In a conversation with Mr. Sankar Kumar Rajan, Global Head – Rail & FMCE, Transportation Business Unit, Tata Elxsi

Metro Rail News Team conducts an email interview with Mr. Sankar Kumar Rajan, Global Head – Rail & FMCE, Transportation Business Unit, Tata Elxsi. He talks about AI, machine learning, and analytics for rail industry along with rolling stock market and cybersecurity. Here are the excerpts:-

• Can you tell us the market growth for the Rail industry in general and Rolling stock in particular? What are the current trends? Moreover, what are your recent development in the rail sector in India?

With an ever-growing need for environmental protection, Rail transportation is increasingly becoming an attractive option. Further, the rolling stock market is driven by the increased demand for passenger transportation which is directly an outcome of rapid urbanization. Factors such as increased rail infrastructure investment and rail network development are also influencing the market's growth. To enhance network capacity, existing rail infrastructure must be upgraded, which is again fuelling the industry's growth.

The transition from traditional railway signaling systems to modern signaling systems has been massive during the previous decade. Sophistication in signaling and advances in communications enable fast trains to run very close to each other without compromising safety. Improving capacity results in reduced operational cost and more profit margins remains a key business and technology driver. With a modern communication-based system that uses radio communication, CBTC is the choice for mass-transit railway operators today. The need for bandwidth is now more than ever before, as most of today's internet traffic from inside the train is driven by running video-centric applications. 5G communication networks and technologies could provide the answer to this need in the future.

Another growth area is railway automation, a critical component in increasing capacity, reliability, energy efficiency, safety, and cost-effectiveness. In the future, railway operations will be more and more autonomously operated, allowing metro systems worldwide to operate automatically up to the most outstanding grade of automation (GoA 4).

Tata Elxsi is well-positioned to offer wide-ranging ER&D services to rolling stock OEMs and signaling system suppliers. We have experience developing various algorithms and software platforms that can be used to integrate multiple sensors – Lidar, Radar, Cameras for rail use cases of detection of objects/people on the platform for passenger assistance, detection of objects on tracks for collision avoidance, etc. Additional sensors will be a key enabler to introducing driverless, automated trains of the future.

• How are cutting-edge technologies such as AI, machine learning, and analytics used in the rail industry?

The rail industry is ready to adapt and integrate new developing technologies to achieve the next level of efficiency and effectiveness. We can see how AI and machine learning are being utilized in rail applications to improve train scheduling, regulate train speeds. These AI applications aid public safety, deliver customer value, and overall train management and operations optimization.

In railways, big data comes with a network of interconnected systems. Cyber-physical systems, the Internet of Things (IoT), and cloud computing are all part of the big data architecture, which work together to produce "Smart Railways." Rail infrastructure providers can reduce costs by using these emerging technologies to replace the manual inspection of wayside assets with automated inspection and health monitoring. Efficient asset management and predictive maintenance are the beneficiaries of digitalization.

Tata Elxsi enables customers in their digital journey by providing engineering services for robotics, video analytics, natural language processing services, edge computing, data modeling, and visualization that aid in a faster return on investment. Also, our repository of ready to integrate "solution accelerators" for a cloud-based system can help turn

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around solutions quickly, aiding our customers to reach the market faster.

• What are the most recent breakthroughs in rolling stock testing and simulation?

For rolling stock product testing, comprehensive and rigorous validation techniques are implemented to ensure product consistency and reliability to meet dynamic regulations. A range of test solutions, test frameworks, and automation services are in high demand across industry verticals to reduce time-to-market by minimizing test cycles and improving quality and efficiency.

More frequent adoption of model-based systems engineering is helping in crunching the product development cycle. Failures found later in the life cycle of on-train testing can affect deadlines and cause penalties. MBSE, in its full-fledged deployment, can enable the left shift of the entire V cycle, which saves cost and time for the customer.

The use of virtual reality experience helps the stakeholders to simplify purchasing decisions and create strong brand loyalty. With the aid of immersive technologies like AR and VR, OEMs are delivering the look and feel of the final product by providing a more

realistic comparison than ever before. The product's digital twin comprises the entire vehicle, software, mechanics, electrical and physical behavior. This allows simulating and validating each step of the development to identify problems and possible failures before producing real parts.

Our capabilities in advanced system engineering practices, HILS validation, test rigs, Modelling & Simulation on the left side of the V cycle, and in general Verification and Validation services at all in the various stages of the traditional "V" model of product development helps us deliver great value by assuring product quality throughout its development lifecycle.

• What is Smart mobility, and what are the value-added applications in this area?

From a train operations perspective, smart mobility could also mean extensive adoption of advanced wireless signaling systems such as CBTC, ETCS L2/L3. However, another critical and often used definition for smart mobility in rail is prioritizing improved "Passenger experience." The key drivers for adopting various digital technologies like Real-time data analytics and machine learning algorithms are all passenger-centric. The focus is to increase passenger convenience, passenger comfort, passenger security to make travel safer and more efficient. It allows people to make their modal choice and provides them with all the necessary information and alternatives. Automatic detection of obstacles on the track and appropriate decision-making could also be construed as smart mobility. Availability of smart mobility applications could be a key decision point for train operating companies when they choose their rolling stock supplier.

Tata Elxsi's rich experience with vision-based systems development could help understand the seat occupancy status of trains and crowd distribution of platforms to aid passenger experience. The same capability could help detect wayside elements/signs/tracks for remote monitoring, obstacle avoidance, etc. Our rich experience working in passenger vehicles, especially in the V2X domain, also opens up further possibilities for realizing seamless intermodal mobility. Our KOIOS – Intelligent Transportation

System is our platform that recognizes the inter-modal way for the road transport scope and could be extended further to connect to the rail network.

• How important is cybersecurity in the future, and how are rolling stock manufacturers tackling these cybersecurity challenges?

The increased degree of connectedness for both rolling stock and infrastructure in today's digitized world provides higher levels of operational efficiency and passenger convenience. Still, it must be monitored and secured by manufacturers, equipment manufacturers, and even operators as the digital transformation in the Rail industry could also increase the vulnerabilities to cyber threats.

To address the cybersecurity challenges, rolling stock manufacturers could integrate the information system security right at the beginning of the product development. They should identify and recommend strategies and techniques to prevent and detect adversarial breaches, identify architecture-level strategies for mitigating attacks, do cyber assessment and life cycle Process to incorporate cybersecurity into the relevant cyber-physical systems, and make sure the systems comply with region-specific regulations.

Tata Elxsi is leveraging its deep expertise in multiple domains such as

transportation, media, communications, healthcare and has been helping its customers build secure products and solutions. We leverage our multi-domain experience in cybersecurity from an ECU level to a network level to offer digital security services.

• Which are the industries that have contributed to Tata Elxsi growth in the past few years?

Tata Elxsi primarily serves industries such as transportation, media & communications, and medical. While transportation & media communications are the established businesses and contribute nearly 90% to our top line, Medical has been our fastest growing division in the last couple of years. Now we are also working to develop our Pharma business. In transportation, automotive leads the numbers, and we are increasing our growth in adjacencies like the rail and off-highway segment, where we see exciting growth opportunities.

• How is the confluence of design and technology playing out in transportation, especially in the green transportation and rail sectors?

As more governments acknowledge the need to cut carbon emissions and the value of adopting a green transportation system, the rail industry is witnessing a considerable push toward green technologies.

The convergence of design and technology also fuels the green transformation of the rail industry. One example of how design and technology collaborate to promote green technologies is virtualization. Rolling stock OEMs can use virtualization during pre-vehicle testing to imitate real-time situations and systems, resulting in fewer machines running and lower power consumption.

Electrification and the usage of hybrid technologies in rail have also aided the transition to green transportation. Hybrid trains contain onboard energy storage systems, continuously powered by a regenerative braking mechanism, which means lesser fuel consumption. In addition, the widespread deployment of electric locomotives and EMUs have benefited in cutting emissions.

Hydrogen fuel cell trains could pave the way for a renewable energy rail system. Cost considerations will, nevertheless, play a role in any new technology adoption.

• **What are uncommon innovations or technologies you are introducing in the rail sector?**

Tata Elxsi brings together the latest technology and user-centric design expertise to assist customers in delivering innovative solutions and exceptional customer experiences. Our integrated design, digital, and technology teams help enterprises reimagine their products and services – from strategy, consumer research and insights, to service and experience design, technology implementation, integration, launch, and beyond.

At Tata Elxsi, we work closely with customers - from advanced R&D in new technology and system architecture exploration to actual development, validation, and deployment. We have solutions that help global companies move beyond proof-of-concept to building scalable products faster. Our ADAS, connectivity, V2X, validation, and other automotive solution accelerators are currently customized to support various rail industry applications

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