

THE INTEGRATION OF SUPPLY CHAIN  
VALUE STREAM MAPPING AND DISCRETE  
EVENT SIMULATION FOR LEAD TIME  
REDUCTION OF WAREHOUSE OPERATIONS  
IN A PHARMACEUTICAL ORGANIZATION

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DOCTOR OF PHILOSOPHY

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## **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy.

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## STUDENT'S DECLARATION

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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## ABSTRAK

Peningkatan jumlah masa keseluruhan (*lead time*) bagi rantai bekalan wujud disebabkan oleh pengurusan inventori di dalam gudang yang meliputi masa menunggu, masa tergendala yang tidak diinginkan yang menyebabkan kesukaran dalam memenuhi permintaan dan keperluan pemegang taruh pihak ketiga. Masalah ini konsisten dan cenderung berkembang tidak kira bagaimana canggih perancangan pengeluaran dilakukan. Inventori rantai bekalan gudang farmasi adalah satu cabaran untuk dikaji atau dipetakan bagi tujuan penambahbaikan selanjutnya. Sebuah gudang syarikat farmaseutikal di Malaysia telah dipilih bagi kajian ini. Setelah kerja lapangan dan jurang sorotan kajian yang terperinci dilaksanakan, pendekatan kajian kes dipilih kerana ianya merupakan metodologi terbaik bagi kajian ini. Ianya dilaksanakan bertujuan mendapatkan kaedah yang berkesan dalam memperkenalkan pemodelan simulasi bersepadu (*lean integrated simulation modeling*) menggunakan *Value Stream Mapping* (SCVSM) dan *Discrete Event Simulation* (DES) untuk merekod, menganalisa dan mengurangkan masa menunggu inventori, kelewatan, dan sisa lain untuk keluarga produk tertentu yang dipilih. Setelah beberapa cadangan untuk masa hadapan dibuat menggunakan SCVSM, hasil kajian menunjukkan penambahbaikan kepada jumlah masa keseluruhan di gudang. Masa pengeluaran dan jumlah masa pemprosesan didapati menurun sebanyak 51.43% dan 44.41%. Jumlah *value-added time* telah meningkat sebanyak 29.21% dan *non-value added time* telah menurun sebanyak 31.86%. Pada segmen kedua, terdapat peningkatan sebanyak 20.22% bagi *value-added time* dan penurunan sebanyak 23.17% bagi *non-value added time*. Model DES kemudiannya dibangunkan bagi meniru keseluruhan sistem sebenar untuk tujuan simulasi keadaan semasa dan cadangan penambahbaikan untuk masa hadapan. Kajian ini terbukti mempunyai implikasi empirikal dan praktikal yang akan membantu dalam pembuatan keputusan lebih baik melalui pemahaman mendalam mengenai aktiviti rantai bekalan gudang di gudang.

## ABSTRACT

The supply chain lead time build-up that occurs due to inventory handling inside the warehouse that comprises of a set of waiting time, queuing time, and unwanted delays creates difficulties in meeting demand shocks and third party stakeholder requirements. These problems consistently prevail and tend to evolve no matter how sophisticated production planning is done. In that case, a pharmaceutical warehouse supply chain inventory would be a real challenge to study or map to find out ways for further improvements. In this research, a Malaysian pharmaceutical company's warehouse was considered for the study. After a detailed field work and literature gap inferences, a case study approach was considered to be the best methodology for this study. It was applied to find effective ways to introduce lean integrated simulation modelling using Supply Chain Value Stream Mapping (SCVSM) and Discrete Event Simulation (DES) to capture, record, analyze, and reduce inventory waiting time, delays, queues and other wastes for a selected particular product family. After several lean suggestions in the future state SCVSM, the results of this study show that there is a considerable improvement in the warehouse lead time. The production lead time and total process time has decreased by 51.43% and 44.41 % respectively. The total value-added time has increased by 29.21 % the non-value added time has decreased by 31.86 %. In the second segment, there was a 20.22 % increase in the value-added time and a 23.17 % decrease in the non-value added time. DES models were then developed to replicate the entire operations for the purpose of present and future state simulation along with the suggestions for improvements. This study proved to possess strong managerial and practical implications that shall help in better decision making by deeply understanding the supply chain activities that occur as discrete events inside a warehouse.

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