Simulating the Mechanism by Which Lean Increases Injury Risk for Operators

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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

ISERC 2014

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Modeling and Simulation
Simulating the Mechanism by Which Lean Increases Injury Risk for Operators
Systematic reviews have found that lean manufacturing generally has negative effects on employees' musculoskeletal health. This study aims to explore why these injuries may be occurring from Lean implementations by simulating the effects removing "waste" time on the operator's physical workload. Using objective instrumented measures of arm kinematics in engine assembly work, synched to video analysis identifying periods of direct and indirect work, we established exposure levels for both types of tasks. We then simulated the removal of "waste" tasks, a central tenant under the Lean paradigm, to examine the consequences for physical risks to system operators based on the new ratio of direct to indirect tasks. Results show that direct tasks generally have higher exposures than indirect work which provide more opportunity for muscular recovery. A simulated systematic removal of indirect "waste" tasks revealed an increase of up to 5% for risk-implying relative time at high wrist velocity, and a concurrent reduction of 44% in recovery-implying time at low wrist velocity. These signs of intensification, with increased risk exposure and decreased recovery, were similar for other risk factor indicators and for other body parts. These results are also consistent with a simulation performed with data is collected from another industrial facility. This study isolates the mechanism by which "waste" focussed lean implementations raise injury risk for operators and helps explain the generally negative effects of Lean on assembly worker health observed in the literature.

Neumann, W.P., Forsman, M., Winkel, J. (2014) Simulating the Mechanism by Which Lean Increases Injury Risk for Operators. Industrial and Systems Engineering Research Sessions (ISERC 2014) at the IIE annual Conference, Montreal, June 1-3