



UNIVERSITI PUTRA MALAYSIA

**STATISTICAL MONITORING OF SUPPLIER PERFORMANCE IN A
QUALITY MANAGEMENT SYSTEM ENVIRONMENT FOR THE IRANIAN
AUTOMOTIVE INDUSTRY**

SOROUGH AVAKH DARESTANI

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QUALITY MANAGEMENT SYSTEM ENVIRONMENT FOR THE IRANIAN
AUTOMOTIVE INDUSTRY**



By

SOROUSH AVAKH DARESTANI

**Thesis Submitted to School of Graduate Studies, Universiti Putra Malaysia, in
Fulfilment of the Requirements for Degree of Doctor of Philosophy**

July 2010

DEDICATION:

To

My beloved Father and Mother



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for degree of Doctor of Philosophy

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July 2010

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Faculty: Engineering

Quality and delivery are two of the crucial indicators in today's automotive manufacturing industry. About 60% of prices of goods are allocated to raw material and purchased parts by suppliers in the automotive industry. The need for evaluation and monitoring of supplier's performance has been emphasized by previous researches and also in Quality Management System of the automotive industry ISO/TS16949. Thus, it is important to evaluate and monitor suppliers in the automotive sector. The review of literature reveals the lack of a multi-variable monitoring system for supplier performance. Therefore, this study was carried out with the aim to develop a multi-variable supply chain performance monitoring model for the automotive industry that would allow companies to monitor their suppliers' performance. Delivery Performance Monitoring Algorithm (DPMA) was developed for monitoring supplier's on-time-delivery (OTD) based on the PDCA approach.

In addition, control charts were also modelled for the OTD and Part per Million (PPM), while Binomial capability process (BCP) was done for measuring the PPM capability. Furthermore, the exploratory product audit method (PQAS) was developed based on normal distribution so as to quantify supplier's quality. For this purpose, the capability process analysis, Johnson transformation, Anderson-Darling normality test, time series prediction techniques were employed. The main contribution of this research is that statistical process control could be used to help automotive companies to monitor their supplier's performance. An investigation carried out on 344 consecutive deliveries performance of OEM's suppliers, in which the mean of OTD was obtained by 79.10 (where standard deviation was 18.77) gave the indication of far from customers' target by 90. Out of control signals were eliminated from the control charts. The capability study indicated that eliminating the out-of-control signals improved the supplier's capability.

Therefore, PQAS was performed and the supplier's quality level was obtained by 77%, indicating the causes of reducing product quality accordingly. The results also indicated that eliminating the out-of-control signals could enhance the product quality scores at significant level 5%. As such, the suppliers' quality rating PPM was quantified and monitored using the control chart and the results indicated that establishing the state of statistical control on the PPM could enhance the PPM capability in 6σ of binomial distribution. Thus, the results from the hypotheses testing significantly met the objectives of the study and the model could be employed by automotive sector. Undoubtedly, the implementation of statistical monitoring could increase organizational performance for both buyer and supplier perspectives.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk Ijazah Doktor Falsafah

**PEMANTAUAN BERSTATISTIK PRESTASI PEMBEKAL DALAM
PERSEKITARAN SISTEM PENGURUSAN KUALITI UNTUK INDUSTRI
AUTOMOTIF IRAN**

Oleh

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Kualiti dan penghantaran adalah salah satu penunjuk penting dalam industri automotif sekarang. Lebih kurang 60% dari harga barangan terdiri dari bahan mentah dan bahagian yang dibeli dari pembekal dalam industri automotif. Keperluan kepada penilaian dan pemantauan prestasi pembekal memang terkandung dalam Sistem Pengurusan Kualiti industri automotif ISO/TS 16949. Oleh sebab itu adalah penting untuk menilai dan memantau pembekal dalam sektor automotif.

Kajian literatur menunjukkan kurangnya sistem pemantauan pembolehubah berbilang untuk prestasi pembekal. Maka penyelidikan ini bertujuan untuk membangunkan model pemantauan prestasi pembolehubah berbilang rantaian bekalan untuk industri automotif yang akan membolehkan syarikat memantau

prestasi pembekal mereka. Algoritme Pemantauan Prestasi Penghantaran (DPMA) telah dibangunkan untuk memantau penyerahan pembekal tepat masa (OTD). Carta kawalan telah dibangunkan untuk OTD dan PPM manakala proses kemampuan Binomial (BCP) untuk mengukur kemampuan PPM. Tambahan pula, suatu kaedah audit barang tinjauan (PQAS) telah dibangunkan untuk mengukur kualiti pembekal. Dalam konteks ini, kajian kemampuan proses, transformasi Johnson, ujian normal Anderson-Darling, ramalan siri masa dan teknik carta kawalan multivariate telah digunakan. Sumbangan utama dari penyelidikan ini telah memungkinkan kawalan proses berstatistik boleh digunakan untuk membantu syarikat automotif memantau prestasi pembekal mereka.

Kajian terhadap 344 prestasi penyerahan berturutan dari pembekal OEM mendapati purata OTD ialah 79.10 manakala sisihan piawai 18.77. Ini menunjukkan prestasi yang jauh dari harapan pelanggan sebanyak 90. Signal luar kawalan telah dinyahkan dari carta kawalan. Kajian kemampuan menunjukkan bahawa, penyingkiran signal luar kawalan memperbaiki kemampuan pembekal. PQAS telah digunakan dan paras kualiti pembekal adalah pada 77% dan sebab pengurangan kualiti barangan dikenalpasti. Keputusan juga menunjukkan bahawa penyingkiran signal luar kawalan memperbaiki mata kualiti barangan pada paras bererti 5%. Dengan demikian rating kualiti pembekal (PPM) diukur dan dipantau melalui carta kawalan. Keputusan menunjukkan bahawa pembentukan rating kualiti pembekal (PPM) meningkatkan kemampuan PPM dalam 6σ taburan Binomial. Tidak disangsikan lagi bahawa pelaksanaan pemantauan berstatistik dapat meningkatkan prestasi organisasi dari perspektif kedua dua pembeli dan pembekal.

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SOROUGH AVAKH DARESTANI

July 2010

I certify that a Thesis Examination Committee has met on 2 July 2010 to conduct the final examination of Soroush Avakh Darestani on his thesis entitled “Statistical Monitoring of Supplier Performance in a Quality Management System Environment for the Iranian Automotive Industry” in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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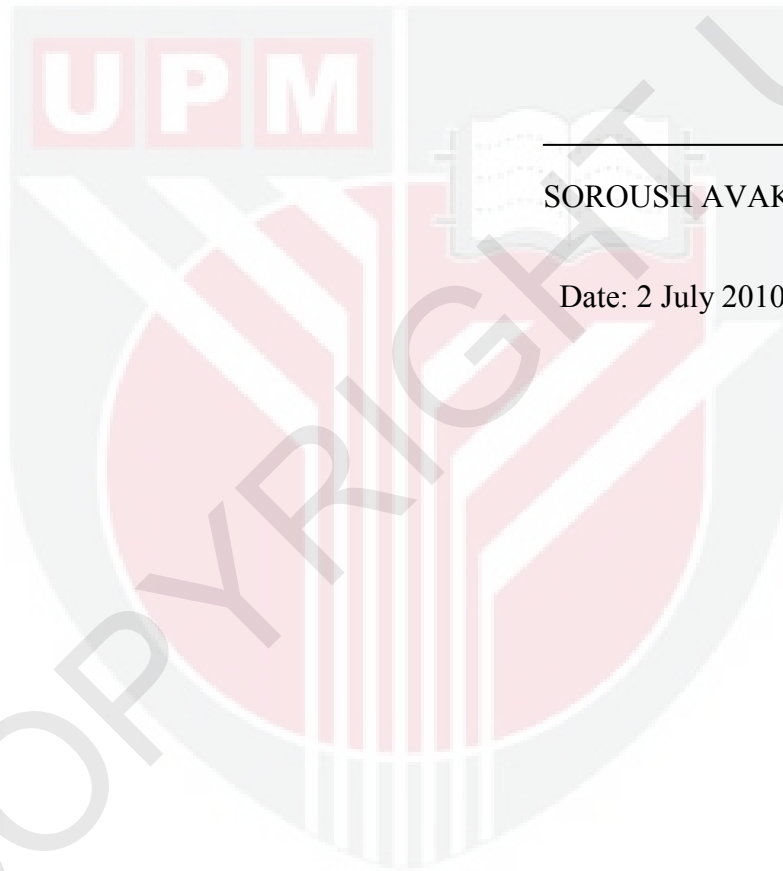
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DECLARATION

Hereby, I certify that the 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 degree at Universiti Putra Malaysia or other institutions or universities.



SORUSH AVAKH DARESTANI

Date: 2 July 2010

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