documents for bi-monthly or quarterly reviews and the task was carried out only before the discussion on the work status. This also led to a lack of ownership at times.

They also found that there was a lot of mismatch and lack of alignment in monitoring and there was no proper way to track goals. Infrequent review meetings not only led to confusion in tracking targets and goal-setting, but also when it came to consistency and ownership. While AIFF wanted to hold reviews more frequently, they couldn't find the time. Travel and other schedules made agreeing on a meeting time difficult, furthering the misalignment.

A lot of research and brainstorming led the teams to explore how some of the big companies including the IT giants were almost always doing things right.

"We needed an impactful monitoring, tracking tool and decided to opt for OKRs [objectives and key results] as part of our endeavour to take Indian Football forward," says AIFF General Secretary Kaushal Das, adding that tracking the progress of the goals on a continuous basis was till then a challenge for them. "There was a lack of ownership and challenge in monitoring the progress of goals and the strategic plan. This was one reason why we knew we had to find a better system."

> AIFF DECIDED TO GO AHEAD WITH THE OKR BECAUSE IT WANTED TO BRING IN MORE TRANSPARENCY IN OPERATION AND IMPROVE COLLABORATION

The solution lay in automating the process using technology and creating a digital framework for defining and tracking objectives and their outcomes. This motivated the sports federation to explore the benefits of adopting OKR software for goal-setting and to track the achievements on a regular, periodic basis.

"We launched our first set of the four-year strategic plan in 2014 and at that time we did not have OKRs. The reviews happened 'as and when' – because it was not a simple task to get everyone involved to agree to one time because of travel and other schedules and accordingly it was not as effective," Das explains.

He adds that AIFF decided to go ahead with the OKR because it wanted to bring in more transparency in operation, improve collaboration, better alignment and accountability. "Inter-departmental goals were a challenge for us. However, the shared OKRs ensured that there was dialogue and engagement between departments to get work done with more efficiency. We were also impressed with the OKR framework provided by Profit.co, which had a mechanism of informing people how their tasks and goals were linked with AIFF's vision and goals.

"As individuals and as a team, we can now discuss how even smaller or bigger objectives can be linked with the bigger picture. It is a lot easier for people to do what they are doing if they know why they are doing it," he says.

According to Das, the software allows the department heads to assign the primary owner for each key result, making individual responsibilities very clear. In cases where significant contribution is required from more than one department to achieve the key result, the task can be assigned to one or more departments with shared ownership. This was a key component for AIFF, which was keen to improve inter-departmental collaboration within the organisation since the 2019-22 plan had seven key strategic goals across 13 core areas, which were identified during the previous plan period.

THE IMPACT OF OKR

The football federation discussed several initiatives while framing the objectives and key results for the period. According the AIFF officials, the OKR has helped the organisation establisha state development department. It has also enabled the organisation createa state gradingsystem to help better support state associations as part of its 'Go Local' goal, offer coaching for referees and specialised courses by European experts in areas such as talent identification, and introduction of a U-17 Girls League. AIFF was also able successfully bid and win the hosting rights for the U-17 FIFA Women's World Cup and the 2022 Women's Asian Cup. AIFF has also keen bid to host the AFC Asian Cup in India in 2027.

Following the OKR rollout and under the new strategic plan, AIFF also launched its revamped website for improved brand communication.It also launched AIFF TV, and despite the pandemic, it became the first sports federation in India to organise on-field sporting events, in October 2020. Additionally, AIFF launched digital programmes and initiatives, created a campaign to bring everyone together, and launched their new motto: 'Indian Football Forward Together'.

"Under the OKR we had planned to develop some e-learning courses in the coming years and COVID-19 acted as an accelerator whereby certain coaching courses are now being conducted online," Das says.

Talking about the return on investment, he indicates that it is still early to fully assess the RoI and impact. "It is normal for companies to take a few quarters before regular implementation of OKRs fully kicksin. However, we have seen positive outcomes as we believe it has provided clarity and structure to the desired outcomes for individuals and teams. It has been witnessed through projects mentioned above which have already been completed," he emphasises.

Das also says that the OKR discussions provided the organisation with a platform to educate everyone about

"WE NEEDED AN IMPACTFUL MONITORING, TRACKING TOOL AND DECIDED TO OPT FOR OKRS AS PART OF OUR ENDEAVOR TO TAKE INDIAN FOOTBALL FORWARD."

— **Kaushal Das,** General Secretary, AIFF

The case file

Organisation name: All India Football Federation (AIFF)

Project name: OKR

Key people involved: Swati Kothari, General Manager, Strategy and Operations; Jai Kumar, Manager, Strategy and Operations; Kishore Taid and Ishan Tyagi, external consultants

Problem and challenges: No precedent of a sports federation or a sports company using OKR, so people had reservations; still inconsistent usage of the tool; regular check-ins and updates on the tool still to be achieved; delay in on-site rollout due to COVID-19

the vision and strategic goals of the AIFF and engage with them on how their objectives can align and help in achieving the overall objective. "OKR helped us create a more structured operational plan for the ongoing strategic plan. The framework stoodout for us because it helps in transparency, especially while having collaborations. OKRs ensure there is a dialogue and engagement between departments to get work done with more efficiency and ownership," he says.

Who uses OKR at AIFF?

Barring a few, mostly everybody in the company is on the software platform – from the coordinator to assistant manager, manager, heads of departments and also the CEO. Overall, around 60 AIFF employees across the country – at the headquarters in Delhi and others working remotely – are on the platform. The exceptions include the technical staff like coaches and the on-field team staff.

ROLLING OUT THE PLATFORM

The vision and the strategic goals were taken as the basis on which discussions were held with various departments on how best AIFF can align and operationalise the strategy by putting in measurable key results and initiatives. The federation also created a department-wise draft that was circulated, and discussions were held with individual departments. Once finalised these were put on the OKR platform.

He says that since multiple rounds of discussions had already taken place on OKRs and they were drafted on Excel, the organisation decided to go for a full-scale rollout with Profit.co, instead of any pilot for proof-of-concept. "However, internally the strategy team continued to review the OKRs, departmentbydepartment,starting with their own to fine-tune the drafting and structure. The process is ongoing," he says emphatically.

The rollout was, however, not without its hiccup. According to Das, in the beginning when the teams were informed about OKR and the companies that use it, there were some reservations. "This was also because we had no example of a sports federation or a sports company using OKRs,So, we had to explain how it can be applied to us."

He also points out that most of the AIFF employees are now aware about their OKRs. "There are people who still have doubts about the tool and the concept, but they know who to reach out to clarify their doubts. We are still in the process of getting people to update on the tool regularly, we haven't achieved that yet," he states, adding thateven though COVID-19 has accelerated certain digital or IT projects, it impacted the OKR platform initiative and has led to delay on-site in plans and activities.

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WFH is here to stay: how to make the most of it

Remote working has a lot of benefits and some drawbacks too. Some tips on how to reorganise people and processes to align with the new realities

Nearly all the surveys conducted recently indicate that remote workingas a trend is here to stay. The world's largest IT companies including Google, Facebook, Twitter, IBM and Microsoft had already announced long back that they would allow a part of their workforce to continue working remotely even after the pandemic is over. Indian IT companies like Infosys, Wipro, TCS and Tech Mahindra have also been working on similar hybrid models. Even the more traditional companies that were earlier sceptical about allowing their employees to work from home have now started realising the benefits.

A recent Gartner survey of 5,000 employees found that service professionals who traditionally did not have many opportunities of WFH are now used to it and like it, and they wish for it to continue at least in some capacity. In another survey of global HR leaders, about 90% said they would continue to allow employees to work remotely, at least part of the time, even after the pandemic is over.

Moving on the road to recovery and renewal, as organisations look for ways to curtail costs and optimise resources, they realise remote working can actually serve as a great tool. Therefore, instead of waiting to return to their old ways, many have started preparing for the 'new normal'. The new generation of workers is seeking far more flexibility and openness in their workplace. Employers will have to accept the new expectations of employees as well as customers. They will have to ramp up existing work structures to align with the changing situation.

As WFH models continue to evolve and gain wider acceptance, the resources, policies and work processes will have to be planned accordingly. Here are some critical factors that must be considered to make WFH more effective for your organisation.

Communication and collaboration: The success of working remotely depends largely on how well the team is able to collaborate and work together. While there are a number of immersive technologies and collaborative tools available for this purpose, a lot actually depends on the approach and attitude of team members. People who are more proactive and responsive usually continue to perform the same way even if they're operating remotely. However, there could be some individuals who are not so communicativeby nature and may not be able to deliver despite constant nudging and follow-ups. Therefore, roles and responsibilities have to be allocated accordingly. Special training sessions can be organised to help employees cope with the new ways of working.

NEW-GENERATION WORKERS SEEK FLEXIBILITY AND OPENNESS IN THEIR WORKPLACE. EMPLOYERS WILL HAVE TO ACCEPT THE NEW EXPECTATIONS OF EMPLOYEES AS Wwell AS CUSTOMERS.

> UNLESS THERE IS A REAL CHANGE IN THE MINDSETS AND ATTITUDES OF EMPLOYERS, UNLESS THEY OPENLY ACCEPT THE CHANGING TRENDS, WFH MODELS WILL NOT WORK FOR THEM.

Change in mindset: Companies that were traditionally opposed to the idea of WFH have started opening up especially after their experience through the pandemic, where they got to see that remote working can actually work without affecting the performance or productivity of employees. While many have realised that their fears were unfounded, many still continue to hold strong beliefs against remote working and are keen to get back to their earlier ways. Even if such companies are forced by circumstances to continue with the WFH option, their biases would come in the way of the career and growth of employees. Unless there is a real change in the mindsets and attitudes of employers, unless they openly accept the changing trends and allow their systems to be modified, WFH models will not work for them.

The trust factor: Just as there are organisations with biases against WFH, there are employees who are equally afraid of switching to remote working as they do not trust this new format. They are not sure if they will be treated at the same level and are constantly worried about the advantages in-office workers might have. Will they consider me an important part of the team and treat me equally? What if they feel I'm not working hard enough? Such fears and lack of confidence among people can create unnecessary conflicts and infighting among employees, which can be quite detrimental for the growth of any organisation. HR managers would have to continuously work at resolving such issues and encouraging employees to embrace the new systems in a positive way.

New work structures: An organisation that wasn't traditionally used to the WFH option would have to work on multiple aspects to make it properly functional. Apart from dealing with cultural issues, it will have to redefine existing processes and create new work structures to accommodate remote working. Workforce planning, performance management, finance, and administration will all have to be re-evaluated to ensure they are well aligned with the new work structure. Online apps and remote monitoring tools can also be used to keep track of the productivity and performance of employees.

Employee engagement and motivation: Despite all the benefits that WFH offers, it brings along a number of other people-related challenges that HR leaders would have to address. A regular office structure provides a certain routine and work environment that automatically keeps one active and agile. You can hop across to a colleague, have an informal chat and discuss ideas without having to plan a formal meeting. Many such little things, which we take for granted while working in office, are missing while working from home. As a result, many employees may suffer from loneliness and depression. Office hours and personal time often get merged into one another, causing undue stress and fatigue. HR leaders must understand the emotional and personal needs of employees and find ways to keep them engaged and motivated.

Finally, the success of WFH will entirely depend on how well an organisation can reorganise its people and processes to align with the new order. There are no standard rules or procedures that can be replicated across different organisations. The canvas is open for you to experiment and innovate to create your own models. The real challenge would be to adapt to the changed environment, while preserving and enhancing the culture and values of your organisation.

Shweta is former Executive Editor, Dataquest and an independent content development professional

Pratima Harigunani
maildqindia@cybermedia.co.in

Meet the **Superman on tap**

It's the next wave in computing, offering unimaginable power of problem-solving. Organisations, however, will have to carefully consider business models

T-Rex at right swipe. Genie in a bottle-cap. Potter's invisible cloak on rent. No matter how you try to explain it, nothing conjures up the sheer scale and surreal wonder of QaaS better than just saying it as it is – Quantum as a Service or QaaS.

Quantum! The word is enough to convey how elusive these machines can be. We know why quantum computers draw so much fascination and curiosity. They are way past classical computers and even supercomputers due to their 'quantum' advantage. Physics has manifested so brilliantly in the world of technology that it is hard to imagine that we were content working with bits and bytes just a few months back. Bits meant zero or one – in classical computing. But in quantum world, there can be two states that exist simultaneously (0 and 1 at the same time). This happens thanks to the superposition principle of quantum physics. What follows is a tremendous spike in processing power than was possible with the 0 or 1 representation of data.

QaaS is not just another alphabet soup. Unlike servers, infrastructure and data-centre hardware that easily and brilliantly fit into the cloud model, quantum computers are too huge or complex to shrink in a cloud bubble-wrap. And yet it looks like a natural course that this giant turning point in technology had to take.

Now that qubits are in the game and now that entanglement, superimpositions and two-state computing are not just possible, but practical; who would not want to exploit the immense speed and scale of calculations that quantum computers pack?

Except that it is not that easy to whip up a quantum computer. It's a complex exercise and the task of maintaining stability of quantum states is riddled with issues around hardware, super-cooling requirements and costs.

Maybe, that's why QaaS make so much sense. Spare yourself the expense and headaches of maintaining a quantum computing infrastructure and just use it the

"CHEMISTRY, COMPLEX OPTIMISATION PROBLEMS (FOR INDUSTRIES LIKE FINANCE), AND ML ARE MAIN AREAS OF FOCUS. WE HAVE A NUMBER OF EXAMPLES IN THESE AREAS."

— **Gargi Dasgupta,** Director, IBM Research India & CTO, IBM India South Asia

way you have used infrastructure on cloud. You have a problem or application which needs massive computer muscle? Just assign it to a QaaS facility and it will spit out quick and actionable results in the blink of an eye (almost) – without you needing to entangle yourself in all the investment and wiring.

Is it a perfect microwave for enterprises? Yes and no.

CLOUD BUT NOT CLOUDY

Yes, there is a huge potential expected from Quantum Computing and QaaS model, affirms Kalyanaraman K, MD, Protiviti Member Firm for India. "It is going to drive that potential to make it accessible for the benefit of the world in solving complex problems, which probably would not have been possible in the case of current classic computers."

R Ray Wang, Principal Analyst, Founder, and Chairman of Constellation Research Inc., unravels the positive side of this new current gaining force in enterprise industry. "The plus side is the scarcity of expertise available in the current commercial market. Also, think of the ever-evolving improvements in technology, and the huge investment of capital." According to him, the market is rapidly evolving and we will see QaaS as part of larger clouds. "AI and automaton would be strong. And in error correction we would witness the biggest advancement."

Similarly, speaking on the recent announcement of the MeitY Quantum Computing Applications Lab, AWS Quantum Computing Director Simone Severini had said that there are a lot of future opportunities that need to be tapped. "It is an early stage for quantum computing and simulation applications. It sounds like a good idea to set up a lab for using quantum computing for accelerating quantum computing-led research and development (R&D) in India. This will be a service that government ministries and departments, researchers, scientists, academia, and developers can tap whenever they need it."

Ajay Sawhney, Secretary, MeitY, had remarked that start-ups and young companies can definitely use such avenues to get started on quantum computing with a simple offering. "Quantum is at a nascent stage in the country. It is important to make access available to the young segments and give them a taste of what is possible so that they can actually experiment and build solutions

"AS OF NOW, THE ONLY VIABLE MODEL WE SEE TO HARNESS QUANTUM COMPUTERS IS THROUGH THE CLOUD ACCESS MODEL OR MAKING IT AS A SERVICE."

— **Kalyanaraman K,** MD, Protiviti Member Firm for India

"THERE ARE A LOT OF FUTURE OPPORTUNITIES THAT NEED TO BE TAPPED. IT IS AN EARLY STAGE FOR QUANTUM COMPUTING AND SIMULATION APPLICATIONS."

— **Simone Severini,** Director, Quantum Computing, AWS

around it. In quantum computing, there is still a tremendous space that we need to learn about together. Access that is simple and available for widespread utilisation is the right move for progress. We welcome AWS to the Indian ecosystem. It is making continuous investments in India with new regions and zones being added."

According to a report by ResearchandMarkets, while classical (non-quantum) computers make the modern digital world possible, there are many tasks that cannot be solved using conventional computational methods – and that explains why QaaS can count on a growing market. The report points out reasons like limitations in processing power, or how fourth-generation computers cannot perform multiple computations at one time with one processor. Consider then what happens when a quantum computer is capable of computational feats that are orders of magnitude greater than conventional methods.

So far we have seen how parallel computing is achieved in classical computers via linking processors together. But quantum computers may handle multiple computations with a single processor. And this quantum parallelism emerges as a major difference between hyper-fast quantum computers and speed-limited classical computers.

So the market is expected to grow – or explode, as some may surmise. As per estimates by Allied Market Research, the global enterprise quantum computing market stood at USD 650 million in 2017 and can reach USD 5,853 million by 2025.

The optimisation segment is expected to exhibit significant growth in the global enterprise quantum computing market between 2018 and 2025. Interestingly, Asia-Pacific could turn out to be the fastest growing region for enterprise quantum computing market. This can be explained by the presence of major players and increase in investments by government organisations.

From what Gargi Dasgupta, Director, IBM Research India, and CTO, IBM India South Asia, unravels, the hotspots are interesting. "We've also said that chemistry, complex optimisation problems (for industries like finance), and machine learning are main areas of focus. And we have a number of examples in these areas. But many industries are exploring how quantum computing could impact the big problems they're trying to solve."

As Kalyanaraman says, "All the big players on cloud computing have already started offering quantum computers for scientific research, education, building circuits, developing applications, eco-system, etc. We will be seeing a lot of enterprises working together to potentially bring this quantum computing environment to a more acceptable and compatible model with necessary infrastructure, technologies and skillsets to connect and commercially exploit the quantum computers through the cloud access model. As of now, the only viable model we see to harness quantum computers is through the cloud access model or making it as a service."

BUY OR RENT, NOW OR LATER?

Easy access and simplicity can be great pull-factors for enterprises to look forward to QaaS. And yet, some details need to be ironed out before this world becomes comparable to cloud models.

Wang does not flinch from asking the business question here. "The flipside is ownership today may give some industries a competitive advantage. For example in life science, pharmacy-discovery, you could find a technique

"THE PLUS SIDE IS THE SCARCITY OF EXPERTISE IN THE CURRENT COMMERCIAL MARKET. ALSO, THINK OF THE EVER-EVOLVING IMPROVEMENTS IN TECHNOLOGY AND THE HUGE INVESTMENT."

— R Ray Wang, Principal Analyst, Founder, & Chairman, Constellation Research

that enables faster molecule-to-market or an aerospace company can simulate material science more efficiently and they want to invest for that competitive advantage."

Besides the alternatives that the customer side is confronting, there are questions that even QaaS vendors have not figured out yet. The pace of development in hardware areas is quite quick and slippery with quantum computing. Investing too much in one type may backfire when a new option or configuration pops tomorrow.

Hardware stabilisation does pose a challenge for QaaS providers until quantum computing matures, Wang avers: "However, not if players play it smartly." He cites how Honeywell built its trapped iron H series. Now that should not be as much of an issue.

"Classical hardware does not pose a challenge to using IBM quantum systems over the cloud. The quantum hardware is fundamentally different from the classical computer," Dasgupta reasons as well.

Even if we forget the 'hardware' parts for a while, there are other areas to be untangled. Players are also struggling with the hurdle of 'noise' – which is a recurrent problem with quantum computers. Approaches for reducing interference and instability are being worked out for this challenge. At the same time, they are trying to handle problems around peak-performance variations, errors and optimisation which assume a serious connotation when a quantum computer is served on a QaaS plate.

Interestingly, the constraints themselves can be flexed as a strong route for QaaS too. Kalyanaraman says that significant constraints in quantum computing currently are its heavy capital investment, physical environment and noise-free technology in deploying necessary technology and resources. "Bringing such large investments in the present scenario as a capex model is far-fetched or may not be possible for several large enterprises; leave alone the mid- or small-scale enterprises. When cloud has given the organisations an opex model of using computing power, in no time we will be witnessing the growth of QaaS as the next level of commercial offerings by the cloud providers of the world."

He believes that the world is yet to know more about quantum computers per se. "At this very early stage of evaluating quantum computers for commercial use, the entire technology around it is yet to be fully built in a reliable and sustainable manner, leave alone its technical challenges, economic feasibility, physical and environmental challenges, availability of skilled manpower and related challenges it may bring upon as we progress ahead."

A lot of players started juggling their options and constraints already. While IBM and Google are at it on the core speed and scale race of quantum computing, enterprise giants have started fleshing out the market areas in their own ways. AWS (Braket), D-Wave Systems, Microsoft, IBM Q, Rigetti Computing's Quantum Cloud Service, Intel, Atos and others have their own ponies in the ring now. Atos has even devised a new metric – The Q-Score for measuring quantum performance – that, it says, applies to all programmable quantum processors. It claims that in comparison to qubits, Q-Score provides "explicit, reliable, objective, and comparable results when solving real-world optimisation problems". It has three parameters: application-driven, ease of use, and objectiveness and reliability.

On the chip front too, there is Intel's Horse Ridge II, a move towards scalable quantum computers. The chip,

AS PER ESTIMATES BY ALLIED MARKET RESEARCH, THE GLOBAL ENTERPRISE QUANTUM COMPUTING MARKET STOOD AT USD 650 MILLION IN 2017 AND CAN REACH USD 5,853 MILLION BY 2025.

as stated by Intel, would read qubit states and control several gates simultaneously and enable faster on-chip, low latency qubit state detection. All that could boil down to scalability of quantum computers, which would matter a lot for enterprise-level usage and for QaaS models.

One major factor to reckon here is the pricing model. Would it be on the lines of cloud economics again? Dasgupta answers, "We have not labelled anything as 'QaaS', but access to all of our systems is via the cloud. And organisations in the IBM Quantum Network are IBM clients with cloud access to our premium quantum computers. Regarding pricing, we do not release any contract terms."

Looks like the wave have started forming into a shape. Enterprises are toying with this next wave and the potential is quite appealing for companies in finance, logistics, telecommunications, transportation and pharmaceutical sectors. IDC has augured that 25% of Fortune 500 companies would secure a competitive advantage from quantum computing by 2023. That should be fun and fruitful. But let us not forget that even cloud models are wrestling with problems around economics, sprawl, data integrity, security, migration, integration and skills – even after all these years.

Would QaaS be quite a party then, as simple as playing song requests with just a spin?

T-Rex at right swipe. Genie in a bottle-cap. Potter's invisible cloak on rent. Quantum with a DJ. Sounds better?

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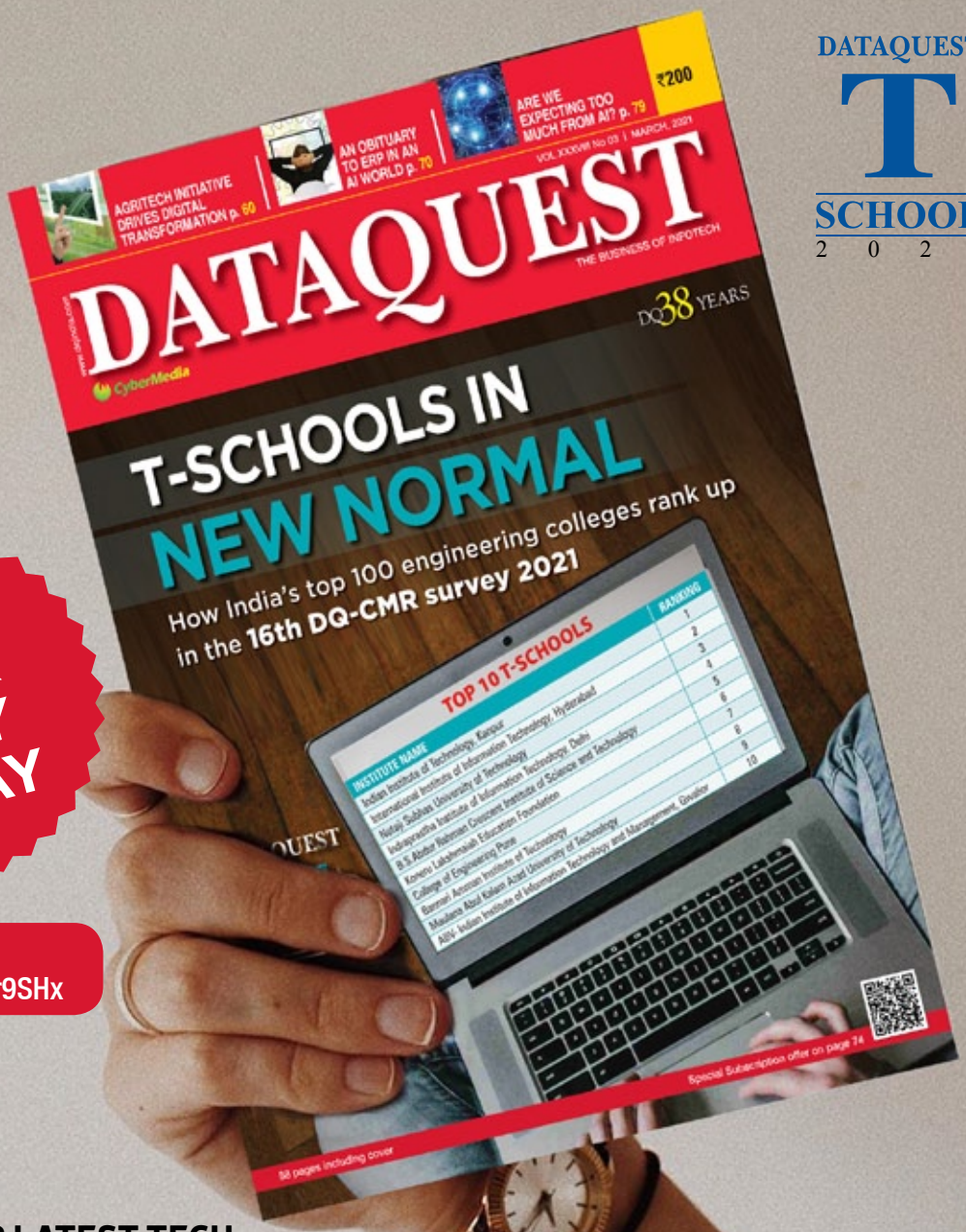

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Pratima Harigunani
maildqindia@cybermedia.co.in

SRIKANTH MANOHARAN
SVP, QA Solutions, Indium Software

THERE IS A TECTONIC SHIFT IN THE QA PARADIGM

How do low-code platforms, APIs, microservices, containers, CI, CD and so on work as dominoes that redefine QA and testing? Indium Software SVP, QA Solutions ***Srikanth Manoharan*** *tells us what happens in a road-test when the car gets new wheels.*

How has QA redefined software delivery and enabled digital transformation in Indian enterprises?

Quality Assurance (QA) has redefined itself as Quality Engineering (QE) due to growing demands in the digital industry, where developers cannot wait for a feedback until QA teams complete testing. They need continuous feedback. Due to the nature of transformational advancements in the digital era where more and more applications are developed as loosely-coupled components such as APIs, microservices, and containers, it has necessitated that testing be done alongside of development. The traditional white-box-based testing is livelier now and is embraced by many QA companies.

How much has changed here with Continuous Integration (CI), Continuous Delivery (CD), micro-services, cloud-based testing, crowd-sourced testing, QAOps, and Black box testing?

Due to CD/CI, microservices architecture etc., there is a tectonic shift in the QA paradigm. QA is now seen as an integral part of development. The feedback cycle is becoming realistic due to QAOps. Cloud has completely taken away the infrastructure related issues, which is a very common issue in the QA space. For example, in the

> CITIZEN-CODERS, LOW-CODE/NO CODE (LCNC) PLATFORMS AND LCNC WITH AI ARE TAKING A BIG LEAP INTO MINIMISING THE DEVELOPMENT EFFORT MULTIFOLD.

THROUGH INSTRUMENTATION OF THE CODE, WE CAN BUILD FAILURE PATTERNS FROM LOGS, AND PROACTIVELY PREDICT AND ALERT THE FAILURE OCCURRENCE IN ANY FINITE SYSTEMS.

good old days the developer would say "It works in my system, not sure why it doesn't work in your system".

Are citizen-coders, AI and automation good news for testers? Where exactly can AI add value to QA?

Citizen-coders, low-code/no code (LCNC) platforms and LCNC with AI are taking a big leap into minimising the development effort multifold. If we were to take anexample from the world of cars, we can compare this trend with traditional human-driven cars vs. the AI-driven cars like Tesla. Though it sounds like a sci-fi movie, it is happening around us. These LCNC platforms are gaining criticism amongst developers reasoning. If something goes wrong, it requires a professional developer to dig deep into the abstracts. The same goes with QA, though these platforms are pre-built, it still requires a fair amount of testing (QA).

AI also offers predictability in any field; it can do the same in QA space. Through instrumentation of the code, we can build failure patterns from the logsand proactively predict and alert the failure occurrence in any finite systems. This facilitates QA to lead from the front with an ability to become proactive than reactive.

Is it pragmatic to balance speed, test coverage, delivery and user interface (UI) enhancement in QA today? What can enterprises embrace to get closer to this tough balance?

Each of these buckets is an indispensable entry in the digital transformation agenda and inclusive in nature. As an analogy, consider a race car. Every aspect of the car is important –powerful engine that delivers speed, aerodynamic design that can withstand the speed, efficient driver who can deliver victory and so on.

So let us talk about speed first. Simply put, speed is an outcome of efficiency; in order to do QA efficiently, we need to break down the application into testable units like API, database queries, and stubs for external entities, etc. In other words, a white-box based test approach that allows you to distribute the testing into multiple hands thereby making the over testing faster and manageable.

Now let us move to test coverage. The genesis of test coverage in IT goes back by two decades or even more. Traditionally we always strive for maximising test coverage. Nowadays the adage given to testers is to stay optimized in test coverage. Testers should be able to balance between maximum and optimum. Another term that is recently being used in the QA space is code coverage. There are tools like 'sealights' that help QA to score and prove how much of the source code the QA tests cover.

And what about UI?

Nowadays automation tools and framework have become extremely powerful. QA teams should leverage automation for testing UI/UX as they are treated as low-hanging fruits. Many of LCNC vendors have their own automation tool that are integrated with IDE.It is easier to generate UI/UX tests as the UI is developed.

What's your outlook on how QA is evolving today and where it can head next?

In terms of QA, organisations should stay abreast with the dynamic nature of the digital transformation journey by adopting a transformation in the quality space. They should do this by following the flow from QA to QE and Intelligent Quality (IQ).

QA is nothing but our traditional testing methods which still are relevant in some cases. QE covers testing the code as white box, early in the development stage using automation along with devops. And IQ is a measurement-driven assessment using code instrumentation, AI-based prediction on failures to become proactive rather than reactive.

Pratima Harigunani
maildqindia@cybermedia.co.in

Wallet 2021: **Different dots, same picture**

What could lighten both the stress meter and wallet of Indian CIOs? The answer is a set of factors that is not hard to guess – cloud, automation, AI and agility

What is that men hide, and women show? Well, you just need to look where your money is, and you would know. A woman would always carry her purse or handbag in a visible way. A man would have his wallet tucked properly in a pocket. But when it comes to the IT wallet, it is a mystery, no matter what gender or vertical the CIO belongs to. A lot of factors, some totally non-IT-related, can affect the weight and place of this wallet.

The year has begun and guesstimates have started emerging on how heavy and different the IT wallets in India are going to be this time. Let's see if we have a pattern already.

CLOUD, THE MAGNET FOR IT COPPER – NO SURPRISES HERE

We have all been witness to the speed and pervasiveness with which businesses embraced remote working, digital models and hybrid processes during the ongoing pandemic – hinting on the continued momentum towards spending on cloud and adjacent services/solutions.

The latest analysis by 451 Research points out that the Cloud Computing-as-a-Service (CCaaS) market in India will maintain solid growth, exhibiting a compound annual growth rate (CAGR) of 15% from 2019 to 2024. The research report attributes this growth to reasons such as deliberated government support, positive investment climate, thriving ecosystem of technology vendors, and growing interest among the digital enterprise. Interestingly, in 2019, the market for CCaaS in India stood at USD 873 million, growing at a projected rate of 23% YoY in 2020, which is expected to slow down to 11.3% in 2024.

Meanwhile, the Platform-as-a-Service (PaaS) segment would show moderate growth throughout the forecast

> AN ANALYSIS BY 451 RESEARCH SHOWS THAT THE CLOUD COMPUTING-AS-A-SERVICE MARKET IN INDIA WILL MAINTAIN SOLID GROWTH, EXHIBITING A CAGR OF 15% FROM 2019 TO 2024

period of 2019-24, with a CAGR of 10.2%. The shift towards cloud has also shown ripples in the Infrastructure-as-a-Service (IaaS) space – revenue here is expected to exceed the USD 1.2 billion mark by 2024 (fuelled by a CAGR of 16.3% throughout the forecast period of 2019-24). Similarly, cloud archiving, cloud backup and disaster recovery are also feeling the trajectory's effect and cloud Storage-as-a-Service market could peak by 2022.

The enterprise information security and risk management end-user spending in India is likely to touch USD 2.08 billion in 2021, an increase of 9.5% from 2020, as per a recent forecast by Gartner. Here, cloud and integrated risk management will register the highest growth in 2021, up by 251% and 27.8%, respectively. Application security will show a growth of 4.2% (against 1.9% in 2020) and data security would mark a growth of 16.6% (in comparison to 9.4% in 2020). In addition, other information security software that saw a negative growth of 0.8% in 2020 is expected to pep up and reflect a positive growth of 3.8%.

Analysts explain that security leaders had to cut down on their security spending in 2020 because of IT budget cuts. The trend, however, is reversing in 2021. It looks like the pandemic gave a fillip to this shift as organisations moved to the cloud for getting closer to cost efficiency and business continuity. Prateek Bhajanka, senior principal research analyst at Gartner, explains, "Enterprises may have been cloud-averse or cloud-uncomfortable to some extent before. Security was galvanised around the data centre. But now it has moved beyond the physical realm of servers. Now it has to come into action in the coffee café where an employee opens the laptop for a meeting. The space has become hybrid and remote and that is creating big changes for security architecture and approaches."

Gartner also forecasts the IT spending in India to reach USD 88.8 billion in 2021 (up by 6.8% from 2020). In 2020, it had dropped by 2.7% as CIOs prioritised on mission-critical technology and services. The worldwide IT spending, in comparison, is expected to touch USD 3.9 trillion in 2021 (up by 6.2% from 2020).

NTT's 2021 Global Managed Services Report echoes these shifts. It underlines that the pandemic has brought about huge change for many, and enterprises in APAC will continue to broaden their investments in digital transformation. The key word is that it will manifest in spite of what has happened, not because of it.

FROM BUSINESS COFFERS – TO BUSINESS COFFERS

Another point worth noting is that a lot of these spends would find a new level of gravity and interest in the boardrooms. IT spends have ceased to be back-burner topics or necessary evils. They are being discussed in a new language and with a new-found respect.

Agatha Poon, Senior Research Analyst at 451 Research, distils that the pandemic has prompted companies, large

> IT SPENDS HAVE CEASED TO BE BACK-BURNER TOPICS OR NECESSARY EVILS. THEY ARE BEING DISCUSSED IN A NEW LANGUAGE AND WITH A NEW-FOUND RESPECT IN THE BOARDROOMS

> IF 2020 WAS ABOUT FAST-TRACKING PROJECTS OR BEING BRAVE TO ACT ON THINGS GATHERING DUST, 2021 COULD BE ABOUT THESE PROJECTS AND MIND-SETS TAKING DEEPER ROOTS

and small, to reinvent their operations and embrace agile models for business resilience. "While the implications of the pandemic vary from one industry vertical to another, companies in the retail, gaming, manufacturing and fintech sectors have been driving demand for big data, IoT and application migration use cases."

Poon cites RBL Bank and Chai Point – one of the major tea chains with over 100 retail stores in India – as textbook examples. "Following the migration of key systems and custom apps such as ERP, CRM, inventory management system, point-of-sale system, centralised data aggregation and custom analytics system to Amazon Web Services (AWS) virtual private cloud, Chai Point has moved up the value chain by leveraging AWS's IoT platform to provide a cloud-based beverage service called boxC.in, with IoT-enabled tea and coffee dispensers. Meanwhile, RBL Bank has collaborated with AWS to deploy Amazon WorkSpaces. The plan is to extend the remote working option to 1,000-1,200 employees in the post-COVID-19 era."

In NTT's report, what pops in a distinct spot is the way almost 40% of the APAC organisations agreed that the more they partner with a service provider to consult, strategise, manage and innovate all aspects of their transformation journey, the more likely they are to be bold and brave, pivoting focus to take advantage of new market opportunities. Almost 51.2% of the organisations in APAC averred that their overall technology strategy is fully aligned with their business strategy needs. About 46.7% know and agree that their organisation's IT capabilities are only slightly effective when it comes to aligning with business objectives by exploring new technologies.

HOW MUCH, HOW LONG?

The year 2020 might have been the push that these areas needed, but what if it turns into more of a nudge that is forgotten after the dust settles down. How many of these shifts in spending will continue and build up in 2021, 2022 and beyond?

Bhajanka augurs that companies are ready to master the situation in case another crisis or lockdown happens. "Indian organisations are now comfortable with cloud, and are re-architecting their security with data centre as a centre of identity and end-points as a centre of connectivity. Now identity is your perimeter."

"Companies that have migrated production workloads to the cloud are striving for advanced automation to keep pace with changing business requirements. In essence, automation is an area where providers continue to benefit from relatively stable demand, as more and more companies move their offline businesses to the digital world for business agility and long-term viability." Poon argues.

This would be a strong factor when we think of spends in new-age areas such as AI.

"Look at how the commercial use of AI is yet to reach mainstream popularity; some areas of AI such as robotic process automation (RPA) and chatbot are approaching an inflection point in the local business market," Poon reasons.

"Bank of Baroda, for example, enables chatbot-assisted digital interaction on its website using IBM's Watson AI capability. The government of Andhra Pradesh provided COVID-19-related answers to citizens' questions using an AI-enabled virtual assistant. Overall, despite a persistent economic slowdown, local companies seem to have an unabated focus on devising a game plan to further their digital strategies for long-term sustainability."

So if 2020 was about fast-tracking projects that were on the shelf for long or about being brave in taking action on things that would have taken years of chewing over, 2021 could be about these projects and mind-sets taking deeper roots. The way IT investments deliver business value and resilience is going to be a big filter ahead. The Queen in your organisation may have just shifted the side and position of her purse, after all. Take a cue.

Neelesh Kripalani
maildqindia@cybermedia.co.in

Ten Commandments of **cybersecurity**

As cyber risks continue to rise, especially with the advent of remote working, ITprofessionals should focus on upgrading their cybersecurity skills

Cybersecurity experts are one of the most in-demand IT professionals, thanks to the high priority that organisations place on building secure digital infrastructures that can scale. The push for remote working has further increased the demand for cybersecurity experts.

According to a research report from the SANS Institute, a US-based security research and training firm, anyone looking to break into the cybersecurity industry should focus more on in-demand skills. With that in mind, if one wants to plunge into a career in cybersecurity, here are some of the in-demand skills to focus on.

#1

Application development security: Application development security is the fastest-growing cybersecurity skill and is predicted to see a 164% increase in available positions over the next five years (source: Burning Glass, a leading labour market analytics firm).

#2

Cloud security: As organisations migrate to the cloud, they need security professionals who are cloud-savvy. Thus, cloud security skillscanhelp build the foundation that one needs to secure data in the cloud.

#3

Advanced malware prevention: The increasing number of malware attacks calls for experts who can leverage advanced malware protection software designed to prevent, detect, and help remove threats in an efficient manner from computer systems.

> APPLICATION DEVELOPMENT SECURITY IS THE FASTEST-GROWING CYBERSECURITY SKILL AND IS PREDICTED TO SEE A 164% RISE IN AVAILABLE POSITIONS OVER THE NEXT FIVE YEARS

#4

SIEM management: Security information and event management (SIEM) is a set of tools and services offering a holistic view of an organisation's information security. It is one of the strongest tools in a cybersecurity professional arsenal. As a SIEM expert, one needs to know how to generate insights from the tool's analytics as those can help identify patterns of suspicious behaviour to help organisations combat cyber threats.

#5

Threat intelligence:Cyber threat intelligence is knowledge that allows security teams to prevent or mitigate cyberattacks. Threat intelligence sources include open source intelligence, social media intelligence, human intelligence, technical intelligence and intelligence from the deep and dark web.

#6

DevSecOps: Organisations are increasingly moving beyond DevOps to DevSecOps. It is a culture shift in the software industry that aims to bake security into the rapid-release cycles that are typical of modern application development and deployment.

#7

Security incident response: Incident response (IR) is a structured methodology for handling security incidents, breaches, and cyber threats.A well-defined IR plan allows organisations to effectively minimise the impact of cyberattacks, thereby reducing IR costs.

#8

Identity and access management: Users need to access systems seamlessly from anywhere,while addressingexpanding regulations, evolving identity theft risks, high-impact data breach incidents, and theft of user credentials. Thus, identity and access management skills are gaining visibility. Organisations need experts to implement programmes, processes, and technology to mitigate access-related risks.

#9

Digital forensics: Computer forensic experts acquire and examine potential evidence during an investigation, including data that has been deleted, encrypted, or damaged. They should have good understanding of the forensic tools used to find anomalies and malicious activities.

#10

Mobile device management: A cybersecurity practitioner with mobile device management capabilities should be able to work with the IT department to integrate cybersecurity in mobile devices such as smartphones, tablets, and laptops. Further, he/she needs to have deep understanding of data loss prevention strategies.

GET READY FOR THE FUTURE

Cybercriminals can quickly turn any digital tool into a digital weapon. Moreover, they are constantly reinventing themselves according to the changing scenarios. The only thing that can help tackle such risks is a team of well-equipped cybersecurity specialists with all the necessary skills in their armoury. The cybersecurity industry has great growth potential and can offer promising career opportunities. And since it lacks the desired cybersecurity professionals with the necessary expertise, this is the best time to acquire such skills and be future-ready.

Kripalani is Sr. VP & Head – Center of Excellence, Clover Infotech

Anusha Ashwin
x-anushaa@cybermedia.co.in

ANANDA MUKERJI
Founder and Chairman, Anunta Tech

VDI AND DAAS ADOPTION HAS WITNESSED A NEAR 100% INCREASE

He has been focusing on providing specialised cloud services focused on end-user experience management in enterprise environments aimed at helping enterprises move to new-generation end-user computing (EUC) environments. In an interaction with Dataquest, ***Ananda Mukerji,*** *Founder and Chairman, Anunta Tech shares his views on the impact of COVID-19, the emergence of desktop-as-a-service, and the company's growth plan. Excerpts:*

How would you describe Anunta's corporate journey so far?

Anunta is a leading cloud-based end-user computing solutions provider focused on managed desktops and digital workspace solutions. We help enterprises all over the world in their workplace transformation journeys by moving their existing workloads from traditional desktop environments to the cloud, thereby allowing their employees to access enterprise applications and data from anywhere, anytime and on any device.

Anunta started its operations in 2012 evangelising desktop virtualisation technologies, which at that time were relatively unfamiliar to most in the industry. The founding team originally came out from Firstsource Solutions, a global BPO company and one of the very early adopters of virtual desktop infrastructure (VDI) technology in the world. The success of this deployment and the clear benefits, both technical and business, encouraged us to take the managed VDI offerings to the market and help other organisations facing IT infrastructure management and user performance challenges. Over the years, we saw more and more enterprises move away from traditional PC-based EUC environments to cloud-based virtual environments, initially on private clouds and now increasingly on public clouds. Anunta has been a key player in this journey, successfully migrating close to 500,000 remote desktops in enterprises across many industries including banking and financial services, manufacturing, travel, media, aviation and IT.

How have the Indian companies faced and dealt with an accelerated demand for digital technologies, especially in the 'new normal' following the pandemic?

In the past few years, digital transformation has gained much prominence with the adoption of cloud-based technologies by organisations of all sizes and forms. The ongoing pandemic has just accelerated this adoption of digital technologies. However, the focus has been shifting to using these technologies to ensure employee safety while at the same time keeping business operational. To achieve this, most organisations had no choice but to create a hybrid work environment that allows a few essentials services to be operating from office premises while many of their employees work from home. This created challenges for IT and business heads of balancing the need for seamless accessibility to data, enterprise applications availability, and smooth communication and collaboration with the necessity of maintaining stringent data security and regulatory compliance. Organisations had to prioritise their spending on technology that assists in business continuity, remote working and workforce collaboration, and make the right technology choices.

As an industry-recognised managed desktop and digital workspace solutions provider, Anunta has helped many businesses with remote working solutions that are secure, scalable, and flexible. Some of the questions that IT leaders needed to ask in choosing the right remote working solution are: Does the solution ensure workforce productivity? Does it provide the users with same experience when accessing business applications in a work from home environment as from the office environment? The answer to these questions in many cases lies in the adoption of cloud-hosted desktops.

With workspaces shifting online, what is the role of desktop-as-a-service in it?

We have seen a significant change in the way we work and live in the past few months and some of these changes will continue beyond this pandemic. We have seen announcements from several major companies in India and abroad that they will allow, and even encourage,

DIGITAL TRANSFORMATION HAS GAINED MUCH PROMINENCE WITH THE ADOPTION OF CLOUD-BASED TECHNOLOGIES BY ORGANISATIONS OF ALL SIZES AND FORMS.

certain category of employees to continue working from home permanently. As the workforce becomes distributed across time zones, locations and devices, providing them secure access to their data and applications with the similar experience, as in an enterprise environment, becomes critical.

Desktop-as-a-service (DaaS) is a long-term solution that can help meet the demands of remote working. It involves hosting your desktops on a cloud using VDI technology, which can be securely accessed by users from any remote location without requiring very high bandwidth. In the past few months, we have assisted many organisations across industry verticals to move their workplace to the cloud while delivering high quality performance and improved business productivity.

With the increase in demand for cloud technology in 2020, accelerated by the pandemic, VDI/DaaS adoption has witnessed a near 100% increase in 2020 and this trend is expected to continue in 2021 as well.

How do you see DaaS emerging, globally vis-a-vis India?

According to MarketsandMarkets, due to the impact of pandemic the global cloud market is expected to grow from USD 233 billion in 2019 to USD 295billion by 2021 at a 12.5% CAGR. IDC estimates that 64% organisations in India are expected to increase the demand for cloud computing while 56% for cloud software to support the new normal. This increase in cloud adoption includes cloud-based technologies like DaaS. It offers a reliable and cost-effective option for enterprises to provide their remote workers with a secure technology for collaboration and communication.

What are the verticals that will play critical roles in increasing the DaaS market in India?

India is among the top markets globally for VDI technology adoption and from our experience we have been seeing an increasing rate of adoption in many industries including banking and financial services, IT/IT-enabled services/ BPOs, manufacturing, professional services and retail to name a few.

What are the company's growth plans?

Anunta's business focus has historically been on the large enterprise market. We are now looking to expand into the SMB market where companies struggle with the same challenges in managing IT infrastructure but have some unique requirements. A couple of months ago, we soft-launched an Anunta branded cloud desktop (DesktopReady) in the US market targeted at small and mid-size businesses and are at present testing this product in India. DesktopReady is a packaged, fully managed Windows desktop hosted on Azure cloud. It takes away many of the complexities involved in migrating to the cloud and is suitable for customer which does not have the necessary IT skills in house to set up and manage a virtual work environment. The 'DesktopReady' desktops can be purchased online through the portal and can be setup in minutes.

We are seeing organisations across industry verticals now adopting cloud-based desktops. The challenge for them lies in migrating their traditional environment to cloud and implementing and managing these cloud solutions. Our proposition to enterprises is a fully managed desktop solution that requires zero IT intervention in designing, implementing and managing it. From the cost perspective, DesktopReady is available on a pay-per-use model and customers need to pay only for what they consume. This makes it very attractive for enterprises which want to use their capital efficiently. As a result of this, VDI/DaaS suddenly has moved from being a niche or specialised technology to a mainstream technology that helps in workplace transformation in India.

APEEJAY EDUCATION

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Apeejay Stya Advantage (50+ Years of excellence in education)

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from pre-nursery to doctoral level

2,500
Faculty

65,000
Strong alumni network

85+
Programmes to choose from

40,000
Students

24
Educational institutions across the country

Some of our Awards and Accolades

'Top Education Brands Award' (Academic Excellence in K–12) by Business World Education in 2020

Awarded as **'Best Education Society for promoting Social Cause in 2019'** by Centre for Education Growth and Research

Apeejay Schools

- Apeejay School, Mahavir Marg, Jalandhar, Punjab
- Apeejay School, Hoshiarpur Road, Jalandhar, Punjab
- Apeejay School, Tanda Road, Jalandhar, Punjab
- Apeejay School, Model Town, Jalandhar, Punjab
- Apeejay School, Panchsheel Park, New Delhi
- Apeejay School International (IB), Panchsheel Park, New Delhi
- Apeejay School, Saket, New Delhi
- Apeejay School, Pitampura, Delhi
- Apeejay School, Noida, U.P., Near Delhi
- Apeejay International School, Greater Noida, U.P.
- Apeejay School, Faridabad, Haryana
- Apeejay Svrán Global School, Faridabad
- Apeejay School, Charkhi Dadri, Haryana
- Apeejay School, Kharghar, Navi Mumbai
- Apeejay School, Nerul, Navi Mumbai
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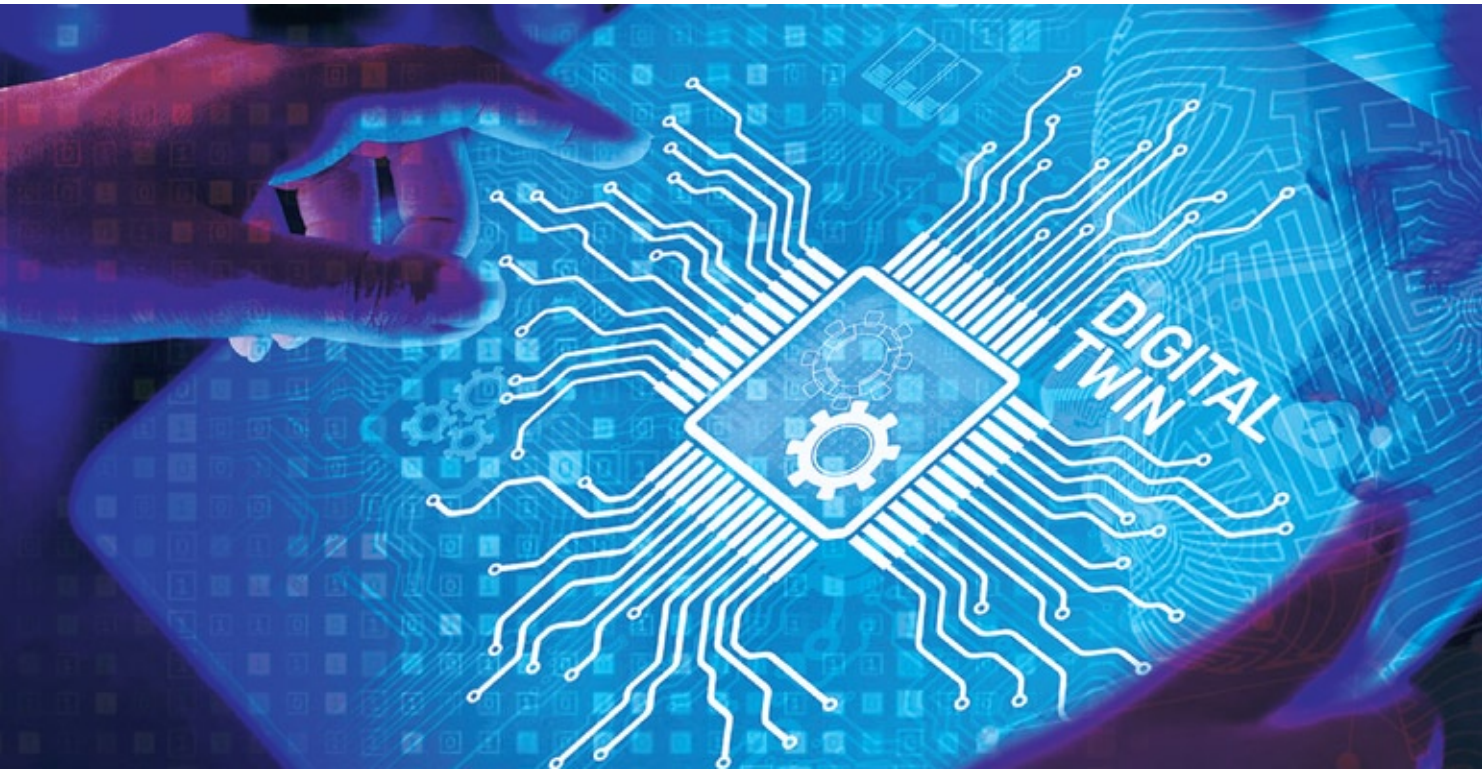
- Apeejay Rhythms, Sector–15, Faridabad
- Apeejay Rhythms Kinderworld, Model Town, Jalandhar

W: www.apeejay.edu | E: aes@apeejay.edu

Aanchal Ghatak
x-aanchalg@cybermedia.co.in

Digital Twins: still infants, **but with great promise**

This nascent technology allows real-time look at industrial processes. Coupled with IoT and AI, it opens new vistas of improvements and innovations



Imagine a typical manufacturing factory. There would be several units producing various parts, but without synchronisation, working in silos. How can information technology help coordinate them? A digital twin is the answer. For the uninitiated, it is a virtual representation that serves as the real-time digital counterpart of a physical object or process.

COVID-19 has added to relevance of the digital twin technology, which can aidin many tasks such as remote monitoring, predictive maintenance and automated processing.Digital twins enable companies to simulate their shop floor or their entire business to identify optimisation opportunities.

But keep in mind that it is a concept, not a single product or a piece of technology. Other technologies like 3D simulation, internet of things (IoT), 4G/5G, big data, blockchain, edge and cloud computing, and artificial intelligence (AI) come together to make the concept a reality.

Gartner named it among top trends in 2017. “Billions of things will be represented by digital twins, a dynamic software model of a physical thing or system,”it noted.

"TODAY, IT IS POSSIBLE WITH THE REVOLUTIONARY PRACTICE OF DIGITAL TWINNING. DIGITAL TWIN HAS THE POTENTIAL TO DRIVE UNPARALLELED EFFICIENCIES IN INDUSTRY 4.0."

— **Pradeep Agarwal,** Senior Director, ERP Cloud, Oracle India.

The next year, digital twin technology was again named among top trends.

Industries like aerospace, defence, manufacturing, healthcare and pharmaceutical, energy and utility, and transportation have adopted digital twins and more are in the process of doing so. Companies like Bosch, Schneider Electric and IBM are creating ground-breaking solutions using this new technology. Digital twins will help accurately forecasting the future of physical assets in industrial services. Over the years, various IT tools have generated massive amounts of data, not all of which is put to use. A digital twin will extract insights from that.

"The digital age has unleashed limitless potential and is transforming the way we work, play and live. It is offering businesses unprecedented opportunities for invention, growth, and value creation. However, to realise these opportunities, it is crucial that businesses not only develop digital capacities but also put digital at the centre of their enterprises to have more efficient and speedier production systems that guarantee close to zero downtime," says Pradeep Agarwal, Senior Director, ERP Cloud, Oracle India.

"Today, it is possible with the revolutionary practice of digital twinning. Digital twin has the potential to drive unparalleled efficiencies in Industry 4.0. With India's thrust on increasing the contribution of manufacturing from 15% to 25% of the total GDP, the sector has an opportunity to increase its overall productivity by accessing valuable data through digitally enabled production lines."

Kiran Divekar, Director, Manufacturing Applications, Dassault Systèmes India, explains that digital twins can be any element that comes in. "It allows you to do unlimited iterations, provides insights of how your production is going on, how the human elements can be improved and so on. There is also the integration with the PLCs and knowledge retention."

Dassault's 3D Experience platform provides a real-time view of business activity and ecosystem, connecting people, ideas and data in a single collaborative environment that empowers businesses and people to innovate in entirely new ways.

Nisheeth Srivastava, Chief Technology and Innovation Officer – India, Capgemini, says: "We have a solution with Nextgen AR/VR platform that digitises the maintenance, repair and operations activities using cutting-edge technologies for smart authoring, advanced planning and simulation, AR/VR/digital twin and AI."

He adds, "The digital twin application provides a real-time 3D model of network assets by using advanced AI algorithms to assess the present condition of the assets and predict their future operating trends. This helps the utility managers take early informed decisions to prevent major failures, thus ensuring reliability and quality of service to our customers and exceeding the regulatory standards of performance."

Rohit Pande, Country Head – AI Applications, IBM India/South Asia saysIBM has been involved with digital twins since the Apollo space program. "IBM's Real-Time Computer Complex (RTCC) was an IBM computing and data processing system at NASA's Manned Spacecraft Center in Houston. It collected, processed, and sent to Mission Control information that directed every phase of an Apollo mission. The RTCC was so fast, there was virtually no time between receiving and solving a computing problem."

IBM continues to do a lot of work with digital twin technologies,especially around the IBM Maximo

"IT ALLOWS YOU TO DO UNLIMITED ITERATIONS, PROVIDES INSIGHTS OF HOW YOUR PRODUCTION IS GOING ON, HOW THE HUMAN ELEMENTS CAN BE IMPROVED AND SO ON."

— **Kiran Divekar,** Director, Manufacturing Applications, Dassault Systèmes India

solutions. The applications keep growing across different industries. For instance, one of the global innovations has been bringing augmented reality (AR) into asset management.

Javed Ahmed, Senior VP, Global Supply Chain International, Schneider Electric India, adds thatthey have digital twin at two levels, Asset Twin and Process Twin. "It helps us to plan, do, check and act throughout the lifecycle of asset and process."

BUILDING A RESILIENT SUPPLY CHAIN BY DIGITISATION

Digitalisation for supply chains is enabling transparency across the entire value chain. Companies are looking to streamline and improve supply chains, but are also under pressure to manage supply chain disruption and meet corporate social responsibility requirements associated with their supply chains.

Industry 4.0 connectivity and digital transformation are creating agile operations that are more capable of responding to disruption and recovering from it.

Nabuath Ulla Khan, Practice Head, IoT Analytics, SAS India, says: "In the current competitive and dynamic market, customer demands and interests are changing continuously, and hence, risk of disruption in the supply chain is also increasing. To be successful in this scenario, supply chain of a firm should be resilient."

Most firms realise that the specific end goal of developing a resilient supply chain calls for a detailed self-assessment of internal performance as the starting block. While a few large multinationals were already on this path of assessment, the pandemic hit the entire globe, which has thrown almost everyoneoff guard. This pandemic impact has driven home the need to address weaknesses of several traditional supply chains, Khan says.

Diwekar says that supply chain has a huge role to play in manufacturing and production activities. OEMs are outsourcing more work to the supply chain. There is need for the supply chain in India to be resilient. Digitalisation will have a big role to play, and there is a strong need for digitalisation within India. "Dassault has a solution for the supply chain. We provide optional accelerators for the MSME segment, so they can quickly ramp up and start executing their production."

DIGITAL TWINS AND IoT

The idea of connecting different devices into one network has been around since the 1980s.IoT has become one of the most– if not the most – useful drivers for connectivity, efficiency, scalability, time-saving and cost reduction for industrial and manufacturing organisations. The name has been a bit modified to industrial internet of things (IIoT) for Industry 4.0.

IIoT's collaboration with data science, 3D modelling, AI and ML has given birth to the new revolutionary concept of digital twin. It helps industries save time and sets the groundwork for customised mass production. With it, even highly complex routes can be calculated, tested, and compiled with minimal cost and effort – and in a short period.

Muthumari S, Head of Data science, Brillio, says: "A digital twin is the digital proxy of a physical object or process or device. The growing demand for IoT sensors and AI/ML makes digital twins crucial in maximising efficiency, predicting complex outcomes, avoiding quality issues, rework, and reducing operating costs."

"THE GROWING DEMAND FOR IOT SENSORS AND AI/ML MAKES DIGITAL TWINS CRUCIAL IN MAXIMISING EFFICIENCY, PREDICTING COMPLEX OUTCOMES, AND REDUCING OPERATING COSTS."

— **Muthumari S,** Head of Data science, Brillio

"Digital twin coupled with IoT duplicates the physical model for remote monitoring, viewing, and controlling, which continuously adapts to operational changes based on real-time data. Besides providing descriptive decision-making capabilities, organisations can make agile AI predictions by coupling AI with real-time analytics. For example, there could be processes running for multiple hours before determining the success and failure of the batch by manufacturing companies. This helps predict the likelihood of a batch failure and quality issues during run-time with the help of sensor data and AI/ML capabilities."

IoT is the key to the implementation of digital twin technology, believes Khan. The increasing affordability of sensors, widespread use of Wi-Fi and the data-throughput capacity of the cloud combine to make the application of large-scale digital twin modelling affordable for a range of manufacturers operating in the IIoT space.

"When manufacturers can see real-time data of how their products are operating, they can make dramatic improvements in design, innovation, efficiency and manufacture. That capability enables them to proactively contact end users so plans can be made for repairs or maintenance – heading off the disruption of potentially costly breakdowns," he adds.

Digital twins have become more complex – connecting not just one asset with another, but also systems of assets or even entire organisations.

ADDRESSING BUSINESS CHALLENGES

With approximately half of industries integrating the use of digital twins, the rest will definitely be losing their competitive edge. CIOs have been – and are – facing big challenges, that digital twins can address and solve. Digital twins offer great opportunities in various domains of the product engineering process. However, current approaches to the use of digital twins only focus on different separated disciplines.

Ahmed says, "We see a couple of challenges in manufacturing which can be identified and managed using digital twins. Quality challenge is improved by detecting failures and causal factors in advance to reduce non-quality costs and improve manufacturing acceptability in the global market. Downtime reduction by having real-time asset data and ability to simulate and predict failures helps us to reduce machine downtime."

He adds, "Productivity/throughput challenges are improved by simulating manufacturing process in the virtual environment and optimising by improving cycle time, reducing inventory, improvement safety and ergonomics helps in improving productivity and throughput yield."

Prahallad CR, Partner- Customer Solutions, Robert Bosch Engineering and Business Solutions,notes thatthe challenge in the field to invest and build a digital twin to drive targeted business outcomes rests entirely on the accuracy of the data across the spectrum of value, which bridges the physical and digital world at all points along the value chain.

"Top five challenges in building the digital twin include field data sanctity, clear business problem narrative, missing or invisible data narrating an incomplete picture, rare class faults, and the human factor. A digital twin can handle business challenges that are predictable and avoidable, which helps garner useful insights. Engineering insights can help improve OEE, reduce unplanned downtime, reduce maintenance costs, and improve quality. Business insights can help understand asset

> "WHEN MANUFACTURERS CAN SEE REAL-TIME DATA OF HOW THEIR PRODUCTS ARE OPERATING, THEY CAN DRAMATICALLY IMPROVEDESIGN, INNOVATION, EFFICIENCY AND MANUFACTURE."
>
> — **Nabuath Ulla Khan,** Practice Head - IoT Analytics, SAS India

criticality, plant efficiency, and reduce failure mitigation cost by enabling predictive maintenance."

Digital twins can create conducive situations that open the door to innovation and multiply the possibilities of what can be achieved through collaboration. Enterprises can now establish perpetual connectivity with the industrial infrastructure, which would help cut costs and derive new business models for additional revenue generation.

RELATION BETWEEN AI AND DIGITAL TWINS

Artificial Intelligence, arguably the biggest invention of the century, is triggering a paradigm shift. The first benefit of a digital twin is the ability to produce simulated data. The second benefit is the ability to plan and test new features. Adding AI to any industrial process will make the process more intelligent by getting more accurate data and predictions, and understanding also visual and unstructured data.Digital twins can marry AI to produce something far greater by creating a usable representation of complex systems.

Prahallad adds that digital twin's unique feature is its ability to provide access to its subject from anywhere. This enables monitoring of the asset and allows for the asset to be remotely controlled under human supervision by deploying appropriate feedback mechanisms. A digital twin is powered by sensors, software and services which in turn are connected to data and algorithms.

AI, data analytics, data science are the core elements that are required to build successful Digital Twins for the organisations.Availability of qualitative data, insights churned out of data analytics and improvement measures suggested by data science will help in more informed and faster decision-making during normal, hardship and distress operating conditions.

With its ability to generate and segregate persona-based recommendations, the automated reporting system of digital twin will ensure availability of the right data to the right people at the right time; thus enhancing predictability and improving transparency.

Organisations aspire to have digital twins that provide insights, correlations and comparisons on as-designed, as-built, as-operated, and as-maintained conditions.

Nisheeth adds: "AI and data analytics are increasingly being used for digital twin application especially in automotive, utility and industrial environment. Digital twins can start by replicating a simple product digitally and extend to replicate an entire industry along with several processes associated in the value chain. By connecting the digital and the physical product with help of sensors and technology, the digital twin can help in providing the real-time operational insights of the physical product or process. This data can further be analysed using some intelligent data mining tools, predefined matrix and KPI's to derive meaningful insights. Equipped with all the particulars, features, financials, and metadata of an 'as-is' processes, organisations can create a model of what's happening today – that is, the digital twin.

This model can be used as a testbed for simulating any number of scenarios, discovering hypotheses and prospects for change. This exposes the DNA of the organization and enables it to work pathways for enhanced evolution.

Manufacturers prefer to use digital twins to improve operations such as plant processes and to optimise supply chains. Digital twins reduce risk because mistakes can be made and corrected offline instead of during actual production or in a working facility.

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Aanchal Ghatak
x-aanchalg@cybermedia.co.in

"IT'S A LENS, PLUS A REAR-VIEW MIRROR AND A TELESCOPE"

JAVED AHMED
SVP – Global Supply Chain International,
Schneider Electric India

What are the solutions you are offering for digital twin?

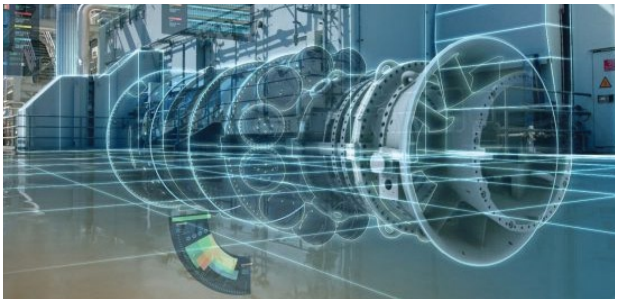
We have digital twin at two levels in Schneider Electric – Asset Twin and Process Twin. It helps us to plan, do, check and act throughout the lifecycle of asset and process. In Asset Twin – AOA, Aveva Insight, Machine Advisor– we get data from sensors and PLCs and provide a real-time visual representation of assets, historic data and predictive analytics. This helps in reducing unplanned downtime. In Process Twin – EcoStruxure Building Operations, Building Advisor, Aveva Process simulation helps in monitoring and managing building operations and manufacturing process.

How can India build a resilient supply chain by digitisation?

Resilient supply chain is the ability to respond to external changes in an optimal way. Digitisation is the foundational block to have data-enabled decision-making. When we have end-to-end supply chain digitised it helps us take real-time decisions. It also helps us do simulation; optimisation and advanced analytics that helps us plan and respond to external changes. For example, network modelling, supply chain stress test can be performed in a virtual environment.

How digital twin is crucial to the development of IoT technology?

Digital twin is the virtual representation of physical environment. To get real-time data from physical environment it is vital to have sensors and systems continuously communicating the data to cloud. IoT provides this unique opportunity to build dynamic real-time digital twin. With emerging use cases on, digital twin is eventually propelling the development of IoT technology.



What organisational challenges do you see in India? How will digital twin play a role in identifying those issues?

We see a couple of challenges in manufacturing which can be identified and managed using digital twins. 'Quality challenge' is improving quality by detecting failures and causal factors in advance to reduce non-quality costs and improve manufacturing acceptability in the global market. 'Downtime reduction', by having real-time asset data and ability to simulate and predict failures, helps us reduce machine downtime. 'Productivity/ throughput improvement',by simulating manufacturing process in the virtual environment and optimising by improving cycle time, reducing inventory, improvement safety and ergonomics, helps in improving productivity and throughput yield.

Will the implementation of AI and data analytics in digital twin enable us to gain more insights? How?

Digital twin is not only about real-time visibility (like a lens), it also includes history (like a rear-view mirror) as well as future – to analyse, predict and foresee what will happen (like a telescope). Digital twin collects a huge amount of data, when we apply advanced analytics on it, we are able to detect anomalies, predict failures and control assets and process in realtime.

In the supply chain process, digital twin coupled with AI analyses, simulation and optimiser helps us respond to business changes such as raw material shortage, logistics route changes or inventory alignment in an agile manner improving customer experience, service level and reducing cost.

"DIGITAL TWIN BREAKS BARRIERS, ENABLES DIGITAL CONTINUITY"

KIRAN DIVEKAR
Director, Manufacturing Applications,
Dassault Systèmes India

What are the solutions you are offering for digital twin?

A digital twin can be any element that comes in. It allows you to do unlimited iterations, provides insights of how your production is going on, how the human elements can be improved, etc. There is also the integration with the PLCs and knowledge retention. Dassault offers the 3DExperience platform.

3DExperience provides a real-time view of business activity and ecosystem, connecting people, ideas, and data in a single collaborative environment that empowers businesses and people to innovate in entirely new ways.

You can build a virtual factory, starting from scanning the factory, building it ground up, etc. You can simulate different what-ifs of your lines, stations, etc. to a level of detail where you have sensors and IoT-related stuff that can be modelled and simulated virtually. We offer V+R, that is, virtual plus real, for digital twin. There are solutions for the real world and the virtual world.

There are companies in India who are using our solutions,for example, Thermax. They are using the Delmia digital manufacturing solution. Globally, one of the biggest customers is Airbus Helicopters. They have employed us for their digital twin and shopfloor virtualisation. Dassault Systèmes was chosen by Alstom to deliver customised trains to Trenitalia. In automotives, there is Scania, who makes buses and trucks out of Europe.

How can India build a resilient supply chain by digitisation?

Supply chain has a huge role to play in manufacturing and production activities. OEMs are outsourcing more work to the supply chain. There is need for the supply chain in India to be resilient. Digitalisation will have a big role to play, and there is a strong need for digitalisation within India. Dassault Systèmes has a solution for the supply chain. We provide optional accelerators for the MSME segment,so that they can quickly ramp up and start executing their production.

They have to ensure that best practices are followed on the shop floor. Here, 3DExperience and Delmia have a role to play. They enable the supply chain to digitalise and standardise their processes, synchronise, etc.

What organisational challenges you see in India? How will digital twin play a role to identify those issues?

There are organisational challenges. There are lots of de-separated companies. A company may have many departments. But all of these companies are working in silos. Information hardly goes down to the shop floor. We still find people on the shopfloor using 2D drawings. They have not yet embarked on the 3D journey.

This is a big organisational challenge. This is a challenge all over the world. Advanced countries like Japan, USA, Germany and Francehave started this journey to break barriers. However, these challenges remain in pockets, even in advanced countries.

Digital twin plays a role in breaking barriers. They enable digital continuity. CATIA is the world's engineering and design leading software for product 3D CAD design excellence from Dassault. The same data can flow to the shopfloor, manufacturing teams, and even to service engineers. There is seamless continuity of data.

Will the implementation of AI and data analytics in digital twin enable more insights?

Implementation of AI and data analytics will help gain more insights. Today, all machines are smart. We need to make sense of the data. Here, AI and ML have a big role to play. Companies can take in huge volumes of structured and unstructured data. We can do the data mining and give some meaningful results.

How is digital twin crucial to the development of IoT technology?

We can enable getting the data from all the machines. Factories are getting more advanced. We can gather data from the sensors. This data can be used for further development. Cloud is another integral part and gaining prominence. We have our data centre. Solutions are also available on the cloud.

Aanchal Ghatak
x-aanchalg@cybermedia.co.in

"DATA-DRIVEN DECISION-MAKING AIDS INTELLIGENT SUPPLY CHAIN"

MUTHUMARI S
Head, Data Science, Brillio

How can India build a resilient supply chain by digitisation?

Logistics costs incurred in the Indian supply chain networks account for 14% of the GDP (global average of 8%), creating a competitive gap of USD 180 billion for India. This is likely to rise to USD 500 billion by 2030. Higher logistics costs result in lower pricing advantage for consumers, which, in turn, slow down adoption and growth.

This situation is a consequence of multiple challenges like poor-quality infrastructure support that leads to breakage and leakage of cost, technology adoption in the supply chain process, unbalanced logistics model on supply and demand leading to opportunity loss, poor inventory management, and availability and quality of data.

While organisations have not reached the highest level of maturity, digitisation and digital adoption have been rising exponentially in India. There has been a monumental shift in businesses, especially after the rise in e-commerce sector in India. Enterprises are more consumers experience-focused; therefore, a lot of technology integration with physical networks has taken place.

However, it has not been planned comprehensively with a clear roadmap of process, governance, and technology. With the proper roadmap and framework aided with technology adoption across the value chain, we could bring the right quality of data and traceability of physical assets in creating a resilient supply chain network. Data-driven decision-making could aid in an intelligent and agile supply chain.

How is digital twin crucial to the development of IoT technology?

A digital twin is the digital proxy of a physical object or process or device. The growing demand for IoT sensors and AI/ML makes digital twins crucial in maximising efficiency, predicting complex outcomes, avoiding quality issues/rework, and reducing operating costs.

Digital twin coupled with IoT duplicates the physical model for remote monitoring, viewing, and controlling, which continuously adapts to operational changes based on real-time data. Besides providing descriptive decision-making capabilities, organisations can make agile AI predictions by coupling AI with real-time analytics. For example, there could be processes running for multiple hours before determining the success and failure of the batch by manufacturing companies. This helps predict the likelihood of a batch failure and quality issues during run-time with the help of sensor data and AI/ML capabilities.

Will the implementation of AI and data analytics in digital twin enable us to gain more insights? How?

Digital natives increasingly expect a seamless, integrated, consistent, and hyper-personalised experience across their digital footprint in the new post-pandemic digital era. 'Information' is a crucial phase in the consumer journey for making informed data-driven decisions.

With evolved modes of communication, integrating the consumer's behaviour across channels to provide an omnichannel experience requires data collection across devices, making sense of the different logs, and building the right AI/ML models at scale.

Digital twin with AI/ML and IoT creates 'connected digital things'. This aids organisations in generating real-time data, descriptive analytics with analysis and insights for better consumption and decision-making, and providing visibility and traceability of assets across the value chain, identify and support to create a balanced logistics model, along with collaboration and planning. It also enables predictive analytics to identify the problems in advance and early warnings on failure, downtime, forecasting of demand, and supply. This helps optimize logistics distribution and inventory stock-out vs. leakage.

"IoT IS THE KEY TO IMPLEMENT DIGITAL TWIN TECHNOLOGY"

NABUATH ULLA KHAN
Practice Head, IoT Analytics,
SAS India

What are the solutions you are offering for digital twin?
Automation, digitalisation, and the adoption of IoT are important requirements for companies that wish to drive lower costs, enhance and unearth new efficiencies that can lead to new business opportunities. SAS helps clients in identifying and quantifying critical quality drivers across the entire production process and allows them to explore and develop a model of the entire end-to-end process (digital twin). The model quantifies the impact parameters on key quality metrics and provides a better understanding of the process, resulting in optimised process parameters. This ensures best quality in the first place and a lesser number of products with defects entering the market.

How can India build a resilient supply chain by digitisation?
The pandemic impact has driven home the need to address weaknesses of several traditional supply chains. The imposition of lockdowns and halt in production across locations severely affected global distribution of inputs and final products. While collaboration has become essential to diversify sourcing across various segments of different supply chains to minimise risks from disruption and enhance resilience, this alone is not an indicator which can help speed up the building of a resilient supply chain.

A few additional indicators (such as sustainability, agility, flexibility, redundancy, visibility, security, public-private partnership, supply chain network design and much more) become very critical aspects.All of these need to be looked together to find correlations, critical signals and so on. As a result, digitisation becomes much more important than ever it was.

In order to create a fully optimised supply chain, analytics and digitisation is necessary. To drive value from supply chain digitisation, we believe three broad areas are critical: Strategising and planning, building a supporting ecosystem and enablement.

How is digital twin crucial to the development of IoT technology?
Digital Twin is most commonly defined as a software representation of a physical asset, system or process designed to detect, prevent, predict and optimise through real-time analytics to deliver business value. Digital twins can be used to predict different outcomes based on input variable data. By using comparatively low-cost data processing and increasingly accurate sensor technology, we foresee huge potential, especially in the field of simulation. With additional data and analytics, digital twins can often optimise an IoT deployment for maximum efficiency, as well as help engineering designers figure out where things should go or how they operate before they are physically deployed.

Contrary to the question, my view is that IoT is the key to the implementation of digital twin technology. The increasing affordability of sensors, widespread use of Wi-Fi and the data-throughput capacity of the cloud combine to make the application of large-scale digital twin modeling affordable for a range of manufacturers operating in the industrial IoT (IIoT).

What organisational challenges you see in India? How will digital twin play a role in identifying those issues?
When it comes to implementing IoT solutions, IT/OT convergence is critical to success. While internal IT and OT challenges are very much visible with the organisations in India, The starting block of having a simple visualisation layer of critical KPI's and leveraging the streaming data to see the behaviour change on real-time basis roughly referred to as a digital representation or digital twin can help sort out a lot of issues and misnomers at hand and get the relational bias completely out of the system and have a streamlined process in place.

How will the implementation of AI and data analytics in digital twin enable to gain more insight?
The heart of the digital twin is the analytics. It's not just about, 'Can you collect the data and visualise it like a Digital twin?', but 'Can you turn it from data to valuable transformative information?' The main driver for that is analytics.This means you have to be able to collect and move the data in effective ways. Then you must understand what the data is telling you, but beyond that, you need to drive the action so that you can achieve that expected result on the back-end.

Aanchal Ghatak
x-aanchalg@cybermedia.co.in

"DIGITAL TWIN ENABLES AND PROMOTES REMOTE WORKING"

NISHEETH SRIVASTAVA
Chief Technology & Innovation Officer – India, Capgemini

What are the solutions you offer for digital twin?
We have a solution with Nextgen AR/VR platform that digitises the maintenance, repair and operations activities using cutting-edge technologies for smart authoring, advanced planning and simulation, AR/VR/Digital Twin and AI. This solution is currently being explored in aftersales value chain with few of our clients in a large aerospace and manufacturing space. In such industries the products are complex, due to which maintenance is challenging as it requires high precision. With digital twin, field technicians can move towards paperless operations, i.e., from text-based complex maintenance procedures to VR-based training content and AR-based assistance.

How can India build a resilient supply chain by digitisation?
One of the biggest challenges faced in building a resilient supply chain is that the information is highly decentralised, residing in non-standard formats. The process of data collation, conversion, communicationand collaboration becomes tedious and time-taking. So, industries are reconfiguring their supply chains and infusing latest technologies like digitisation within their framework of supply chain management to achieve resiliency.

Digitisation can play a major role as it can help standardise data and make it available securely and timely for use by supply chain management stakeholders. With this in mind, we have developed AI-based robotic process automation (RPA) solution to enable faster digitisation process and build a resilient and reliable supply chain.

How is digital twin crucial to the development of IoT technology?
To develop a digital twin model, we require access to real-time asset attributes and operating parameters. That is one of the reasons why digital twin applications are playing crucial role in the development of IoT technology. Development of digital twin application requires elaborate use of IoT-based sensors for measuring the physical and electro-mechanical parameters of industrial assets.

It also requires a robust communication infrastructure for transmitting IoT data of assets to remote storage systems for archiving, retrieval, processing, modelling and analytics. Digital twin is a highly data-driven application, and as a result catalysing the development of IoT technology.

What organisational challenges do you see in India? How will digital twin help identify those issues?
The major challenges are loss of sales and production due to lockdowns and restrictions, manpower and capacity issues and so on.The major technological disruptions faced by these industries are digitalisation, shared vehicles, autonomous vehicles, automated factories and intelligent industries among others.

The digital twin enables real-time remote monitoring of what's happening with the physical asset. This will also promote remote working. In order to cope with the pandemic-induced disruptions and also keep pace with disruptive innovations in parallel, it is important for organisations to be agile and build state of the art products that are valuable, rare, inimitable and organised.

Digital twin will enable them to design better with real-time operational insights, better manufacturing via continuous learning and feedback, better operations via informed service and support, and accelerated risk assessment. It can help optimise the cost in development, reducing the number of prototypes that are to be manufactured and encourages paperless operations to aid environment.

Will the implementation of AI and data analytics in digital twin enable to gain more insights?
AI and data analytics are increasingly being used for digital twin application, especially in automotive, utility and industrial environment. Digital twins can start by replicating a simple product digitally and extend to replicate an entire industry along with several processes associated in the value chain. By connecting the digital and the physical product with help of sensors and technology, digital twin can help in providing the real-time operational insights of the physical product or process. The digital twin coupled with technologies like AI, ML, data mining, AR/VR and IoTcan boost the adoption of Industry 4.0 to transform manufacturing.

"DATA IS INDEED AT THE CORE OF DIGITAL TWIN TECHNOLOGY"

PRADEEP AGARWAL
Senior Director, ERP Cloud, Oracle

What is the role of digital twin in the Indian IT landscape?
India is a burgeoning economy, for which the next decade of manufacturing will focus on adopting cognitive solutions that infuse intelligence into all processes – from a factory's floor to the finished product.Digitalisation of theindustries can optimise them, but deployment of digital twinshas the potential to improve scalability, reduce the cost of production, minimise production defects, and reduce production time.

In process-driven functions, digital twins constantly receive data feeds from interconnected machines, helping in predictive maintenance and running the business as usual without downtime. Many key industry verticals in India will benefit from this.

What challenges foes the industry facein linking technologies like IoT, AI, ML with digital twin?
One, there is a clear gap between technical skills and digital dexterity. Two, there are concerns around data security. Three, handling data growth is something organisations often grapple with. As more companies become dependent on AI usage, they will be faced with more data that is being generated at a faster pace and presented in multiple formats. To wade through these vast amounts of data, AI algorithms need to be able to combine data that might be of different types and time-frames.

Deployment of digital twins can be revolutionary in tacking these issues.Predictive maintenance solutions powered by digital twins help in precisely monitoring and timely recognisingpotential anomalies within a system. For instance, a predictive twin offered under Oracle IoT Intelligent Applications can detect future problems or state of a machine and can determine trends and patterns from contextual machine data. With this information, problems like potential security can be addressed in advance to prevent loss of time.

In which sectors can businesses refine their operations by implementing digital twin technology?
Application of digital twins is versatile and can work forvarious industry sectors including automotive, food and beverages, pharmaceuticals, power utilities, transportation and logistics, aerospace and defence, and data centres, to name a few.

How is data core to digital twin technology and how does it help in delivering value and unlock data insights?
Data is indeed at the core of digital twin technology. Two-way communication between the physical and digital is essential for digital twins. Data flows from the physical asset to the digital twin and vice versa.That data is leveraged using data science,whether that's AI, ML, or basic data analysis. Insights derived from this data helps provide better decision-making resulting in interventions that are fed back to the physical asset, providing better outcomes. The more that machine-to-machine data exchanges are used, the better the results are.

How is digital twin vital to the expansion of IoT technology?
A digital twin is essentially a virtualmodel of a physical device. It is used by IoT developers, for running simulations without an actual physical device. In one way or another, digital twins can be credited for the burgeoning growth of IoT. An IoT device takes its place like a physical object in the concrete world. A digital twin on the other hand is the virtual representation of the same IoT device which exists within a system. It basically replicates the physical dimensions, capabilities, and functionalities of the IoT device in a virtual environment. Hence, there is an intrinsic connection between the two.

What kind of solutions is Oracle offering around this new technology?
Oracle IoT Intelligent Applications core offering includes key digital twin elements including virtual twin, predictive twin and twin projections. In a virtual twin, Oracle's device virtualisation feature creates a virtual representation of a physical device or an asset in the cloud to retrieve a last known status or to control operation states of an asset. In a predictive twin, the digital twin implementation builds an analytical or statistical model for prediction by using a machine-learning technique.

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Aanchal Ghatak
x-aanchalg@cybermedia.co.in

"A DIGITAL TWIN HELPS FORM A UNIFIED DIGITAL ENTERPRISE"

PRAHALLAD CR
Partner – Customer Solutions,
Robert Bosch Engineering and Business Solutions

What are the solutions you are offering for digital twin?

We offer Data Twin, Product Twin, Application Twin, System Twin (will be available from 2022) and Process Twin (will be available from 2024). Their key traits include: tailor-made, organisation-driven, modular digital transformation solution and cyber-physical system built on sensors, software, and services framework. It has four layers: connect, collect, consume, and cognition.

The AI-powered IAPM that relies on natural intelligence and first principles and digital prediction machine generates physics, engineering, operational and business insights. These are enhanced by virtual sensors and 3D interactive, immersive environment. A set of evolving digital engineering models built to address specific business problems include digital tools to transform traditional workforce into an interdisciplinary digital workforce, and collaborative digital solution that enable the C-suite to drive business outcomes.

How is digital twin crucial to the development of IoT technology?

Today industrial systems are designed, built and operated based on diverse data sources, numerous operating environments and specific business models. Gradual proliferation of IT into the industrial space has encouraged enterprises in multiple ways to work with enormous amounts of data.

A digital twin is a super integrator; it can contextually ingest information stream from every idea, every process, every machine, every stakeholder and eventually the business objectives of the enterprise. Ultimately, this forms a unified digital enterprise that helps improve companies of any size.

In this digital era, we are exposed to volumes of data generated from multiple sources that are flowing in as continuous streams. Gathering this data and understanding it to decipher an insight to support management decisions is a big challenge.

A digital twin creates a digital highway that combines all the lanes of data, collating them into a single point of truth through a dashboard or as an immersive environment or as an APMIC. It reduces the anxiety around digital transformation or Industrial IoT by employing full life-cycle data to drive real-time innovation. It also brings in transparency and real-time visibility into systems, assisting companies in critical decision-making.

> ENTERPRISES CAN ESTABLISH PERPETUAL CONNECTIVITY WITH INDUSTRIAL INFRASTRUCTURE, WHICH WOULD HELP CUT COST AND DERIVE NEW BUSINESS MODELS FOR ADDITIONAL REVENUE GENERATION.

A DIGITAL TWIN HELPS AN ORGANISATION CONVERT INFORMATION INTO DATA, DATA INTO KNOWLEDGE AND KNOWLEDGE INTO WISDOM, WHICH HELPS IT DRIVE BUSINESS OUTCOMES.

What organisational challenges do you see in India? How will digital twin play a role in identifying those issues?

The challenge in the field to invest and build a digital twin to drive targeted business outcomes rests entirely on the accuracy of the data across the spectrum of value, which bridges the physical and digital worlds at all points along the value chain. The top five challenges in building the digital twin include field data sanctity, clear business problem narrative, missing or invisible data narrating an incomplete picture, rare class faults, and the human factor.

A digital twin can handle business challenges that are predictable and avoidable, which helps garner useful insights. Engineering insights can help improve OEE, reduce unplanned downtime, reduce maintenance costs, and improve quality. Business insights can help understand asset criticality, plant efficiency and reduce failure mitigation cost by enabling predictive maintenance. With this progression, organisations experience impetus resulting in the evolution of reliability centred maintenance.

Digital Twins can instil efficiency and help offset increased costs of infrastructure, materials, and components, with predictive and preemptive maintenance scheduling, and agile production processes causing less wastage. This would also help reduce production downtime and lead times, giving enterprises a competitive edge. It can create conducive situations that opens the door to innovation and multiplies the possibilities of what can be achieved through collaboration. Enterprises can now establish perpetual connectivity with the industrial infrastructure, which would help them to cut costs and derive new business models for additional revenue generation.

Will the implementation of AI and data analytics in digital twin enable more insights? How?

A digital twin basically helps an organisation to convert information into data, data into knowledge and knowledge into wisdom. This wisdom helps organisations drive business outcomes. A unique feature which sets the digital twin apart is its ability to provide access to the subject of digital twin from anywhere. This enables monitoring of the asset and allows for the asset to be remotely controlled under human supervision by deploying appropriate feedback mechanisms. A digital twin is powered by sensors, software and services which in turn are connected to data and algorithms.

AI, data analytics, data science are the core elements that are required to build successful digital twins for organisations. AI, in simple terms, is responsible for transforming a digital twin into a scalable decision factory.

Availability of qualitative data, insights churned out of data analytics and improvement measures suggested by data science will help in more informed and faster decision-making during normal, hardship and distress operating conditions. With its ability to generate and segregate persona-based recommendations, the digital twin's automated reporting system will ensure availability of the right data to the right people at the right time; thus enhancing predictability and improving transparency.In common parlance, organisations aspire to have digital twins that provide insights, correlations, and comparisons on as-designed, as-built, as-operated, and as-maintained conditions. They want their personnel to be augmented with physics, engineering, operational and business insights, enabling them to drive business outcomes.

Realising this scenario in a practical time frame is extremely difficult when the organisation has missing or invisible data. On the contrary, if the organisation possesses systems that have the highest degree of sensor deployment with reliable telemetry, high-end automation, data centres, and command and control centres, they are likely to be more successful.

Aanchal Ghatak
x-aanchalg@cybermedia.co.in

"WE OFFER DEEP TECH KNOWLEDGE ACROSS INDUSTRIES"

ROHIT PANDE
Country Head – AI Applications,
IBM India/South Asia

What solutions does IBM offer for digital twin?

IBM has been involved with digital twins since the Apollo space program. IBM's Real-Time Computer Complex (RTCC) was an IBM computing and data processing system at NASA's Manned Spacecraft Center in Houston. It collected, processed and sent to Mission Control information that directed every phase of an Apollo mission. The RTCC was so fast there was virtually no time between receiving and solving a computing problem.

IBM continues to do a lot of work with digital twin technologies, especially around our IBM Maximo solutions. And the applications keep growing across different industries. For instance, one of our global innovations has been bringing augmented reality (AR) into asset management.

The IBM Maximo lab services 'turns on' many visual and voice (natural language processing) features for our clients' workforce. This enables them to see their assets in a new dimension and get instant access to critical data. Those insights can be fed back to others using an AR helmet with voice and video in the visor. This makes 'interacting' the next evolution of working.

Our offerings are built upon IBM's deep industry and technology knowledge across all industries. IBM supports our clients all stages in the product lifecycle from inception to recycling or disposal.

How is digital twin crucial to the development of IoT technology?

A digital twin uses data from connected sensors that are part of the IoT setup to tell the story of an asset all the way through its life-cycle, from testing to use in the real world. With IoT data, we can measure specific indicators of asset health and performance, like temperature and humidity, for example.

By incorporating this data into the digital twin for, let's say, an automotive OEM, the engineers will have a full view into how the vehicle is performing, through real-time feedback from the vehicle itself. Anyone looking at the digital twin will be able to see crucial information about how the physical thing is doing out there in the real world.

What this means is that a digital twin is a vital tool to help engineers and operators understand not only how products are performing, but how they will perform in the future. Analysis of the data from the connected sensors, combined with other sources of information, allows the organisations to make those predictions using solutions for digital twins like IBM Maximo Application Suite. With this information, they can learn more, faster. They can also break down old boundaries surrounding product innovation, complex lifecycles, and value creation.

How will the implementation of AI and data analytics in digital twin help gain more insights?

Digital twins can help organisations stay ahead of digital disruption by understanding changing customer preferences, customisations and experiences. This knowledge means businesses can deliver products more rapidly, with higher quality, from the components, to the code. Yet the promise of digital twin can still go further.

The use of cognitive computing technologies like AI and analytics increases the abilities and scientific disciplines in the digital twin. Technologies and techniques such as natural language processing (NLP), machine learning, object/visual recognition, acoustic analytics, and signal processing are just a few of features augmenting traditional engineering skills.

For example, using cognitive to improve testing a digital twin can determine which product tests should be run more frequently. It can also help decide which should be retired. Cognitive digital twins can take us beyond human intuition to design and refine future machines. No more 'one-size-fits-all' model. Instead, machines are individually customised. That's because cognitive digital twin is not just about what we are building, but for whom.

Aanchal Ghatak
x-aanchalg@cybermedia.co.in

Secure OT for **enhance productivity**

Manufacturing process systems that were mostly stand-alone and operated by experts are now open to cyber threats. It's time to plug the hole

The rise of digital technologies brings a new level of cyber complexity to factories. The Fourth Industrial Revolution heralds an era of tremendous potential for innovation and growth. It also brings new risks and challenges. And this might be most evident in today's manufacturing cyber landscape. Speaking at the Dataquest-Fortinet webinar OT Cybersecurity Best Practices in Manufacturing Industry Aasef Iqbal, Solution Architect, OT Cybersecurity, EMEA, Fortinet said that OT security solutions includes a wide range of security technologies – from next-generation firewalls (NGFWs) to security information, event management (SIEM) systems, and identity access and management.

There have been several OT attacks on the infrastructure over the past decade. Iqbal spoke about two attacks, specifically. The first was on SolarWinds Orion, which faced a ransomware attack on Honda, Fresenius, at the end of 2020. There was also an attempted poisoning of the Tampa Water Supply in Florida, USA.

"There are major security concerns, especially for remote access. This is applicable for any ICS/OT infrastructure, which includes HMI, PLC/RTU, sensors, and CCTV, etc. In

"THERE IS NEED TO DEPLOY DEFENSE-IN-DEPTH CYBER SECURITY. THIS IS ALSO KNOWN AS DEEP OR ELASTIC DEFENSE."

— **Aasef Iqbal,** Solution Architect, OT Cybersecurity, EMEA, Fortinet

the current situation, where we have COVID-19 lockdown, a lot of engineers are working remotely."

"The hacker accessed the facility and tried to add some chemicals via the HMI. There could have been poisoning of water and damage to the community. For the remote engineer, there is the remote desktop, as well as monitoring and diagnostics (M&D). The malicious actor can access those and cause potential damage to the systems and the environment. However, there are several ways to protect oneself," he said.

The second case was a little more complex. The attacker probably compromised the software distribution library using malicious code, making use of supply chain vulnerability.

The legitimate code was mixed with the malicious code. An engineer downloaded the compromised software distribution library, and that led to the attack. The attacker exploits the service provider/software vendor, and manipulates the legitimate code. The digital certificates and trust are exploited, and impersonate they legitimate code. It gave the attacker full access to the resources.

There has been an expanding digital attack surface. The perimeter is everywhere. There are various devices and users in the network, across the campus, branch, customers, etc. The access points will continue to grow. The industry outlook is of zero trust access. We need zero trust access across the network. There is knowing and controlling everyone and everything on and off the network. This ensures consistent security policy across the on-network and off-network assets.

There is need to deploy defense-in-depth cyber security. This is also known as deep or elastic defense. Multi-layered security approach is also known as the castle approach, layered security, layered defense, etc. It is similar to how microprocessors and OSs utilise protection rings architecture. This is very common in the IT and information security domains. We can have multiple systems having multiple security layers.

How do we apply defense-in-depth planning in ICS/OT? We first need to identify the threats and vulnerabilities. We need to secure the ICS operations, personnel, and technology, with physical controls, perimeter defenses and monitoring, internal defenses, policies/procedures, training, have situational awareness, and supply chain security. We can have proactive security as an iterative process.

We need to have vulnerability management, leading to incident response, and lessons learned. There are security controls, asset identification and management, threat and risk assessment, and training and awareness involved.

There are five key security counter measures that make defense-in-depth doable for industrial control systems (ICS) and operational technology (OT), as the US Department of Homeland Security (US-DHS). These are:

- Identify, minimise and secure all network connections to the ICS/OT.
- Harden the ICS and supporting systems by disabling the unnecessary services, ports, and protocols, enable available security features, and implement robust configuration management practices.
- Continually monitor and assess the security of the ICS/OT, networks and interconnections.
- Implement a risk-based defense-in-depth approach to securing the ICS/OT systems and networks.

"MANUFACTURERS HAVE NOT BEEN EXPOSED TO THE OUTSIDE WORLD SO FAR. DUE TO PANDEMIC, THE PHYSICAL AVAILABILITY OF A PERSON HAS BEEN ELIMINATED."

— **Ranganathan Iyer,** Group CIO and EVT-IT, JBM Group

- Manage the human — clearly identify requirements for ICS/OT, establish the expectations for performance, hold individuals accountable for their performance, establish policies, and provide ICS/OT security training for all the operators and administrators.

We need to combine the people and process with an integrated technology platform. The people point of view should cover the security governance, security awareness, and security culture. Process should cover the risk assessment, security architecture, and compliance audits. Technology should cover visibility, control, and actionable intelligence.

At the CISO level, we need to manage the risk. At the engineer level, we need to automate the operations. The challenge lies in the complexity, cost and slow response. As per a study by Ponemon Institute, organisations typically deploy on an average of almost 47 separate security solutions and technologies. This may also lead to multiple point products, too many alerts, slow response, and trained staff shortage. About 75% of the organisations state that their security teams struggle to respond to the security incidents within 24 hours.

Fortinet offers a broad, integrated and automated platform. The Fortinet security fabric provides a broad image of the entire digital attack surface to better manage risk. The integrated solution reduces management complexity and shares threat intelligence. The automated self-healing networks come with AI-driven security for fast and efficient operations.

In summary, it is wise to follow a risk-based approach so that defense-in-depth is doable for ICS and OT. Balance your cyber security investments, across the people, process, and technology. Cyber security automation is a key. There is need to adopt an integrated and automated cyber security platform.

OT MATTERS

This was followed by a panel discussion that was joined by Ranganathan Iyer, Group CIO and EVT-IT, JBM Group and Srikanth Subbu, CISO, TVS Motor Co, besides Iqbal.

First, there are lot of operational risks due to convergence of IT and OT. What is the CIO's take on these? Iyer said that OT security issues are there. Manufacturers have not been exposed to the outside world so far. Due to pandemic, the physical availability of a person has been eliminated.

Now, we are vulnerable, and it has created some fear. We were doing machine management for a limited level. Intelligence has been helping us, which are pandemic related and security related. We have certain areas where security has also increased. The mindset change has happened. We have understood we have to do remote machine maintenance, and monitoring, going forward.

Srikanth added that there are some challenges. "We have to see the environment. The IT area is protected. The OT area is gearing up. The OT areas typically have some old systems. Recently, some IoT-related systems have come in. We need to look at their vulnerabilities," he said.

Iqbal noted that connectivity has increased. There are interconnected global plants. There are also several critical infrastructures, as well. Hackers are looking to exploit such plants. The hacker may attack a toy manufacturer, so that it damages that company. We need to ensure that

"THE IT AND OT ARCHITECTURE IS IMPORTANT. WE NEED TO BE AWARE OF TECHNOLOGIES INVOLVED, AND PROPER INSIGHT OF THE INDUSTRIES."

— **Srikanth Subbu,** CISO, TVS Motor

the security controls are in place. We also need to educate the people regarding the vulnerabilities.

AWARENESS STRUCTURE

Regarding an awareness structure in place, Iyer said having the right mindset is very important. We have various facilities for security. We have insurance for all the machines. We are trying to get funds for security. We are working on protecting our data.

We are working with many OEMs, and some NDAs are already in place. We also need to have the history of activity. Data is also moving to the cloud. For the visibility of the whole process for management consumption, we bring that to the cloud, as well. We are focusing more on, who is doing what, how is the data being handled, and how it is being managed. Bringing on the latest security, along with the existing security will be done in a phased manner. We are still vulnerable, despite all of this.

Srikanth said the IT/OT architecture is important. We need to have a proper architecture in place. We need to be aware of technologies involved, and proper insight of the industries. We need to prepare a proper governance and control, also for the OT side.

Iqbal added that there needs to be balance. You need to have adequate security in place. From an IT point of view, there are mature, top-down approaches. In manufacturing, there are many concerns, including data classification. You need to optimise the cost. You need to assess your environment, develop your framework, and implement, as per the maturity of the organisation, and maintain and secure your environment.

As for the importance of tracking and reporting on compliance to security standards, Iyer said, we are not yet like the OEMs. We are on the exploration side. With respect to OT, we need to do risk assessment. We are creating a framework. Multiple CIOs are also involved. We are now finding a right balance. We will be deploying security in a phased manner in the future. Risk assessment has been helping us, and we are also learning from the internal and external discussions.

Coming to the security best practices that manufacturers can adhere to, Srikanth said that we need to identify the key areas and provide security. We need to build a strong security culture across the organisation. Vendor risk assessment also needs to be done on the OT area. There should be continuous threat detection and vulnerability management, as well, for IT and OT.

Iyer added that they are concentrating in OT. Awareness is required, along with risk assessment. Educating the manufacturing workforce around security is also needed. People are more bothered about production. They need to be aware more about what is being said to them. There should also be some improvements in the third-party ecosystem. Acting at the right time and getting the right inputs are also very important.

Iqbal noted that there are value additions. We need to implement security on the controls. We need to follow hygiene. We can also disable systems that are not operational or needed at any given point of time. If there is a greenfield deployment, there is need to look at automated solutions. Look for a solution where security is embedded within the platform. There is also need to have some detection technology that can provide you with actionable intelligence. We need to have centralised visibility with zero trust.

DQ Bureau
maildqindia@cybermedia.co.in

The server market remains **under the pandemic impact**

The overall market remained depressed in the fourth quarter but there are signs of improving demand from select sectors along with the government pipeline

The overall server market in India witnessed a year-over-year (YoY) decline of 11.2% in terms of revenue to reach USD 266.1 million in Q4 2020 (Oct-Dec) versus USD 299.6 million in Q4 2019, according to the latest IDC Worldwide Quarterly Server Tracker, Q4 2020. The x86 server market contribution grew to 92.9% in terms of revenue, a growth of 4.8 percentage points over the same quarterlast year.

The highest contribution in the x86 market mainly came from the professional services, telecommunications and manufacturing verticals. In the professional services vertical, original design manufacturers (ODM) and new-age IT companies witnessed positive YoY growth with respect to the server spend. At the processor brand level, AMD witnessed YoY revenue growth of 4.7 percentage points, claiming a revenue share of 8.4% at the end of Q4 2020.

The x86 server market in terms of revenue declined YoY by 6.3% to reach USD 247.2 million in Q4 2020 from USD 264.0 million in Q4 2019. The contribution largely came from the custom-built server category with revenue growth of 28.7% YoY. Hyperscalers continues to spend towards building robust data centres and support the global and local customer demands. The general-purpose server revenue declined 13.4% due to weakening demand across different industries. During Q4 2020, verticals such as utilities, resource industries, and securities and investment services witnessed the highest YoY growth in terms of revenue at 331.5%, 218.7%, and 160.6% respectively.

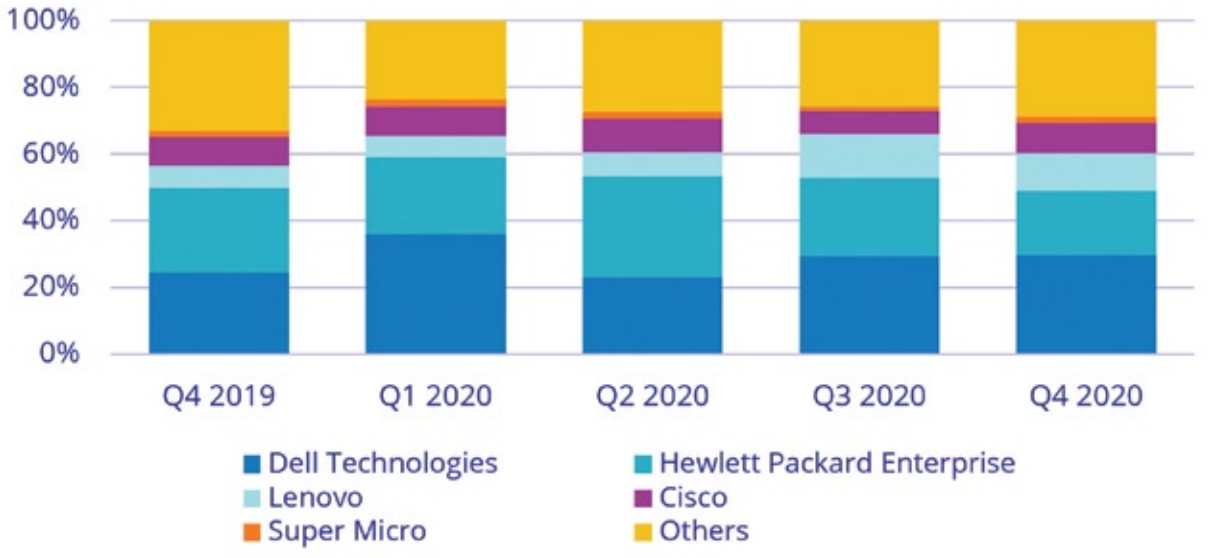
The non-x86 server market declined YoY by 47.1% to reach USD 18.9 million in revenue in Q4 2020. IBM continues to dominate the market accounting for 49.4% of revenue share, during Q4 2020 with revenues of USD 9.3 million. HPE came at second position, followed by Oracle with a revenue share of 27.8% and 8.3%, respectively.

In Q4 2020, Dell Technologies emerged as the top vendor in the India x86 server market with a revenue share of 29.6% and a revenue of USD 73.1 million. Top three verticals for Dell Technologies were professional services, banking and discrete manufacturing. HPE came at second spot with a revenue share of 19.5% and revenues of USD 48.2 million. Key verticals for HPE were telecommunications, discrete manufacturing and professional services. At number three is Lenovo with a revenue share of 10.9% and revenue of USD 27.0 million. Cisco came in fourth, accounting for a revenue share of 9.1% and revenue of USD 22.6 million.

> IN Q4 2020, DELL TECHNOLOGIES EMERGED AS THE TOP VENDOR IN THE INDIA X86 SERVER MARKET WITH A REVENUE SHARE OF 29.6% AND A REVENUE OF USD 73.1 MILLION.

AT PRESENT, THE X86 SERVER MARKET IN INDIA IS EXPECTED TO WITNESS A YOY GROWTH IN VALUE BY 29.7% DURING THE PERIOD OF 2020-21, ACCORDING TO IDC.

Top 5 x 86 server companies in India (Q4 2020, by revenue market share)



Source: IDC Worldwide Quarterly Server Tracker, Q4 2020

"During 2020, the server market failed to recover as it remains impacted due to the pandemic. For 2021, we expect the server market demand to grow across hyperscalers, local data centre players, telecommunication companies, banking and financial institutions, and manufacturing firms. Government pipeline looks promising and can expect spend in H2 2021," HarshalUdatewar, Market Analyst, Server, IDC India, said.

INDIA FORECAST

India's economy is on the verge of gaining momentum post-COVID-19 lockdown and the rollout of Coronavirus vaccines. From an enterprise spending perspective, investments are anticipated to come from global hyperscalers and local DC players, telecommunications vertical, banking sector, and manufacturing vertical.

Overall, telecommunications spending would be focused on network modernisation, VAS services, and preparing for 5G rollout. At present, the x86 server marketin India is expected to witness a YoY growth in value by 29.7% during the period of 2020-21, IDC stated in a press release.

DQ Bureau
maildqindia@cybermedia.co.in

R3 Fund invests **USD 10 million in 20 start-ups**

Enterprise software firm R3's Development Fund has announced that it has deployed over USD 10 million in capital across 30 investments in more than 20 of the early-stage blockchain and confidential computing companies. The Fund invests in innovative start-ups building apps on R3's enterprise blockchain platform, Corda, and its new confidential computing platform, Conclave. The Fund was launched in 2019 to support firms leveraging blockchain for global commerce and to further establish R3's presence in financial services, trade finance, insurance and digital assets.

David E Rutter, CEO at R3, said: "R3's strength is derived from its community, which includes a diverse range of start-ups from a myriad of industries – from insurance to education, supply chain finance to payment messaging – building and deploying apps for customers across the globe. The R3 Development Fund is already known in these industries as an expert strategic investor with a strong track record in backing the most promising early-stage companies."

"We recognise the importance and value of partnership and work very closely with all of our portfolio companies to provide support across a multitude of aspects, from fundraising to product and business development. We are excited to see so many of them going from strength to strength," he said.

With the launch of Conclave, the Fund expanded its investment thesis to include promising start-ups building with the confidential computing software. While the Fund's core goal is to further the adoption of Corda and Conclave in R3's core markets, it takes an opportunistic approach in other non-core segments such as digital advertising, media, healthcare and more.

Mavenir announces USD 500 million **private placement with Koch**

Koch Strategic Platforms (KSP), a subsidiary of Koch Investments Group, has announced that it has signed an agreement for a strategic minority equity investment in Mavenir. Affiliates of Siris Capital Group, a technology focused private equity firm, will remain majority equity holders, the company said in a press release.

Mavenir is the only US based provider of end-to-end, cloud-native software to meet the growing demand for 5G digital transformation by communication service providers ("CSPs") and enterprises. "KSP, which focuses on growth equity through four thematic sectors – computing and connectivity, industrial automation, energy transformation, and health care – is a natural partner for Mavenir's 5G transformational efforts," the release stated.

"We have built a next-generation software platform that has driven, and will continue to drive, the digital transformation of mission-critical networks. Together with KSP and our service provider customers, we expect to bring innovation and 5G to revolutionize industries such as energy, industrial automation, and health care," said Pardeep Kohli, President and Chief Executive Officer of Mavenir.

"Not only do we have the only end-to-end, cloud-native, 5G software platform in the world, but we also have strong and extensive relationships with CSPs and proven deployments of our technology around the globe. With 5G here, Mavenir is well positioned to build the future of networks," he added.

Infosys, bp to provide integrated **Energy as-a -Service solution**

Digital services and consulting company Infosys and integrated energy major bp have joined hands to work together to develop an integrated Energy as-a -Service (EaaS) offering that will provide end-to-end management of a customers' energy assets and services. The companies recently signed a memorandum of understanding (MoU) to explore opportunities using bp's energy and mobility expertise and Infosys' digital capabilities to manage energy assets, provide low carbon power, low carbon heating/cooling, and low carbon mobility to campuses. The initiative will be driven by an AI based digital platform.

"bp's integrated energy offer draws on technologies and businesses in solar and wind together with gas for power, fuels, electric vehicle charging, battery swapping and advanced mobility solutions," the companies stated in a press release.

The integrated EaaS solution aims to enable Infosys campuses to access reliable low carbon energy and mobility options, use energy more efficiently, and to optimize supply and demand across multiple users and assets, without having to invest in additional energy infrastructure. Following a pilot at Infosys' Pune campus, the companies intend to extend the offer to other Infosys campuses and explore opportunities to manage energy and reduce emissions at industrial and business parks as well as cities.

"Infosys achieved carbon neutrality in 2020 – 30 years ahead of the timeline set by the Paris Agreement. bp has an ambition to become a net zero company by 2050 or sooner and help the world get to net zero. Together both companies see potential in applying digital services to integrated energy solutions and help decarbonise corporations and cities," the press release said.

FarmersFZ makes unit-level traceability **possible for vegetables**

A nascent agri-tech firm under the Kerala Startup Mission (KSUM) has come up with the country's first system that enables the consumer to detect the origin of the branded vegetables in the market. The Kochi-based Farmers Fresh Zone has introduced a unit-level traceability feature called 'Know Your Farmer' as part of quality control, facilitating regular checks to ensure non-toxic and pesticide-free products.

"We run on a simple philosophy: connect rural farmers with urban customers by sourcing produce that is fresh as well as pure produce, delivering it at their doorsteps," said Pradeep P S, the CEO, FarmersFZ. The firm, which provides access to safe-to-eat fruits and vegetables that are directly sourced from the farmers, has been disrupting the highly unorganised agriculture sector with its unique features. "We are earning immense support and appreciation from the customers and farmers," Pradeep said.

FarmersFZ, which operates from four Kerala cities, achieved a five-fold growth in the 2020-21 fiscal. "With focus only on fruits and vegetables, we are India's first startup in the direct-to-consumer sector to cross one million dollars in revenue in a financial year," the CEO revealed.

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Rajiv Pathak | rajivp@cybermedia.co.in | 8010757100

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