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How 5G and smart cities will change metallurgy

The 5G mobile network is expected to enable truly automated businesses. It will make it possible to improve manufacturing processes through the development of intelligent technologies such as AI sensors and real-time data transmission. How exactly can the steel industry create a competitive advantage amid the development of new technologies?

On 3 April 2019, former Olympic figure skating champion Yuna Kim became the world's first 5G subscriber. The advent of 5G technology heralds an era when humans will finally transcend time. Now, we can forget about delays in receiving or transmitting information anywhere in the world. While 5G networks have not been fully commissioned yet, and the effects of this technology are still being conceptualised, it will not be long before subscribers can take full advantage of these services.

To understand why time delays are so important to industry, consider the following example. When an autonomous robot detects an error and stops work in a plant, there is a time delay before the signals detected by the sensors can be processed and transmitted to the control unit. Solving this problem requires the installation of special programmes performing arithmetic calculations, which leads to increased equipment costs. Controlling equipment online using cloud solutions can significantly reduce the amount and cost of the necessary equipment. In this case, time matters. If the equipment can respond faster than humans, it will be a major breakthrough.

Currently, controlling the production processes of a steelmaking plant with minimal delays requires an on-site control centre. However, if signals can be transmitted smoothly and ultra-fast over long distances, a control room located anywhere can simultaneously control several similar enterprises.

Another example is connecting people throughout an organisation. Many companies hold remote online meetings these days. Video conferencing may malfunction if the video and audio bit rates are not satisfactory. This problem can be solved with the help of 5G technology. Online meetings have the power to make people feel like they are

talking to each other face to face without any delay in communication. If you add a three-dimensional holographic image, it will feel like holding a conversation with a real person, even if they are actually on the other side of the world.

The commercialisation of 5G technology will quickly change the life of society. The expansion of co-working space will be the next step in changing the working ecosystem. If large companies and government agencies place their co-working spaces near the residential areas where their employees live, this will significantly reduce the time and material costs of staff logistics. It will also reduce the carbon footprint by decreasing the amount of commuting.

Fewer people will buy cars. There is already a significant decline in car sales in New York, Tokyo and other major cities. The number of driving licences being issued is also declining. This approach is changing the landscape of the automotive industry.

Today, it is common for several colleagues to share one desk at their workplace. Moving from desk sharing to remote office sharing will not take long. Greater business opportunities will be available to people when they can meet and exchange ideas with colleagues from different teams or companies.

Autonomous cars are an example of a futuristic technology already in use. These cars collect traffic information to find optimal routes and use sensors to identify risks by tracking the movement of nearby cars. Intelligent autonomous car technology will evolve through the significant increase in communication speed with the ‘big data’ cloud servers responsible for processing information. The roll-out of 5G technology will help to complete the real-time intelligent control systems that autonomous cars need.

The coming years or decades will see more significant change than the last century. Lifestyle changes will drive a fundamental transformation of the manufacturing and consumer sectors. The question is who will be the first to take advantage of these opportunities. In material industries, the first companies to adapt to the new rules of the game will undoubtedly take the lead.

The Korean Institute of Metals and Materials (KIM) has identified five future material-related issues:

- Adapting to a new climate normal
- Preparing for a super-ageing society
- Improving disaster management
- Ensuring continuous economic growth
- Fostering a close-knit society

KIM has suggested the following types of materials to address these five challenges:

- Materials adapted to climate change
- Biomaterials for health
- Safe materials
- Environmentally friendly materials
- Intelligent materials

For the steel industry, materials of the future that are adapted to climate change, safe and environmentally friendly will be increasingly important. The social changes brought about by 5G technology are closely related to the construction of smart cities using materials of the future.

Prosperity of future megacities

Modern megacities are mainly composed of business and residential areas. People commute long distances from where they live to where they work every morning and then return home in the evening. Long-distance work commutes will disappear if co-working spaces become commonplace near public transport stops. People will be able to go to co-working spaces in the suburbs near their homes, creating new business opportunities through interaction with people from other companies. Unlike in the past, when people worked with the same group of people in the same office, interacting with representatives of various sectors will help them to take a more creative approach to developing business solutions.

The time that was previously spent on the road will be available for self-development and relaxation. Sport and entertainment facilities, including theatres, indoor sport centres and tennis courts, will expand and the small businesses serving their communities will thrive. A more diverse range of buildings will appear in such cities and there will be an abundance of projects to reimagine old urban centres.

Steel will remain the most suitable construction material to actively adapt to a rapidly changing society. Rising labour costs and stringent environmental restrictions in construction will see steel once again replace concrete as the most popular construction. In the UK, where steel is widely used in construction, it is easy to purchase steel components. However, this industrial structure is less developed in Asian countries, where concrete buildings prevail due to low labour costs. This is one of the main reasons why it is so important to develop various types of new structural steel materials. In addition, the steel industry needs to inform consumers about the benefits of steel as a construction material.

Creation of new logistics systems

Although the mobility of people may decrease, the volume of freight traffic is projected to increase. The flourishing of e-commerce businesses like Amazon has made logistics one of the most important industries of the future. SoftBank chairman Masayoshi Son, who has made a significant profit on his investment in China’s Alibaba online shopping chain, recently invested in the Korean e-commerce company Coupang, highlighting the importance of this area. The distribution of goods will play a crucial role. The rapid delivery of large volumes of products will require new types of transport systems connecting farms to cities and businesses to communities. In this respect, it will be important to improve energy efficiency and reduce pollution in a future when mass logistics becomes standard practice.

The development of materials for transport, including cars, trains, ships, planes and drones, is primarily focused

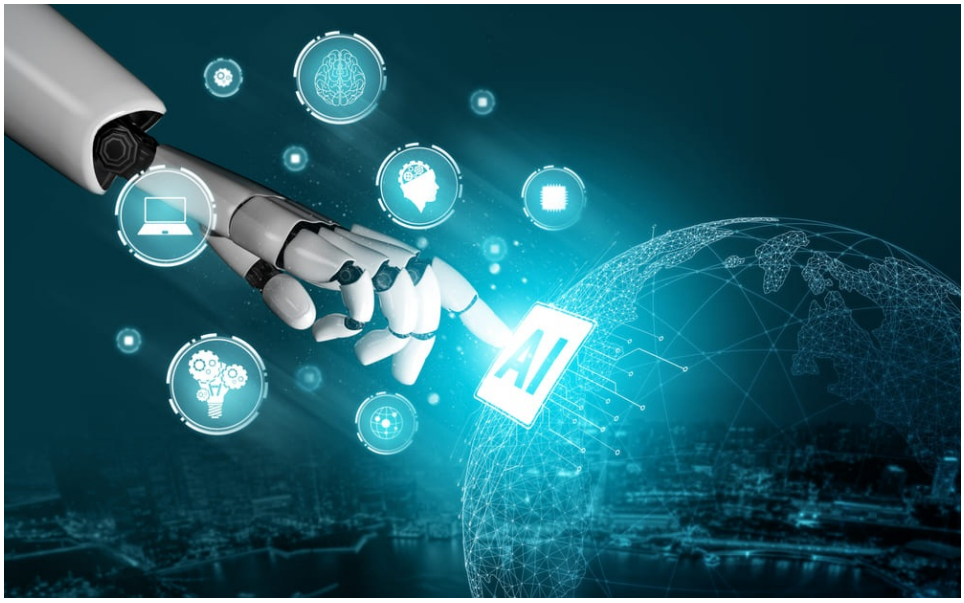
on weight reduction as a means of improving energy efficiency.

While steel has long been more profitable than its alternatives, it is being challenged by lightweight materials. Improving fuel efficiency, especially for the automotive industry, has become a topical issue given increasingly stringent environmental standards. The US government aims to achieve a vehicle fuel economy of 23.9 kilometres per litre by 2025. The global automotive industry is seeking to improve fuel economy by an average of more than 50% by 2025.

The steel industry is preparing for this situation by developing a new generation of automotive steel. One example is the high-strength Fe-Mn-Al-C alloy, which is made 10% lighter than conventional manganese steel by adding 5-10% aluminium and, therefore, more competitive in engineering design. The disadvantage of light steel is usually a tensile strength of less than 1 GPa. To solve this problem, precipitation hardened martensitic steel is being developed and an analysis of more efficient use of retained austenite is being carried out.

Aluminium is one of the fastest growing materials for use in vehicles, and carbon fibre-reinforced composites and titanium are increasingly being used as materials for the aerospace industry. While steel is used for aircraft landing gear, its scope of application is dwindling. To reduce the weight of high-speed trains, the proportion of steel frames in railway rolling stock is decreasing, and high-strength aluminium extrusion alloys and aluminium plates are increasingly used in lightweight frames. Recently, extensive research has been carried out to reduce the weight of frames and interior materials using flame retardant magnesium alloy. TGV Duplex is the first high-speed train to use seat components made from AZ91 magnesium, which is 16.7% lighter than conventional aluminium alloys. Korea's KTX high-speed train also uses magnesium alloys for seat components, allowing for a reduction in weight by as much as 35.6%.

In shipbuilding, steel is increasingly being replaced by corrosion-resistant aluminium alloys for both high-speed vessels and pleasure craft. For the logistics industry, when the cost of energy to transport a specific volume of cargo exceeds the cost of materials in transport, a wider selection of materials will be available. Consistent with these changing trends, the market research company Markets and Markets reported that in 2014, the production of aluminium, magnesium and titanium grew by 9.2%, 8.0% and 6.3%, respectively.



To reduce pollution, fossil-fuelled vehicles may be driven out of the urban logistics industry. The Hyperloop, a future high-speed transport concept pioneered by Elon Musk, can be used for long-distance journeys, while electric vehicles or drones can be used for rapid, short-distance deliveries.

Due to the heavy weight of batteries, weight reduction is an important issue for electric vehicles. The steel industry is actively working to meet this demand using advanced high-strength steel (AHSS).

Steel pipes seem to be the most suitable material for creating a hyper-loop for cargo. While a passenger hyperloop may require alternative materials to reassure people who may feel uncomfortable inside opaque steel pipes, steel is the most cost competitive option for a cargo hyper-loop. Eco-friendly container vessels or transcontinental trains can be used to transport transnational and transcontinental cargoes.

Suitable city systems

Megacities around the world have one common feature: it is difficult for them to raise the huge funds needed to reimagine their cities. Since buildings have a lifecycle of more than 100 years, restoration costs are usually not included in the calculation of costs for their construction, falling on the shoulders of future generations. As a result, major cities around the world are becoming fatigued. To create more sustainable urban systems, the cost of building restoration needs to be budgeted for from the outset. Urban design should take into account the

optimisation of urban energy consumption and re-use of materials.

Steel is undoubtedly the most competitive material for sustainable urban design. Since almost 90% of steel structures are recyclable, steel is the most suitable material for green cities. If reducing energy consumption and resource circulation are the top priorities in material development, improving the weight of high-strength steel may be a solution. The development of modular buildings will require significant changes, for example using new steel materials such as printed coloured steel plate. Such steel materials must be able to withstand earthquakes, typhoons and fires. Further technological development will be needed to solve competitive price problems, including noise and thermal insulation.

Need for innovation in steels and alloys

Historically, technological development has driven social transformation. It was only after the industrial revolution that workplaces were separated from places of residence. Flats, the most common living premises, were built to accommodate the growing number of urban workers. The industrial revolution brought profound changes to a way of life that had existed for centuries.

During the First Industrial Revolution, steam engines created value through mass production. During the Second and Third Industrial Revolutions, the introduction of automation using electricity and information technologies led to a breakthrough in manufacturing. Mass production has reduced costs, which in turn has expanded markets and increased sales. Meanwhile, it also has led to unsustainable use of energy and resources, which has caused numerous environmental and social problems.

The Fourth Industrial Revolution in the field of data will also bring about seismic changes in people's lives. The advent of 5G telecommunications will allow for better use of valuable information. Customised mass production solves the problem of wasted resources while changing lifestyles. The Fourth Industrial Revolution will bring workplaces back to residential areas. Perhaps, distant and even broken relationships between families and neighbours can be rekindled. New communities can be created.

New opportunities will emerge for some social groups that were previously overlooked. The question is who will be the first to respond to these changes. A profound transformation of society is not far off. It will test the strength of the steel industry, where the ability to quickly adapt to these changes will be the deciding factor.

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