Internet of Things for Smart Steel Making

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Abstract—***The manufacturing of steel is quite a difficult process which consists of a combination of legacy system and high-tech machineries. For making steel, initially the iron ore is dug out from the earth. After that it is smelted in the blast furnaces where the impurities are eliminated and the addition of alloys is performed. The constant observation and instantaneous remedial actions are needed at the time of manufacturing. This makes the job of the operators in steel plant extremely monotonous. In order to overcome that, the importance of Internet of Things (IoT) is revealed in this paper. IoT refers to the interconnection of physical devices around us to the Internet to make it as Internet worked.***

Keywords— ***Internet of Things, Manufacturing, Steel.***

I. INTRODUCTION

Today steelmaking plays a vital role in the development of society [3]. The use of technological advancement in steel industry not only changes the process of steel making but also the whole industry structure. The steel industry stimulates the growth of a nation and acts as the economy enhancer for the countries industrial growth [6]. The major industries like ship building, automobile, railway, construction, energy sector rely on the accessibility of steel and as a result it becomes the backbone of each and every industry [11]. From the environmental safety and ecology perspective, steel is one of the finest substances to use. A substantial part of components made of steel can be used again as scrap for manufacturing of new steel goods. Those steels which are not reused gets decay rapidly and does not produce any harmful to the surroundings. Only a small amount of steels were made by 19th century. After the Bessemer process invention during the 19th century and succeeding technological improvement in process control, huge amount of steels were produced. The continually increasing requirements for the consumers and producers for the quality of steel materials won't be accomplished without the use of automation. Recently the steel manufacturers are looking forward for the innovative technologies to improve the steel production [4], [7]. The steel industries can be made smarter by employing one of the most advanced technologies called Internet of Things (IoT). By the use of IoT the operators can monitor and control the machines in the industry over the Internet [1], [8].

II. STEELMAKING PROCESS

The steelmaking route is shown in Fig. 1. Today the steel industry uses recycled as well as traditional raw materials. At first the iron is to be made as it is the major element of steel. In a blast furnace coke, lime and iron ore are melted. Then the molten iron obtained from blast furnace is formed. Basic Oxygen Furnace (BOF) and Electric Arc Furnace (EAF) are the two main processes for producing steel. In BOF steel making, the steel scrap is added to the molten iron and the oxygen is blown through the liquid to eliminate the impurities. In EAF steel making, the steel scrap is added to molten iron and heated to about 1650° C in the electric arc furnace.

In order to meet the ideal steel properties the newly produced molten steel is to be fine tuned. The fine tuning may be carried out either by controlling the temperature and/or by taking out certain components. For this purpose the methods like stirring, argon bubbling, vacuum degassing, and ladle injection are used. Next in the cooled moulds the liquid steel is poured to cool the metal faster. After cooling it is cut into required sizes based on the end use. For example blooms for beams and billets for wiring. The initial shapes of blooms, slabs, and billets are made into variety of shapes by means of hot rolling. The hot rolled products are separated into flat products, faultless tubes, and forte products for final processing stage. At last, various secondary forming methods like machining, coating, shaping, and jointing provides final shapes and properties to the products [10].

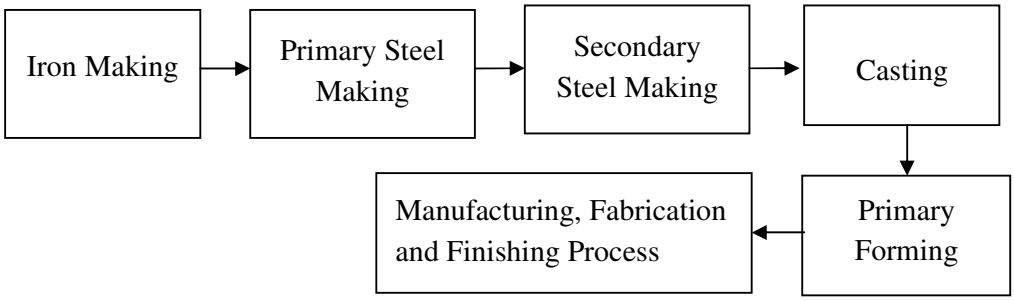

Fig. 1 Steelmaking route

III. INTERNET OF THINGS (IOT)

In the year 1999, technologist of the UK, Kevin Ashton introduced IoT. The idea is to allow computers to collect information with their own ways. Until now the information in the Internet is created by humans. Now it's the time to allow the devices to create data that should be given to the Internet and stored in the cloud. A comprehensive study can be made on the collected data with the help of Big Data systems to bring out some useful resolution. IoT represents the group of devices, which has embedded technology to communicate with the outer world or with its own internal conditions. In IoT, the devices are linked to the Internet all the time and at any place. The IoT makes normal things like sensors and fans become Internet facilitated, environmentally known, with the capability to communicate with its environments. A clear idea is needed about what are people, systems, things, network, and communication that form the fundamentals of IoT [2].

A. *Three As of IoT*

The three A's of IoT is described in Fig. 2. An IoT system can be easily identified with the help of three A's.

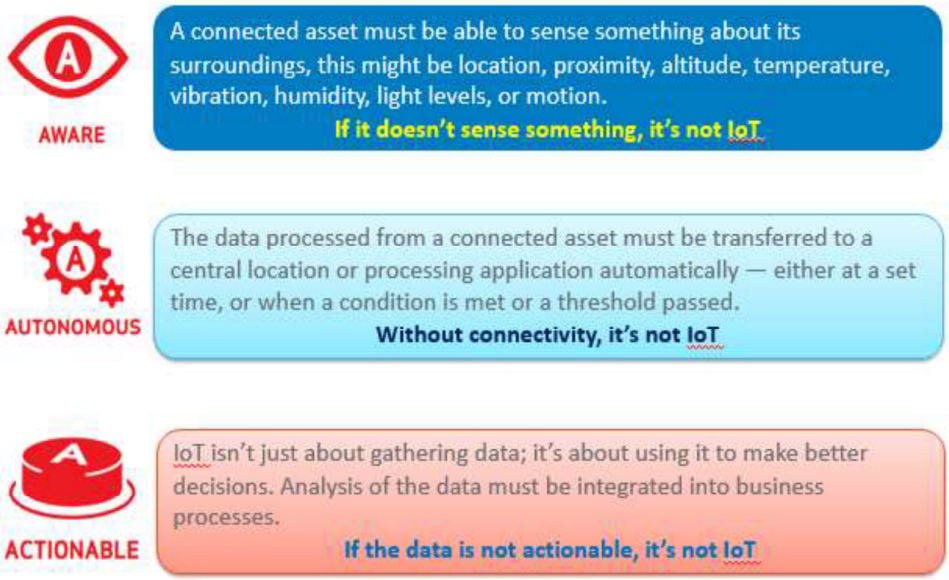

Fig. 2 Three A's of IoT

B. *IoT Solution*

The IoT solution consists of many parts and those are discussed in Fig. 3. The parts are sense, transport, store, analyze, control, and share.

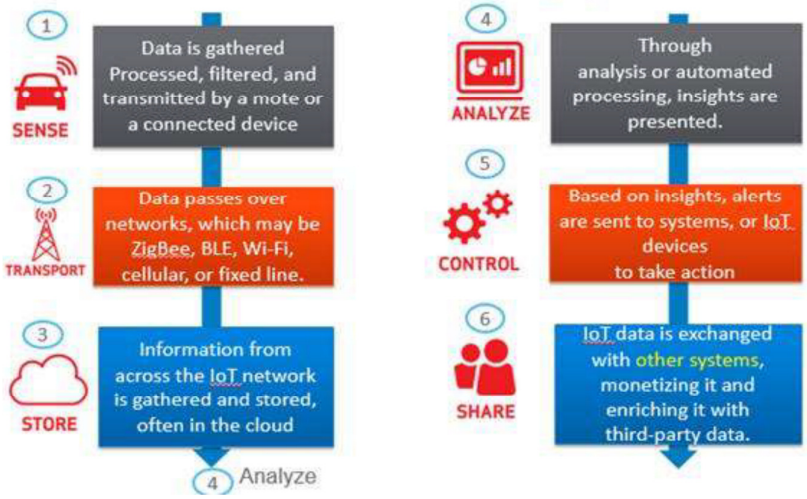

Fig. 3 IoT solution

C. Vision of IoT

The DIKW pyramid is shown in Fig. 4. The DKIW represents Data, Information, Knowledge, and Wisdom. In future, tons of data will be created by IoT. Those tons of data have to be analyzed for a provided context to obtain meaningful information. The useful information gives rise to knowledge and the wisdom is acquired by provided set of reflections and insight to knowledge.

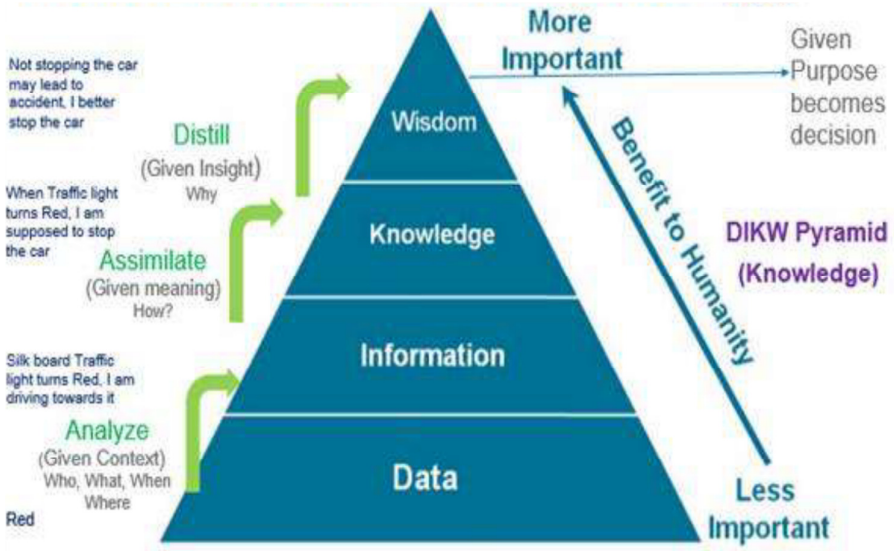

Fig. 4 DIKW pyramid

In future, almost all things will be enabled through Internet either directly by wireless communication or indirectly by Bluetooth or ZigBee linked to user's smart phones. Battery life is one of the important factors to be considered in the era of IoT. Nowadays ZigBee, Bluetooth LE (Bluetooth Low Energy) and Zwave are the well-known protocols to deal with that. The next vital factor to be considered is the privacy and security. Wireless connectivity, microcontrollers, sensors, smart phone applications, Big Data, and Cloud computing are the thrust for IoT.

D. Industrial versus Consumer IoT

The IoT is classified as industrial IoT and consumer IoT. The comparison between that two is shown in Fig. 5. For consumer IoT, the home automation is the main focus and industrial IoT focuses on smart factory, buildings, city, machines, grid, and e-health [5], [9].

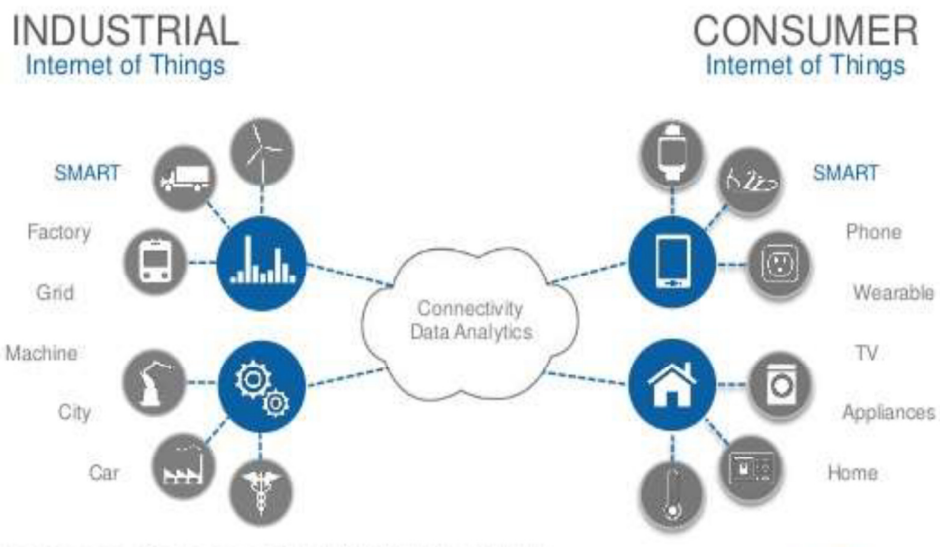

Fig. 5 Industrial versus consumer IoT

IV. CONCLUSION

Steel production in the steel industry comprises of many stages. Each and every stage is monitored and controlled by humans. All the stages are interrelated. This paper emphasized that the Internet of Things (IoT) technology can be used in steel plants for better monitoring and control. This in turn may help the operators in steel industries to take decisions faster, reduces the wastage of materials, and increases the production, quality as well as customer satisfaction.

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