



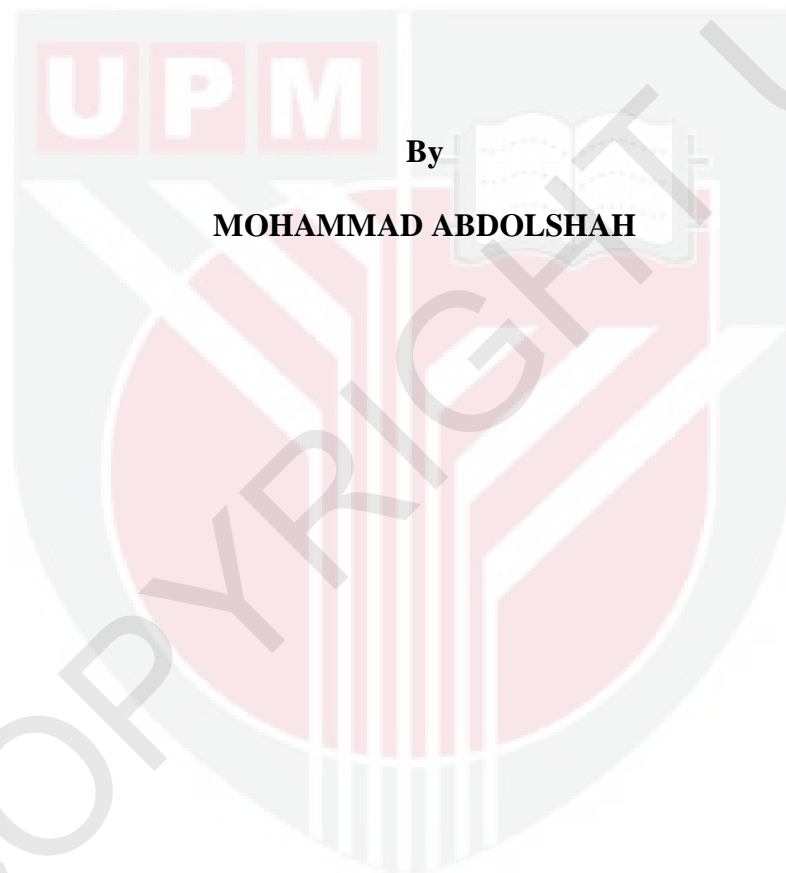
UNIVERSITI PUTRA MALAYSIA

***DEVELOPMENT OF A FUZZY LOSS-BASED PROCESS
CAPABILITY INDEX***

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**DEVELOPMENT OF A FUZZY LOSS-BASED PROCESS
CAPABILITY INDEX**



By

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

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Abstract of Thesis Presented to the Senate of University Putra Malaysia in
Fulfilment of the Requirement for the degree of Doctor of Philosophy

**DEVELOPMENT OF A FUZZY LOSS-BASED PROCESS
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December 2010

Chairman: Rosnah bt. Mohd. Yusuff, PhD

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Process capability indices are appropriate tools in order to measure the inherent capability of process, but most of these indices cannot take into account the losses of a process such as rejects, while in today's competitive business environment, it is becoming more and more important for companies to evaluate and minimize their losses. Since most of process capability indices do not consider the losses, the process capability indices based on losses can help manufacturers to understand the real capability of their processes in order to improve them.

Literature review showed two main gaps in loss-based process capability indices. The first gap is that there is not a loss-based process capability index, which has more features such as reject based, asymmetric, bounded, and target based. In order to overcome this problem, an appropriate loss function (asymmetric inverted normal loss function) was employed to propose a new loss-based process capability index.

The methodology is to compare the standard loss for a capable process with other cases. The proposed process capability index is bounded, asymmetric and it is able to provide a more realistic metric to evaluate and predict the performance of processes.

The second gap in literature review is that among all loss-based process capability indices, just C_{pm} has been fuzzificated, while literature review showed that the index C_{pm} is not an appropriate process capability index. Then fuzzy logic and operation research model were employed to fuzzificate the new proposed loss-based process capability index. The α -cuts of the fuzzy observation was the method employed to find the fuzzy membership function of the new loss-based process capability indices.

The result of this study is a new loss-based index with more specifications such as mean-based, target- based, variation-based, bounded, and loss-based compared with other process capability indices. The new process capability index was fuzzificated using α -cut method. Therefore a fuzzy loss-based process capability index was developed that is useful for vague data. In order to validate the new loss-based method, the sensitivity of this index to process specifications was studied. Sensitivity analysis showed that this index is sensitive to the mean, variation, and target of data. The new index has 99.6% relationship with the loss especially asymmetric inverted normal loss function. This relationship with loss is the highest relationship compared with other process capability indices. Moreover a regression analysis showed that the new index has the most relationship with the value of loss compared with other process capability indices.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
Sebagai memenuhi keperluan untuk ijazah Doctor of Philosophy

PENGEMBANGAN PROSES SEBUAH INDEKS RUGI FUZZY BERBASIS

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Indeks keupayaan proses adalah alat yang tepat untuk mengukur kemampuan yang melekat pada proses, tetapi kebanyakan mereka tidak mengira kerugian dari sebuah proses, sementara di lingkungan perniagaan yang kompetitif saat ini, hal ini menjadi semakin penting bagi syarikat untuk menilai dan meminimumkan kerugian mereka. Kerana sebahagian besar indeks kapabilitas proses tidak mempertimbangkan kerugian yang terang nyata, kemampuan proses berdasarkan indeks kerugian dapat membantu pengeluar untuk memahami kemampuan nyata dari proses mereka dalam rangka untuk memperbaiki mereka.

Sastera ulasan menunjukkan dua jurang utama dalam proses indeks rugi berasaskan kemampuan. Perbezaan pertama ialah bahawa tidak ada proses kehilangan kemampuan berasaskan indeks, yang mempunyai lebih banyak ciri unggul seperti menolak berasaskan, asimetris, melompat, dan target berasaskan. Untuk mengatasi masalah ini, asimetris terbalik fungsi kerugian muzik dikembangkan untuk

mengajukan kerugian indeks kapabilitas proses berasaskan. Metodologi ini adalah untuk membandingkan kerugian standard untuk proses mampu dengan kes lain. Indeks ini proses baru kemampuan terhad, asimetris dan mampu memberikan lebih realistik metrik untuk menilai dan memprediksi prestasi proses.

Kesenjangan kedua dalam tinjauan literatur adalah bahawa di antara semua proses kerugian indeks berasaskan kemampuan, hanya C_{pm} telah fuzzificated, sementara kajian literatur menunjukkan bahawa indeks C_{pm} bukan merupakan indeks keupayaan proses yang sesuai. Dalam bahagian ini logik fuzzy digunakan untuk fuzzificate proses indeks dicadangkan baru kerugian berasaskan kemampuan. The α -potongan pemerhatian fuzzy kaedah yang digunakan untuk mencari fungsi keahlian fuzzy terhadap proses baru kerugian indeks berasaskan kemampuan. Akhirnya, pada setiap bahagian dengan satu contoh, penggunaan indeks kapabilitas proses baru digambarkan.

Hasil keputusan kajian ini adalah suatu indeks baru berasaskan rugi dengan lebih banyak spesifikasi, seperti berasaskan purata, berasaskan sasaran, berasaskan variasi, terbatas dan berasaskan rugi berbanding dengan indeks keupayaan proses yang lain. Indeks keupayaan proses yang baru ini adalah disamakan menggunakan kaedah α -cut. Oleh kerana itu indeks keupayaan proses samar yang berasaskan rugi telah dibangunkan yang berguna untuk data samar. Untuk mengesahkan kaedah berasaskan rugi yang baru ini, kepekaan indeks ini untuk spesifikasi proses telah diselidiki. Analisis sensitiviti menunjukkan bahawa indeks ini sensitif terhadap purata, variasi, dan data sasaran. Indeks yang baru mempunyai hubungan 99.6% dengan kerugian terutama asimetris terbalik fungsi kerugian biasa. Hubungan dengan

kerugian adalah yang tertinggi berbanding dengan indeks keupayaan proses yang lain. Selain itu analisis regresi menunjukkan bahawa indeks baru ini mempunyai paling besar hubungan dengan nilai kerugian berbanding dengan indeks keupayaan proses yang lain.



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I certify that an Examination Committee has met on June 2010 to conduct the final examination of MOHAMMAD ABDOLSHAH on his Doctor of Philosophy thesis entitled “Development Of A Fuzzy Loss-Based Process Capability Index” in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The committee recommends that the student be awarded the relevant degree.

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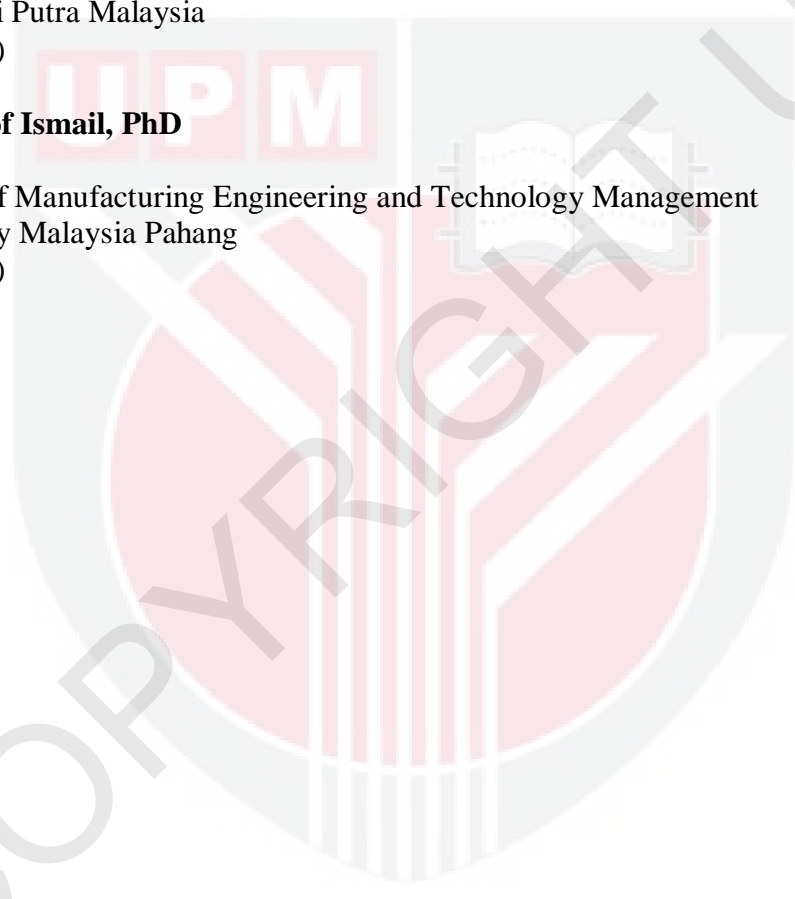
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TABLE OF CONTENTS

	Page
ABSTRACT	iii
ABSTRAK	v
ACKNOWLEDGEMENTS	viii
APPROVAL	ix
DECLARATION	xi
LIST OF TABLES	xv
LIST OF FIGURES	xvi
LIST OF NOMENCLATURE	xviii
LIST OF NOTATIONS	xix
CHAPTER	
1 INTRODUCTION	1
1.1 Introduction	1
1.2 Statement of the Problem	2
1.3 Objective of the Study	3
1.4 Significance of the Study	4
1.5 Managerial Implications	5
1.6 Limitation of the Study	5
1.7 Scope of the study	5
1.8 Organization of Dissertation	6
2 LITERATURE REVIEW	7
2.1 Introduction	7
2.2 Statistical Process Control (SPC)	8
2.3 Process Capability Study	8
2.4 Process Capability Indices (PCIs)	9
2.4.1 The Original Five Capability Indices	11
2.4.2 PCIs with Asymmetric Specification Limits	17
2.4.3 Relation between PCIs and Rejects	20
2.5 Quality Loss Functions	25
2.5.1 Traditional Approach	26
2.5.2 Taguchi Loss Functions	27
2.5.3 Ryan Loss Function	28
2.5.4 Inverted Normal Loss Function	29
2.5.5 Asymmetric Inverted Normal Loss Function	30

	2.5.6	Weaknesses of Quality Loss Functions	31
	2.6	Loss-Based Process Capability Indices	33
	2.7	Fuzzy Process Capability Indices	35
	2.8	Literature Review Summary	39
	2.9	Results	41
3		METHODOLOGY	43
	3.1	Introduction	43
	3.2	Methodology of Developing of new Loss-Based PCI	45
	3.3	Methodology of Fuzzification of New Loss-Based PCI	48
4		PROPOSED PROCESS CAPABILITY INDEX BASED ON THE ASYMMETRIC INVERTED NORMAL LOSS FUNCTION	52
	4.1	Introduction	52
	4.2	Proposed Process capability Index Based on the Asymmetric Inverted Normal Loss Function	54
	4.3	Numerical Example	63
	4.4	Validation (Sensitivity)	71
	4.4.1	Introduction	71
	4.4.2	Sensitivity in the Case of Change in Specification Limits	74
	4.4.3	Sensitivity in the Case of Change in Standard Deviation	75
	4.4.4	Sensitivity in the Case of Change in Target	77
	4.4.5	Sensitivity in the Case of Change in Losses (Standard Deviation)	78
	4.4.6	Sensitivity in the Case of Change in Losses (Specification Limits)	80
	4.4.7	Sensitivity in the Case of Change in Losses (Change in Target)	81
	4.4.8	Results and discussion	82
5		MEASURING PROCESS CAPABILITY INDEX AIPCI WITH FUZZY DATA	85
	5.1	Introduction	85
	5.2	Concepts of Fuzzy Logics	88
	5.2.1	Fuzzy Interval	88
	5.2.2	Fuzzy Set	88
	5.2.3	Membership Functions	89
	5.2.4	Fuzzy Numbers	92

5.2.5	α - Cut	93
5.3	Measuring Process Capability Index AIPCI with Fuzzy Data	94
5.4	A Numerical Example- Comparison with Other PCIs	105
5.5	Comparison Fuzzy AIPCI with Other PCIs	120
5.6	Conclusions	126
6	CONCLUSION AND RECOMMENDATION	128
6.1	Conclusion	128
6.2	Future Work	132
	REFERENCES	133
	APPENDICES	139
	BIODATA OF STUDENT	199
	LIST OF PUBLICATIONS	200