

# Digital twins report: Conclusion

A proof-of-concept simulation model is being provided to assess impact of the improvement opportunities. The developed generic simulation model on the abattoir process flow provides insights into how an inspection process can be optimised and then transformed using technologies. It offers an opportunity analysis for the FSA to equip its inspectors with latest technologies to increase efficiency and reduce inspection inaccuracies. In addition, this proof-of-concept has the potential to help the FSA understand the impact of technology intervention at different critical control points to support a strategy for deploying the right balance of technology and workforce for inspections. This study showed the capabilities of DES modelling to simulate where and how interventions can be made to increase the inspection process efficiencies, while optimising the use of resources.

This study is a starting point for the development of digital representations of abattoir flows. To adapt the generic simulation for a particular abattoir, the data points that are shown in Table 1 need to be collected and validated with stakeholders. In addition, to update the layout, a CAD drawing of the abattoir layout plan should be imported to the model to set the machineries and conveyors to the right scale and orientation. All the data points in the model can be connected to a database for automatic update on the current state of the system.

To develop a digital twin of the system using the current model, live databases that are connected to the sensors at the data points are required. The right sensor systems may be different for different abattoirs. A generalised sensor (such as RFID, tags, cameras) /IoT technology systems have to be investigated to be able to spread the usage of this technology. Digital connectivity through sensors, IoT devices and innovation in data governance can complement the development of a more robust predictive digital twin model. This study also contributed theoretically to solving regression problems in developing a digital twin by combining both the discrete event simulation model and neural network model by automatically assigning different weights to each of the models.

The advantage of developing a hybrid model solves the problem from the beginning of the digital twin development when there is not enough data and facilitates the incorporation of neural network solutions at later stages with higher prediction accuracy. It is observed that the simulation result of this novel approach leads to lower mean squared errors (MSE) or differences between model estimates and actual values, compared to neural network and discrete event simulation models. We found that adding a discrete event simulation model helped PhysiNet find better local minima.

To summarise, this project provides an enhanced version of a generic abattoir process flow simulation model in which selected process variables could be updated through a user interface. The model is improved with 2D and 3D animation and this proof-of-concept study set the stage for further work that needs to be done to validate and amplify this model. Furthermore, a detailed list of technical and managerial recommendations has been produced for future studies, suggesting investment in these areas could enhance the ability of FSA to deliver its protocol more efficiently with better accuracy while overcoming its resource constraints.