

TESIS DOCTORAL – PhD Dissertation

Programa de Doctorado de Ingeniería y Producción Industrial



UNIVERSITAT
POLITÈCNICA
DE VALÈNCIA

TITLE:

Development of systemic methods to improve the management techniques based on the Balanced Scorecard in the Manufacturing Environment

TÍTULO:

Desarrollo de métodos sistémicos para la mejora de las técnicas de gestión basadas en el cuadro integral de mando en entornos de fabricación

AUTHOR / AUTOR:

Rafael Sánchez Márquez

SUPERVISED BY / DIRIGIDA POR:

Dr. Eduardo Vicens Salort

Dr. José Miguel Albarracín Guillem

OCTUBRE 2019

TABLE OF CONTENTS

ACRONYMS AND ABBREVIATIONS	5
ABSTRACT	7
RESUMEN	9
RESUM.....	11
AGRADECIMIENTOS	13
ACKNOWLEDGEMENTS	15
1 INTRODUCTION AND OBJECTIVES	17
1.1 PROBLEM STATEMENT	17
1.2 OBJECTIVES.....	20
1.3 RESEARCH METHODOLOGY AND RESOURCES	21
1.4 STRUCTURE.....	22
1.5 PUBLICATIONS AUTHORS' CONTRIBUTIONS	25
1.6 REFERENCES.....	26
2 PUBLICATIONS	29
2.1 A SYSTEMIC METHODOLOGY FOR THE REDUCTION OF COMPLEXITY OF THE BALANCED SCORECARD IN THE MANUFACTURING ENVIRONMENT	29
2.1.1 <i>Introduction</i>	29
2.1.2 <i>Literature review</i>	30
2.1.3 <i>The proposed methodology</i>	35
2.1.4 <i>Discussion of the results</i>	40
2.1.5 <i>Conclusions and future research</i>	49
2.1.6 <i>References</i>	50
2.2 A STATISTICAL SYSTEM MANAGEMENT METHOD TO TACKLE DATA UNCERTAINTY WHEN USING KEY PERFORMANCE INDICATORS OF THE BALANCED SCORECARD	54
2.2.1 <i>Introduction</i>	54
2.2.2 <i>Literature review</i>	57
2.2.2.1 Review on significant trend analysis.....	60
2.2.2.2 Review on significant shift analysis.....	61
2.2.2.2.1 Significant shift analysis for proportions.....	61
2.2.2.2.2 Significant shift analysis for Poisson rates.....	62
2.2.3 <i>Proposed methodology</i>	63
2.2.3.1 Methods for significant trend analysis.....	64
2.2.3.2 Methods for significant shift analysis	65
2.2.3.3 Significant shift analysis on L&OH CPU	66

2.2.3.4	Statistical system management method flow chart.....	75
2.2.4	<i>Results and discussion</i>	75
2.2.4.1	Extended case study.....	83
2.2.5	<i>Conclusions and future research</i>	84
2.2.6	<i>References</i>	85
2.3	INTELLECTUAL CAPITAL AND BALANCED SCORECARD: IMPACT OF LEARNING AND DEVELOPMENT PROGRAMS USING KEY PERFORMANCE INDICATORS IN MANUFACTURING ENVIRONMENT	89
2.3.1	<i>Introduction</i>	89
2.3.2	<i>Literature review</i>	91
2.3.3	<i>Proposed methodology</i>	94
2.3.4	<i>Results and discussion</i>	96
2.3.5	<i>Conclusions and future research</i>	104
2.2.4.	<i>Optimization with Excel Solver</i>	105
2.3.6	<i>References</i>	111
2.4	DIAGNOSIS OF THE QUALITY MANAGEMENT SYSTEM USING DATA ANALYTICS – A CASE STUDY OF THE MANUFACTURING SECTOR	116
2.4.1	<i>Introduction</i>	116
2.4.2	<i>Literature review</i>	117
2.4.3	<i>Data and methods</i>	120
2.4.4	<i>Results and discussion</i>	126
2.4.4.1	Results including all models	126
2.4.4.1.1	Quality predictability	126
2.4.4.1.2	Quality feedback	132
2.4.4.2	Results by model	139
2.4.5	<i>Conclusions</i>	142
2.4.5.1	Conclusions on Quality Predictability.....	142
2.4.5.2	Conclusions on Quality Predictability.....	143
2.4.6	<i>References</i>	144
3	GENERAL DISCUSSION OF RESULTS	148
4	CONCLUSIONS	154
4.1	CONTRIBUTION	154
4.2	FUTURE WORKS.....	155
5	ATTACHMENTS	157
5.1	JUSTIFICATION OF THE PAPER IN THE STATUS ‘UNDER REVIEW’	157
5.2	JUSTIFICATION OF THE PAPER IN THE STATUS ‘UNDER REVIEW’	158