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IMPLEMENTATION OF A DATA-CENTRIC SYMBIOTIC SIMULATION TECHNIQUE FOR ENHANCING FORD PTME THROUGHPUT SIMULATION PROCESSES

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ABSTRACT

With the ever-increasing importance of simulation in supporting decision making, strategic planning and operations within a fast paced business environment, traditional simulation has lagged behind, constrained as it is by long lead times for model update and validation. Symbiotic simulation has emerged as a solution, enabling a timely response to abrupt changes in the physical system. In this presentation, we introduce the implementation of symbiotic simulation as part of an overhaul of Ford Power Train Manufacturing Engineering throughput simulation methodology and discuss challenges, opportunities and lessons learned.

1 INTRODUCTION

The paradigm of Symbiotic Simulation describes a close mutually beneficial relationship between the simulation system and the physical system in which the simulation system benefits from an up-to-date supply of data from the physical system, while the physical system benefits from the optimised decisions arrived at through what-if experiments executed by the simulation system (Fujimoto et al. 2002). Extending the scope of symbiotic simulation to non-sensor based systems, this presentation covers the work done by a consortium comprising Ford, University of East London (UEL), High Speed Sustainable Manufacturing Institute (HSSMI) and Lanner on the implementation of symbiotic simulation as part of an overhaul of Ford PTME throughput simulation methodology, with a focus on process automation and efficiency improvement. We discuss challenges on implementing the new concept of symbiotic simulation on an automotive engine production line, highlight the lessons learned and review the prospects going forward**.**

2 PROJECT SCOPE AND SPECIFICATIONS

A survey by Robertson and Perera (2002) established that a significantly large proportion of input data for simulation modelling is stored in enterprise resource planning (ERP) systems. This is especially so for the manufacturing sector and operational data such as cycle times, buffer sizes, bill of materials, etc. One of the biggest challenges in the project involved streamlining the various data repositories within the Ford ERP system. With production data spread so far and wide apart, the task of linking these systems together and extracting simulation input data was made even more challenging by the absence of standardized protocols for access to these systems. The team was tasked with building a bespoke software solution linking throughput simulation models to the plant facility monitoring systems in order to achieve a symbiotic relationship. Two work streams were therefore defined as follows:

- WS1: Streamline data sources, collate, refine and reformat input data and insert into a simulation database, ready for injection into simulation models.

- WS2: Automatically update simulation data within existing models, verify & validate the models.

In partnership with other consortium members, these work streams were further subdivided into work packages and allocated according to the expertise available within the group.

3 IMPLEMENTATION STRATEGY

Simulation input data integrity is critical, as it determines not only the fidelity and accuracy of simulation results, but also the level of confidence that can be reposed in a simulation project by stakeholders. In this regard, HSSMI undertook the task of data analytics, with a view to providing deeper insights into the data, flagging up inconsistencies and highlighting root causes for discrepancies. Automation of manual analysis enabled speedy comparison of datasets over different but equivalent time intervals. With Witness as the simulation engine on which the project is anchored, Lanner's role revolved around run time improvements, including research into programmatic simulation run length analysis, implementation of key output statistics and random number utilisation. Lanner achieved a 40% reduction in model run time, thereby facilitating multiple experiments in much shorter times.

Figure 1: Process flow diagram for symbiotic simulation**.**

4 OUTCOMES AND PROSPECTS

As at today, project targets have been exceeded and work streams have been extended to cover a wider spectrum of Ford PTME throughput simulation aspirations. Some of the outcomes achieved include:

- Development of the symbiotic simulation application incorporating data analysis, model verification, validation and update.
- Development of a relational database for storage and retrieval of simulation data.
- Development of Alteryx workflows for precision filtering of production data (shifts, cycle times, machine breakdowns, build sequence, tooling and jobs per hour output).

Completion of this project will facilitate the application of artificial intelligence on the data that now resides in the simulation database, where input and output data is being collated. This will facilitate predictive analytics with wide ranging exploitation opportunities. While the scope of the project is currently limited to powertrain operations, a rollout to other business units such as vehicle operations is envisaged and already being planned.

5 LESSONS LEARNED: CONCLUSION

Organizational fit and adaptation was identified as critical to the implementation of such an innovative concept that needs to coexist and interact with existing large-scale enterprise systems that were built with a pre-determined business process, infrastructure and purpose.

REFERENCES

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