Comments during presentation:

1. The real issue is whether there will be sufficient description of the current state is going to be available to make decision in real time or half daily basis?
2. You have to in visit what would be complete description of construction site would be that allow digital twin system or **automated control system.**
3. **I think the reality of multiple sub-contractor and redeploying workforce and all the flexibility is going to make it…..( I think he meant … is going to make it difficult). You really need to test the hypothesis that enough information is ever going to be available.**

**Some idea about digital TWIN below**

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| **Challenges, issues and solution in implementing digital twins.** | **Digital Twin**  Turner, C. J. *et al.* (2020) stated that the Digital Twins approach offers the possibility of reproducing a construction site virtually across geographical regions using network technologies. Turner, C. J. *et al.* further stated that Digital Twin offers users the ability to create and test hypotheses before actual implementation. The authors also mentioned that this capability provides unprecedented data and knowledge on working sites. They expand their thoughts by stating that It offers the ability to spot trends and anomalies that will feed into the next generation of policies for hazardous working environments and management practice**. However,** Turner, C. J. *et al*. acknowledged that **as with most of the technologies discussed in their paper, the digital twin concept still faces challenges in its adoption by the construction industry. They elaborated by identifying two issues one of which is how digital twins should be used in such a dynamic and real-time environment and the other one**   **is the format of data presentation or visualization to the users**.  Another important consideration to be made, the authors stated, is t**he mode of data visualization within a digital twin especially when communicating multi-modal complex information coming from various sensors and sources to users**. **Turner, C. J. *et al.* stressed that the ability to relay information in a context and location- sensitive fashion may be the key to digital twin adoption in construction.** Turner, C. J. *et al.* hold the view that technologies like Augmented Reality (AR) provide a unique visualization solution that enables a worker to document, monitor construction site activities and mark up important information for a digital twin to intelligently run offline hypotheses generation and analysis. Turner, C. J. *et al.* emphasizedthat digital mark-ups and important messages could be placed and left in the construction environment for use by other workers in a fashion like staggery in natural ants. Turner, C. J. *et al* stated that the approach outlined by Zollmann et al. (2014) allows construction industry professionals to view building details overlaid in real time on partially built structures via AR. The system proposed by Zollmann et al. provides annotated live views with comments for others to read when they view an area on site. Turner, C. J. *et al.* proposedDiscrete Event Simulations (DES) can be used to run various hypotheses in a digital twin in order to provide a more accurate estimate of the effects of workers’ actions on construction activities. These types of simulations have the functionality to superimpose AR visualizations overlaid onto real world scenes and viewed on-site by construction workers. Such work has been undertaken in the modelling of factory production lines. The digital nature of BIM further supports this possibility and provides a framework for building navigation on large-scale and complex construction sites  Turner, C. J. *et al* stressed that the application of BIM in digital twins provide better visualization, tracking of worker locations (through utilizing RFID tagging) and an improved level of contextual information. Using worker positions, geometrical layout of buildings, contextual information and DES, it will be possible to relay real-time warnings to machines, workers, and supervisors when potentially dangerous situations are identified. In such a modern “connected” construction site, multiple data  The authors also emphasized that sources can be combined and analyzed to provide operational and strategic-level insights for improved site management, enhanced cross-site safety and more efficient decision making (e.g. team and plant deployment, earthwork planning and overall workforce management etc.All the above will invariably improve the productivity statistics of the construction sector. As more data sources are increasingly becoming available from external sources (e.g. remote weather stations) to the growing smart and connected infrastructures projects, connecting all of them seamlessly using industrial connectivity. Such connectivity will become increasingly important in order to ensure that the benefits of Industry 4.0 is fully realized in the construction sector. |