HARDWARE RESERVATION OF CYBER-PHYSICAL PRODUCTION OF THE INDUSTRY 4.0

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An actual task has been studied to increase the Industry 4.0 production companies functioning safety with methods of cyber and physical systems machine reserving. The production machine reserving shall include some additional components to the technological equipment, which in their functions and properties duplicate the existing low-reliable components. With the method of cyber and physical systems reserving in production they can realize different schemes of assembly units transportation within the smart factory technological lines. Cyber and physical systems reserving schemes could be described as equivalent schemes (chains) to calculate the parameters and evaluate company duplicating efficiency are done according to the methods of the reliability theory. There is a scheme of typical technological line of cyber and physical production. There is a way of low-reliably cyber and physical systems reserving. There is a way of machine reserving of cyber and physical production with a pool of reserved cyber and physical systems. There is a scheme of the Industry 4.0 cyber and physical production transport system duplicating.

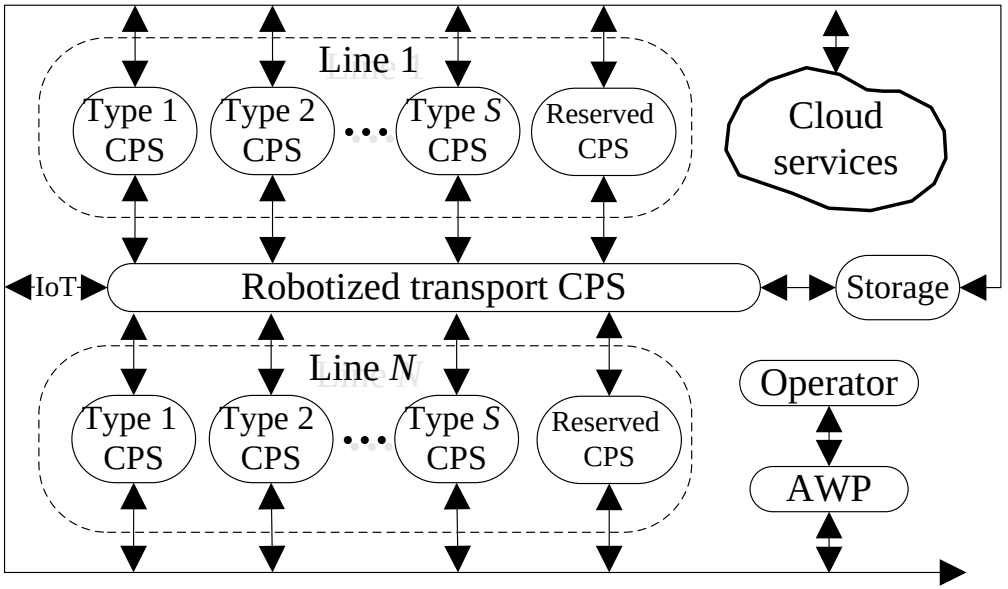

Figure 1. Low reliability CPS reservation scheme within a technological line (AWP – Automatic Work Place, IoT – Internet of Things).

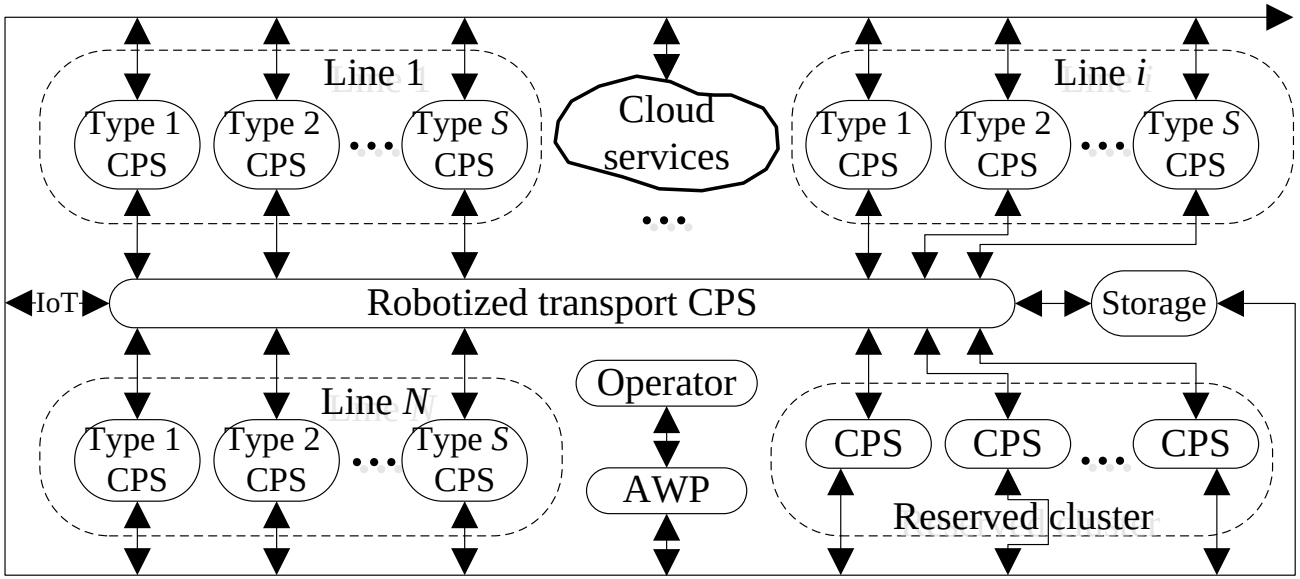

Figure 2. The production division increased reliability scheme based on a pool of reserved CPSs.

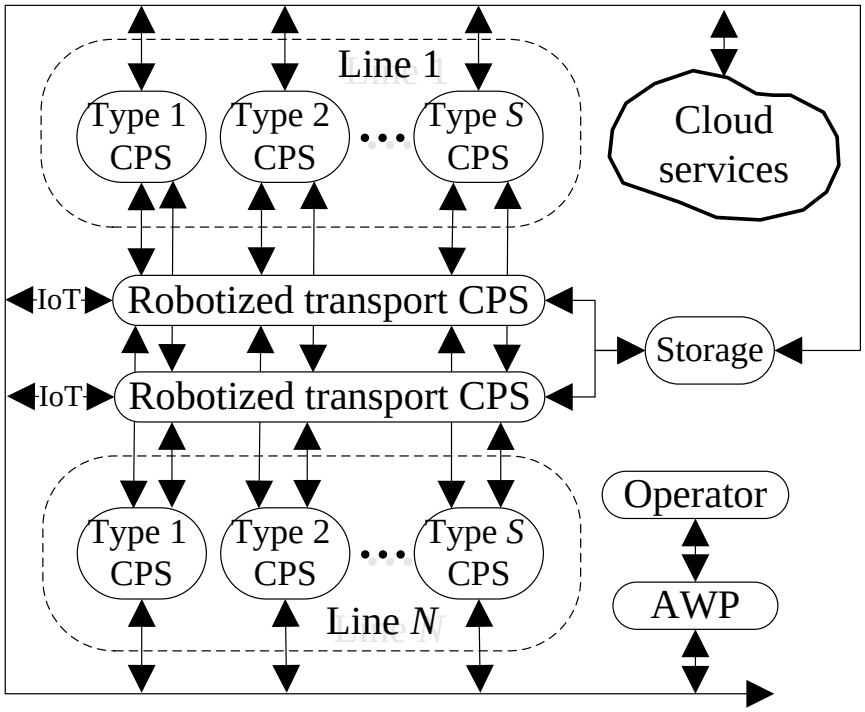

Figure 3. Transport system duplication scheme in a cyber and physical production.

The machine way of reserving cyber and physical production components may increase the Industry 4.0 smart factory functioning reliability. The machine reserving is done for cyber and physical systems and industrial physical lines of production data transmission. The machine way of CPS reserving is a number calculated with the methods of the reliability theory.

Machine way reserving of cyber and physical production main problem is a problem to choose the number of CPSs necessary and sufficient to provide production division continuous functioning. Redundant number of duplicating CPSs application makes the smart factory architecture more complicated and creates additional redundancy in production. Insufficient number of duplicating CPSs may provide cyber and physical production reserving not fully. So they must develop methods of CPS machine reserving to provide the necessary values of digital production functioning reliability.

The Industry 4.0 cyber and physical production reliability functionality values are formed in the technical task requirements and shows the level of reserving of cyber and physical systems (duplicating, tripling and other). Smart factory designer main problem how to increase reliability of an automatic production is to define the low-reliable and highly-loaded cyber and physical systems which in fact are probability characteristics where the technological line in general may fail. Such production components must be reserved in the first hand.

The machine reserving for production reliability increasing make better the level of the Industry 4.0 smart factory protection against failure but does not affect its measures against failure (the personnel and production components protection against the consequences of a CPS failure). To increase smart factory cyber and physical production protection level and measures against failure, which must be done with some special means of protection and some organization means to increase the personnel culture in production.