Chapter 10

The Support From Industry 4.0 to the Management of Change (MoC)

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ABSTRACT

Dealing with maintenance activities in complex systems often configures the so-called management of change (MoC). MoC is a process for evaluating and controlling modifications to facility design, operation, organization, or activities—prior to implementation—to be sure no new hazards are introduced. Traditionally, MoC is related to technical changes. Safety implications from organizational changes have recently led to proposed integrated management of both types. An inadequate MoC is recognized as a recurring cause of accidents, often resulting in major accidents, mainly in the process industry. Despite this recognised criticality, the MoC workflow in many companies is still far from being mature and there are still evident shortcomings in its application that have to be compensated. The technical solutions composed by the enabling technologies within Industry 4.0 can offer a valid support to overcome the MoC shortcomings, as will be discussed within this chapter.

INTRODUCTION

Dealing with maintenance activities in complex systems often configures the so-called Management of Change (MoC). Management of Change is a process for evaluating and controlling modifications to facility design, operation, organization, or activities—prior to implementation—to be sure no new hazards are introduced. As discussed by Martinetti et al. (2017) maintenance and changes cannot be reconduted...
only to the productivity and safety (RAMS factor), but new paradigms for taking into consideration supportability and environment need to be implemented to minimize the risks.

Regular maintenance usually does not require to be managed as a change, since it can be configured as a “in kind” modification, which substantially leaves the equipment exactly as it was prior to starting the work. Special maintenance activities instead fall within the changes to be managed.

Traditionally, MoC is related to technical changes. Safety implications from organizational changes have recently led to proposed integrated management of both types, based on Prevention through Design (PtD) approach, applied in the tunnelling work environment in Borchiellini et al. (2013) and in Labagnara et al. (2013).

An inadequate management of change is recognized as a recurring cause of many accidents, often resulting in major accidents, mainly in the process industry, as discussed by several authors. The Flixborough accident, occurred in the UK on 1.6.1974 (Mannan, 2012) is the representative case of a major accident happened because of a unperformed management of change. A massive explosion in a caprolactam manufacturing process following a release of hot cyclohexane virtually demolished the site, killed 28 persons and injured 36. The cause of the accident was traced back to the improper management of a change made to the plant for maintenance purposes. In particular, being the process carried on in 6 cascade reactors, when a leakage was discovered in the reactor n. 5, due to a crack of about 2 m in the reactor shell, it was decided to install a temporary pipe to bypass the leaking reactor to allow continued operation of the plant while repairs were made. In the absence of 28-inch pipe, adopted in the reactor cascade, a 20-inch pipe was used to build the bypass pipe for linking reactor 4 outlet to reactor 6 inlet. The effect of the thermal and pressure cycles inherent in the process brought to the pipe or bellows material to yield, initiating the accidental event. The plant modification was not designed, constructed, tested and maintained to the same standards as the original plant and this brought to the destruction of its technical integrity.

Levovnik & Gerbec (2018) reviewed different sources highlighting the links between MoC and accidents. Their analysis started from the contribution of Keren et al. (2002), that performed a survey, on how often changes occur in the industry, and found among the respondents the rate between 1 and 37 changes per annum per ten employees (with an average at about 10). Then they consulted the two main accident databases related to process safety. Lessons learnt from the ARIA (Analysis, Research and Information on Accidents) database of the French Bureau for Analysis of Industrial Risks and Pollutions, consisting at the time of almost 49,000 events, mention examples of 28 events where MoC was reported deficient/absent. The review also found that 8 out of 15 closed investigations by CSB, the US Chemical Safety and Hazard Investigation Board, in the period from 2015 till the end of 2017, explicitly list MoC issues among the causes.

In Han Siong et al. (2017) a total of 630 chemical process industry related accidents cases were reviewed. Preliminary result shows how the contribution of MoC failure to the accidents analysed was found to be 9.1%, the 6th behind other 5 process safety management elements: process hazards analysis (17.7%), operating procedure (17.6%), employee participation (11.5%), training (11.3%) and mechanical integrity (10.1%). Among the MoC failures, requesting system change demonstrated the highest percentage contribution of 45.6% in MoC typology failure percentage. Breakdown/failure system change contributes for the 30.9% followed by temporary system change, for 10.1%, administrative system changes for 8.1% and organisation system change for 5.4% as summarised in Figure 1.