

Total Professeurs Associés



INTRODUCTION IN MANAGEMENT OF MAJOR RISKS IN THE
PETROLEUM AND CHEMICAL INDUSTRY

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MODULE SAFETY AND 4IR

Industrial Revolutions

- ◆ The First Industrial Revolution took place from the 18th to 19th centuries in Europe and America. It was a period when mostly agrarian, rural societies became industrial and urban. The iron and textile industries, along with the development of the steam engine, played central roles in the Industrial Revolutions

- ◆ The Second Industrial Revolution took place between 1870 and 1914, just before World War I. It was a period of growth for pre-existing industries and expansion of new ones, such as steel, oil and electricity, and used electric power to create mass production. Major technological advances during this period included the telephone, light bulb, phonograph and the internal combustion machine

Industrial Revolutions

- ◆ The Third Industrial Revolution, or the Digital Revolution, refers to the advancement of technology from analog electronic and mechanical devices to the digital technology available today. The era started during the 1980s and is ongoing. Advancements during the Third Industrial Revolution include the personal computer, internet and information and communication technology (ICT).

- ◆ The Fourth Industrial Revolution builds on the Digital Revolution, representing new ways in which technology becomes embedded within societies and even the human body. The Fourth Industrial Revolution is marked by emerging technology breakthroughs in a number of fields, including robotics, artificial intelligence, nanotechnology, quantum computing, biotechnology, the IoT, 3D printing and autonomous vehicles.

Industry 4.0

- ◆ **Industry 4.0 is a name for the current trend of automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the IoT, cloud computing and cognitive computing.**
- ◆ **Industry 4.0 creates what has been called a "smart factory". Within the modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical world and make decentralized decisions.**

Four design principles in Industry 4.0

- ◆ **Interoperability:** The ability of machines, devices, sensors, and people to connect and communicate with each other via the Internet of Things (IoT) or the Internet of People (IoP)
- ◆ **Information transparency:** The ability of information systems to create a virtual copy of the physical world by enriching digital plant models with sensor data. This requires the aggregation of raw sensor data to higher-value context information.
- ◆ **Technical assistance:** First, the ability of assistance systems to support humans by aggregating and visualizing information comprehensibly for making informed decisions and solving urgent problems on short notice. Second, the ability of cyber physical systems to physically support humans by conducting a range of tasks that are unpleasant, too exhausting, or unsafe for their human co-workers.
- ◆ **Decentralized decisions:** The ability of cyber physical systems to make decisions on their own and to perform their tasks as autonomously as possible. Only in the case of exceptions, interferences, or conflicting goals, are tasks delegated to a higher level.

Big Data Analytics in Industry 4.0

◆ **Big data analytics consists of 6Cs in the integrated Industry 4.0 and cyber physical systems environment. The 6C system comprises:**

1. **Connection (sensor and networks)**
2. **Cloud (computing and data on demand)**
3. **Cyber (model & memory)**
4. **Content/context (meaning and correlation)**
5. **Community (sharing & collaboration)**
6. **Customization (personalization and value)**

Process Safety in 4IR

◆ Opportunities

- Weak signals can be detected very fast (« immediatly »)
- Potential high risk deviations can be stopped automatically by robots
- Humans can be removed from hazardous interventions
- Huge amounts of data can be analyzed easily
- Intelligent materials and machines (auto-detection) before failure

◆ Additional Risks

- Loss of control over the installation (« digital runaway »)
- Lack of understanding of the processes