INDUSTRY 4 AND INNOVATION IN PROCESS SAFETY OF SMART FACTORIES

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ABSTRACT

Developing technology leads to innovations in the field of industry, while information technology started Industrial 4, which is called Industrial Revolution. The biggest problem of Industry 4, which is rapidly integrating into mechanical production lines, is the cyber-attacks that threaten the information integrity. Smart Factory period has started with the transfer of control technology of Information technology which makes life easier to the chemical production processes. In smart factories, devices, systems, robots and all the objects in the network are communicated with each other by a certain protocol and carried out by the concept of Internet of Objects or Systems.

Particularly in smart factories, it is inevitable to experience catastrophic accident by the operating parameters go out of control, as well as economic impacts by cyber-attacks. The healthy establishment of the security management of Smart Factories requires proper planning of the "Safety Instrumented System" design done next to the process design. This design can be carried out with remote secure access considering all possible risk combinations, and the establishment of accessing to system in when logical decisions can be necessary in complex situations.

Keywords: Industrial revolution, Internet of Objects, smart factories, cyber security, process security

INTRODUCTION

Human beings had been making innovations that would make life easier with the use of human powered mechanical tools while maintaining the livelihood by agriculture and farming till the beginning of the industrial revolution. Starting with the Industrial Revolution, which started with the use of water and steam powered machines since 1787, the period of Industry 1 started which made the mechanization of industry. In this period, although mechanically assisted equipment operating with water and steam power had entered the industry, their use had been intensified in the textile sector which often requires low power due to low efficiency. This first revolution, which took place in industrialization, has also been very influential on the shift of rural life to cities. The way to the use of electricity from the discovery of static electricity discovered by the Greek philosopher Thales (640-546 BC) extended to the 19th century by the lead of Nikola Tesla's commercial use of electricity, with work on AC motors and multiphase electrical distribution systems. In the second half of the century, the use of electricity in the industry started with the construction of energy distribution lines. With the Industrial 2 period in which the efficiency of the steam power generation in serial production has increased by use of electricity, great development in the industry had been come. In this period, the concept of production line emerged and the first steps towards serial production were taken. In the 1970s, the increase of production efficiency and the introduction of computers into control created a new era in industrialization and started factory automation with the period of Industry 3. This industrial revolution, which has been going on at an unbelievable pace in the last two centuries, has begun the production period by machines that can be controlled in the digital environment by crossing the international borders which are called Industry 4 because of the adoption of information technology and the use of internet as a part of life. In this period, the intelligent technology path was opened with the connection power provided by the internet in addition to the possibilities of the three step development of steam, electricity and computer. The Industry 4 is called as Industrial Revolution with the unbelievable operational simplicity that it brings when it entered to the area. The Industrial Revolution was first used in 2011 at the Hannover Fair in Germany. By entering the remote automation in the field industrialization has gone inevitable acceleration. Adapting to Industry 4 has been inevitable by the innovation that comes with the developing industry.

INDUSTRY 4 AND EMPLOYMENT

While the industry 4 provides digital transformation in production and services, it also leads to changes in the way of the performing the work. It is a definite fact that the work and production will be carried out by robot automation. Weaknesses in decision-making mechanisms and the inability of robots to bring creative solutions to complex problems will increase rather than reduce the need for man. In the period of Industry 4, creative thinking will come to the forefront. A situation where the robotics system is weak in decision mechanisms is also a security issue.

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INDUSTRY 4 AND SMART FACTORIES

Internet use and data sharing have revealed new concepts. The Internet of Things (IoT) is a concept of information technology, defined as a world-wide network of uniquely addressable objects, and the objects in this network must communicate with each other through a specific protocol. Nowadays, the ease of way working of companies by communicating and sharing the knowledge through an intelligent network using whole devices by various protocols has made the internet concept as a part of the working life and the terminology of the Internet of Systems has also been introduced. With this system, intelligent sensors, interactive linked robots and so on, the combination of the superior power of data technology opens the faster and more efficient production way with lower costs. In addition to smart phone, smart home terminologies, to control of production line by the connected chain of production devices and decisions taken by themselves using of information technology have now become widespread intelligent production.

INDUSTRY 4 AND PROCESS SAFETY

In addition to the control of the production line, automation of process safety was been achieved by entering of computers to industry. Single use of computer technology could have prevented it from unauthorized entering to system, but the spread of information raises the risk of accessibility and confidentiality of information and therefore loss of integrity of knowledge. The first thing that comes to mind when it comes to high-data-sharing over a large network is security. In addition to accessing and misusing personal / company information, cyber-attacks are also used as a bad tool in the economic area. Not being exposed to the destructive effects by misuse of the computer, as a means of attacking the morale of society by limiting the daily life services in the field of terror emphasizes the importance of cyber security. Discussion as the cyber war, cyber army concepts in the international area has also become a subject. If there is not enough improvement in the safety and measures are not taken by the companies the situations of negative effects on the development of Industry 4 is inevitable.

Cyber safety requires preventive measures for reaching and interfering the systems, and this area is supported by information technology. So, the issue of information security for Industry 4 is just a cyber-area? The cyber-attacks of intelligent factories will not be limited to the destructive economic impacts caused by production losses. The safety vulnerability can lead to catastrophic accidents that can be transformed into faults in production lines where technological devices are used in connection with each other. In intelligent factories, can this possibility only be occur by a cyber-attack? At this point, it is very important for smart factories how to achieve process sustainability and safety. The widespread use of safety systems in the industry was aimed at protecting the plants rather than production rate. The safety facility based on the principle of sensor warning and remote monitoring also provides advantage in terms of business efficiency by monitoring of personnel. Cyber safety should not only be limited to data protection but should also provide a way approaching the safety of the process in the Smart Factory period.

The industry 4 has also led to innovation in security. In this innovation in which planning of maintenance and repairs activities to prevent interruption of production is considered, in addition to the preventive shields to unauthorized entering, the system must allow the intervene of authorized person in case of complex events occur that would put the process integrity in jeopardy. In Intelligent Factories where security management system is not well integrated, wrong information intervention may take place when needed. Because of this, it is necessary to set up the Internet of Systems with suitable software related to operation continuity. In the prevention of process accidents caused by equipment failures, including design and installation errors, improper maintenance and repair, misuse, material failure, human error, and so on, identifying and analyzing process hazards is a fundamental principle in the process safety management system and it is necessary to begin to evaluate all risk possibilities in the design process and plan how they will be executed during the whole process life cycle.

One of the most important requirements of industry 4 is the security systems can be remotely monitored and remotely accessible to authorized personnel in response requirements. Based on addressable sensing systems in terms of remote traceability, especially fire, flood, etc., accident presentation systems are used effectively. But prevention of process accidents by preventing the way to the loss of integrity in process safety is fundamental. Possible deviations from the design target in chemical production processes lead to different behaviors of the chemicals, bringing the operating parameters quickly closer to situations that can cause an accident. Triggering of deviations to other increases confusion in the process. It is not easy to draw back the values to design parameters under these complex events by the system intervention. Making the logic error in this complex situation of the system will require remote access intervention.

It is necessary to plan the safety system that will be established at the design stage in order to control in the entire life cycle by evaluating all possible deviations by a health hazard-risk analysis. A "Safety Instrumented System" (SIS) design for the safety requirements subsequent to the process design is introduced. The system to be installed at this point needs to be designed for internet access, remote traceability and accessibility when needed. The healthy operation of this system, which requires intelligent sensor management and prevention of false detection, should also include integration of dynamic measurements. Establishment of a healthy safety management system in the construction of new factories can be accomplished easily with planned work. The explosion, which caused 15 deaths, 170 injuries and major environmental damage on 23 March 2005, was caused by an instrumentation fault at the Texas Refinery, the third largest refinery in the world. The explosion occurred on 26.01.1982, at ASCO a small family-owned company that produces and packs acetylene in New York, which led to 3 deaths and 1 injury, control valve system was misplaced. The spread of chlorine on 14.08.2002 in the chlorination of DPC's chlorine packaging plant in Missouri was caused by erroneously installed security management system. Examples of these and similar industrial accidents caused by control devices' errors and wrong intervention put the importance of proper safety management. Even though there are problems in the security establishment and working of security managements systems of originally designed plants, integration of existing processes into Industry 4 requires rigorous security work and the installation of a security system that provides technical solutions with logic circuits. At this point, to overview of the whole process design process will make things easier and will not lead the wrong decisions.

EVALUATION

To do industrial investments now, is not enough for catching the age and to increases our competitive power in the global world. It is necessary to integrate Industry 4 into all production activities, for economic and safe production. At first glance, the Industrial Revolution, which seems to be an approach to reduce employment, will create new professions, and human needs will not be diminished due to the weak decision mechanisms of robots against complex problems. Continuous control with remote access in situations where out-of-robot or software decision mechanisms are inadequate is also important for process safety as well as production assurance.