

FUNCTIONAL SAFETY OF CYBER-PHYSICAL PRODUCTION OF THE INDUSTRY 4.0

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An actual task has been studied to develop science and technical organization measures to provide functional safety of an Industry 4.0 smart factory. Functional safety is an industrial company property to provide continuous manufacturing of item designing components should some emergency cases in production happen. There is a typical structure of cyber and physical production and some schemes (a cluster scheme and a matrix scheme) to provide company functional safety by applying reserve cyber and physical systems. Reserve cyber and physical systems could be part of automatic technological line and is engaged should some primary equipment components are failed. It is clear that cyber and physical system reserving method selection depends on necessary level of functional safety in the Industry 4.0 smart factory.

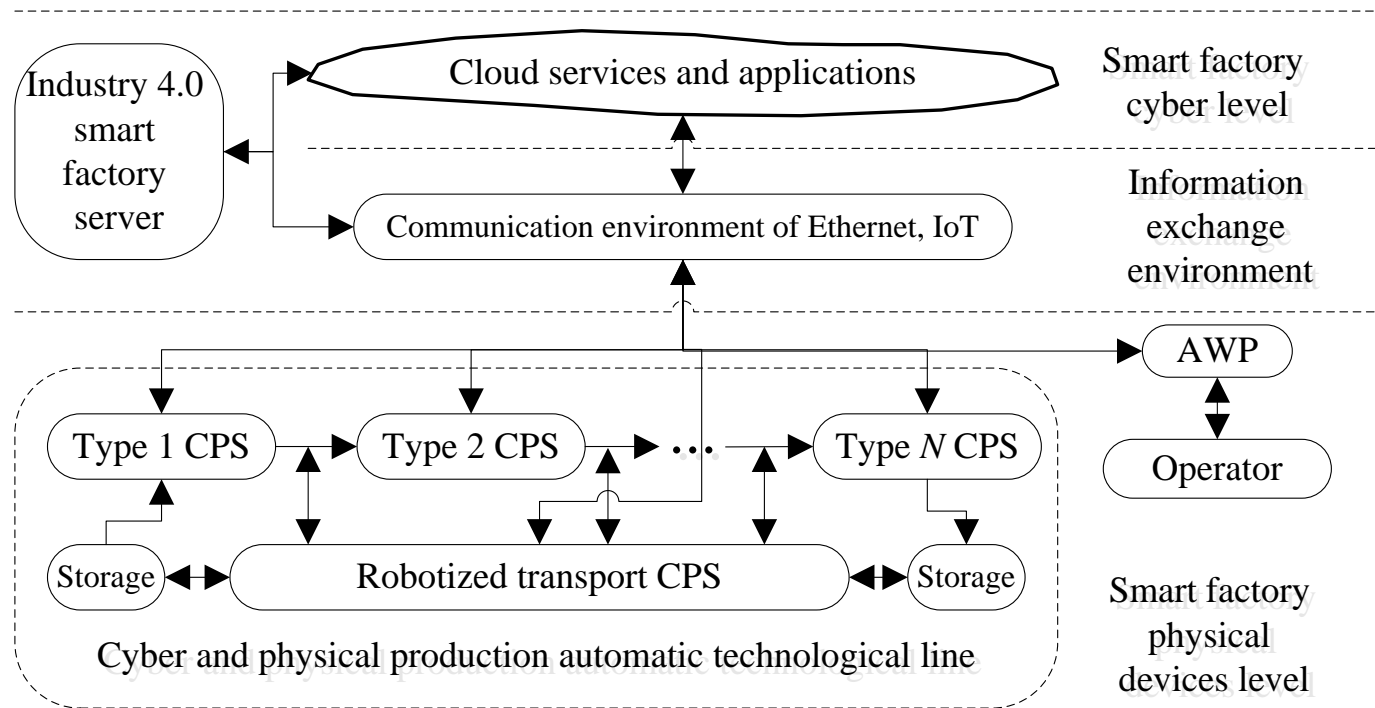


Figure 1. The Industry 4.0 cyber and physical production typical three-level scheme

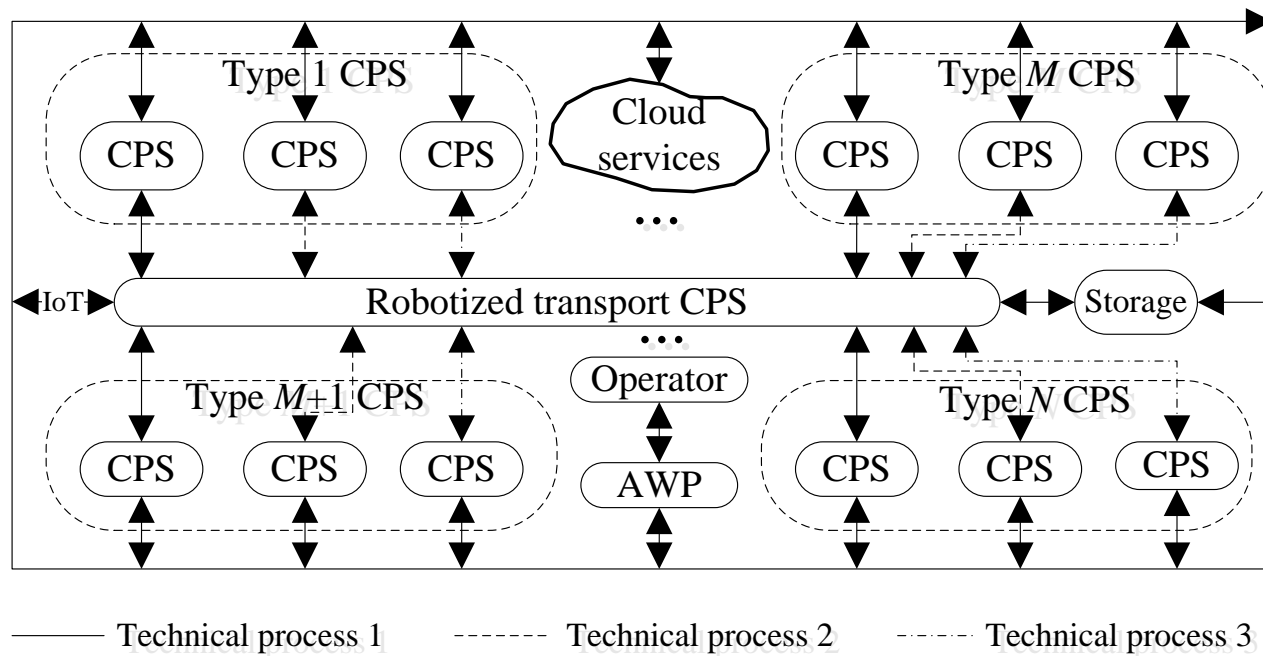


Figure 2. The Industry 4.0 cyber and physical production matrix structure (IoT – Internet of Things).

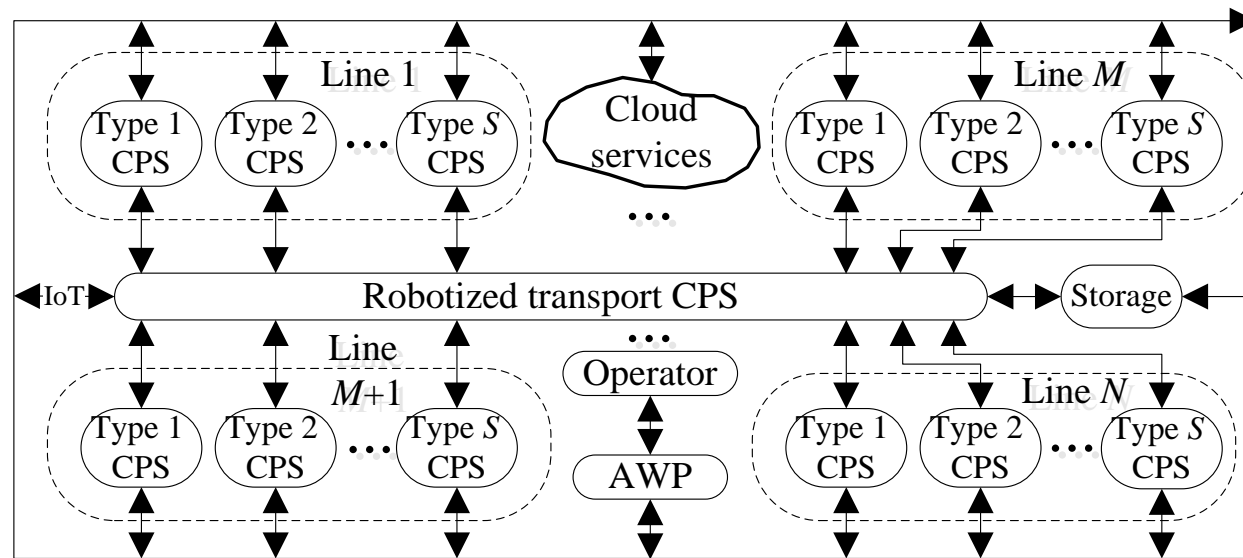


Figure 3. The Industry 4.0 cyber and physical production cluster structure.

Functional safety of cyber and physical production is an important property of the Industry 4.0 smart factory. Production functional safety is provided by the reserving of low reliable components, which first include cyber and physical systems, which are realized with a software and in the physical level.

Highly reliable cyber and physical productions projection with the increased functional safety is done by calculations based on mathematical analysis of the real CPSs exploitation statistical data and their specifications. CPS specifications show the points of CPS probable failure in time, which enables to create equivalent schemes (models) of cyber and physical production technological lines reliability. The reliability equivalent schemes calculation of different topology CPSs helps to detect the low reliable section and components, which must be duplicated in reality.

Real production exploitation statistical data helps to make sure the evaluation of technological lines reliability, which were calculated to increase the CPS reliability mathematical models adequacy and to increase the functional safety of the Industry 4.0 smart factory.