

**TRIZ Innovation Management Approach  
for  
Problem Definition and Product Service Systems**

**By  
Ahmad Abdelkareem Abdalla**

A thesis submitted in partial fulfilment of the requirements of  
University of Bolton - Bolton, UK  
for  
The degree of Doctor of Philosophy

April 2006



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Band 7

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Shaker Verlag  
Aachen 2006

**Bibliographic information published by Die Deutsche Bibliothek**

Die Deutsche Bibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data is available in the internet at <http://dnb.ddb.de>.

Zugl.: University of Bolton, Diss., 2006

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Printed in Germany.

ISBN-10: 3-8322-5265-7

ISBN-13: 978-3-8322-5265-6

ISSN 1613-3609

Shaker Verlag GmbH • P.O. BOX 101818 • D-52018 Aachen

Phone: 0049/2407/9596-0 • Telefax: 0049/2407/9596-9

Internet: [www.shaker.de](http://www.shaker.de) • e-mail: [info@shaker.de](mailto:info@shaker.de)

By the Name of  
Allah  
The Most Gracious  
The Most Merciful

*See you not that Allah sends down water (rain) from the sky, and We produce therewith fruits of varying colours, and among the mountains are streaks white and red, of varying colours and others very black. And of men and moving living creatures, and cattle, in like manner of various colours. It is only those who have knowledge among His slaves that fear Allah. Verily, Allah is Almighty, Oft Forgiving.*

*(The Holly Quran, Suraht Fatir: verses 27 and 28)*



## **Dedication**

To the sole of my father who was deprived the right of education and wished to see me educated.

To my mother who sacrificed her life for me and my brothers and sisters. Who sailed her life journey in between waves of hardship one after another and succeeded in delivering men and women of values and morals.

## **Declaration**

No portion of the work presented in this dissertation has been submitted in support of another award or qualification either at this institute or elsewhere.

## **Acknowledgement:**

“One hand can’t clap”, for me the research and writing of this thesis was an enrichment course through which I am delighted to take the opportunity to acknowledge the many hands that helped me clap.

First I would like to thank my first supervisor Prof. Dr.-Ing. Berthold Bitzer, the Dean of Engineering at South Westphalia University of Applied sciences and head of the department of the Automation technology. Prof. Bitzer gave me the support, encouragement and stimulating atmosphere to always set and define my benchmarks to be at the top of the scale. An atmosphere that exposed me to be integrated in an international research community, participate in conferences and workshops, project management and foremost “success”.

Many thanks go for my second supervisor, Prof. Danny Morton from the University of Bolton, who was patient enough to direct me in my PhD journey to align and stimulate well structured bricks of thoughts for the research and thesis writing.

Acknowledgement is due also to: Prof. Bitzer as the INNOPSE project coordinator for which major parts of this research was conducted, to the “International Universities research institute” (IURI) for the support along the past three years, and for the South Westphalia University of Applied Sciences research funds for the financial support for the last two months.

This thesis would not have been possible without the support and understanding of my dear family. My wife who spent tremendous efforts in providing me a productive, placid and encouraging atmosphere to do tomorrow’s tasks today. My pearls and peace of mind: Ekram, Maisan, Abdalla and Almuthanna, whom, whenever I see, I remind myself to be the good model that I want them to be.



## Preamble

In the course of my master program in Electronic Systems and Engineering Management I became acquainted with the topics of innovation and problem solving through the INNOPSE project (“Innovation Studio and Exemplary Development of Product Service Engineering” a three years research project, May 2002 – April 2005, funded by the European Commission “GROWTH” Programme). In fulfilment for the master degree, my master research project was the development of concept and the realization of the Innovation Studio. The concept of the Innovation Studio has been developed based on the results of the best practice case studies, from a survey conducted for the project, and the basic research conducted on obstacles impeding innovation.

It was through that research that I was first introduced to TRIZ and other creativity and innovation management methods and tools and there I had developed the first concept, called 4Ts (Abdalla, 2003; Abdalla et al, 2003), for a systematic process for problem solving and idea management.

It was then that I realized the interest I have in the process of problem solving and the use of innovation management methods and tools, especially the TRIZ methodology. It was also apparent that I needed to deepen my knowledge about the existing methodologies, thus we had acquired three different software tools that implement the methodology of TRIZ and implemented them in the Innovation Studio on case studies and new problems. More literature research was done to broaden my knowledge about TRIZ and problem solving. **It was due to that knowledge that the research problems of this PhD thesis had arose.**

Many issues are amidst “hidden” contention and ambiguity in the realm of innovation and problem solving among researchers. Each claims the supremacy of his/her approach to problem solving and creativity techniques. None of the published work gave complete and satisfying answers to many critical issues for the success of problem solving and innovation. Different combinations of tools have been introduced in different case studies. I have not noticed, even in an instance, where the author admits the inadequacy of his/her combination of methods and tools for problem solving. Still issues like problem definition, knowledge identification and creation, creativity techniques...and many others have not matured and still beyond complete understanding.

On the other hand, the research has been directed by the goals of the INNOPSE projects. One of the goals of INNOPSE was to develop a methodology for developing product service systems (PSSs). The developed methodology was based on the TRIZ tools and knowledge

base. This is where the two strands of research meet. The problem solving and PSS development research has been joined by the implementation of innovation management methods and tools.

This is the background for the research reported in this thesis. The research has been conducted in South Westphalia University of Applied Sciences in Soest, Germany under the supervision of Prof. Berthold Bitzer from South Westphalia University of Applied Science and Prof. Danny Morton from the University of Bolton in Bolton, UK.

My aim in conducting this research is not just to fulfil the requirements of the degree and not only to publish work. Rather I aim at meeting standards of rigorous research to provide knowledge that contribute in building a theory of excellence that will help researchers, scholars and experts to come in this field.

## **Abstract**

The research carried out in this thesis dealt with two strands that are closely related in their research theme. The first is pertaining to problem solving processes, specifically the problem definition stages, and the second is concerned with the role of TRIZ in developing Product Service Systems (PSS).

One of the most important developments in innovation management in the recent past is the systematic approach of making creativity and innovation learnable through generalising knowledge and best practice for problem solving. Solution generation and evaluation attracted more emphasis while more important aspects of problem solving lie in the problem identification and definition stages. TRIZ provided the core of the generalised knowledge and best practice that many state of the art innovation methodologies look into for problem solving. This research has investigated the structure of some of these methodologies and their approaches for the purpose of identifying possible areas for enhancement in the problem definition stages. The research also presented key findings after analysing 93 case studies that were published using state of the art methodologies and other proprietary approaches.

These two research activities identified the major shortcomings in problem identification and definition stages to be related to identifying the root causes and the right system parameters involved in the root causes as well as the way by which the problem model is drawn and communicated. The research contributions to this research strand are manifested in a systematic approach for problem identification and definition called the Problem Construction Model (PCM). This model provides answers to the identified deficiencies. The research also reported an evaluation and a comparison of the PCM with other state of the art approaches.

The research for the second strand is centred on the role TRIZ can play in developing PSSs. The research investigated the state of the art in PSSs development methodologies in terms of approach, structure and tools implemented. While many of the investigated methodologies provided organisational and evaluation tools, they stayed short from incorporating TRIZ or any of its tools in the PSSs development processes and did not tackle the issues in problem identification and solution. The research contributions in this strand are a concept for developing PSSs called “Balance” and the development of 40 inventive principles for developing eco-efficient PSSs.

## Table of Contents:

Dedication .....	iii
Declaration .....	iv
Acknowledgement.....	iv
Preamble .....	v
Abstract .....	vii
Table of Contents: .....	viii
List of Figures .....	xiii
List of Tables:.....	xiv
List of used abbreviations .....	xvi
1. Chapter 1: Introduction and Executive Summary .....	3
1.1. Research contexts .....	4
1.1.1. Problem solving.....	4
1.1.2. Product Service System Development .....	9
1.2. Motivation for the Research .....	11
1.3. Research Problems .....	11
1.4. Research Objectives .....	11
1.5. Research Focus and Boundaries.....	12
1.6. Research Methodology.....	13
2. Chapter 2: State of the Art in problem definition.....	15
2.1. State of the art in Problem solving methods and tools .....	15
2.1.1. Classical TRIZ.....	16
2.1.2. Creax Innovation Suite (CIS).....	22
2.1.2.1. Comments on CIS .....	23
2.1.3. Innovation WorkBench (IWB).....	29
2.1.3.1. Structure and logic of the IWB .....	30
2.1.3.2. Comments on IWB.....	32
2.1.4. Systematic Inventive Thinking (SIT), Unified SIT and Advanced SIT .....	33
2.1.5. TRIZ combined with other Methods and Tools .....	35
2.2. Creative problem Solving.....	36
2.3. Creativity Thought .....	37
2.4. Chapter Summary.....	40
3. Chapter 3: TRIZ Case studies .....	43
3.1. Innovation Obstacles and the Evaluation Factors .....	43
3.1.1. Summary of the innovation obstacles .....	43
3.1.2. IMMT relevance to the identified obstacles.....	44
3.1.3. Summary of the IMMT Evaluation factors .....	45
3.1.4. Evaluation Process .....	46
3.2. Customizing the Evaluation factors for TRIZ.....	48
3.3. Considered case studies:.....	52
3.4. General overview .....	53
3.4.1. Types of Problems.....	53
3.4.2. Problem definition factors.....	54
3.4.3. Knowledge tools Utilization.....	57
3.4.4. Other tools .....	58
3.5. Precautions .....	58
3.6. Research Key findings .....	60
3.7. Chapter Summary.....	67
4. Chapter 4: Problem construction model.....	71

4.1.	Knowledge Creation Trends.....	71
4.2.	Steering Language.....	73
4.3.	“Problem Construction” model.....	76
4.3.1.	Perception Mapping.....	82
4.3.2.	Functional Correlation.....	84
4.3.3.	Dynamic Elimination.....	86
4.3.4.	Free-Perfect-Now.....	92
4.3.5.	Steering language choice.....	92
4.3.6.	Problem Diagram.....	93
4.4.	Conflicts and Contradictions in best practice.....	94
4.5.	Chapter Summary.....	99
5.	Chapter 5: Evaluating the PCM Approach.....	101
5.1.	Implementing the PCM.....	101
5.1.1.	Functional Correlation:.....	102
5.1.2.	Dynamic Elimination:.....	103
5.1.3.	Steering language.....	105
5.1.4.	Free-perfect-and now.....	105
5.1.5.	Model of the problem.....	106
5.2.	Evaluation Example Two: Liquid Transportation.....	109
5.2.1.	Functional Correlation:.....	111
5.2.2.	Dynamic Elimination:.....	111
5.2.3.	Steering language.....	112
5.2.4.	Free-perfect-and now.....	113
5.2.5.	Model of the problem.....	114
5.3.	Innovation Management Students implementing the PCM.....	115
5.4.	Chapter Summary and Evaluation Key Findings.....	116
6.	Chapter 6: Product Service Systems Concept.....	121
6.1.	PSS definition.....	122
6.2.	Drivers for developing PSSs.....	123
6.3.	Types of PSS.....	125
6.4.	Dematerialization and PSS.....	127
6.5.	Function economy and PSS.....	128
6.6.	Chapter Summary.....	129
7.	Chapter 7: Review of the State of the Art in PSS development.....	131
7.1.	Research in PSS.....	131
7.2.	PSS development obstacles.....	132
7.3.	PSS development strategies.....	134
7.4.	PSS development methods and tools.....	143
7.5.	TRIZ State of the art in the development of PSSs.....	144
7.6.	Chapter Summary.....	146
8.	Chapter 8: TRIZ for developing PSSs.....	149
8.1.	PSSs development strategy.....	149
8.2.	“Balance” a PSS development method.....	152
8.2.1.	Characteristics of Balance:.....	155
8.3.	Developing inventive principles for PSSs Development.....	155
8.3.1.	Principles’ Development Methodology.....	156
8.3.2.	40 Eco-Efficient Inventive Principles.....	157
8.4.	Chapter Summary.....	185
9.	Chapter 9: Conclusions.....	187
9.1.	Research Main Findings.....	187
9.1.1.	For the Problem Solving strand.....	187

9.1.2.	For the PSSs Development strand.....	188
9.2.	Research Contributions .....	189
9.2.1.	For the Problem Solving strand.....	189
9.2.2.	For the PSSs Development strand.....	192
9.3.	Further Research .....	192
10.	References and Bibliography .....	195
10.1.	References for Chapter one .....	195
10.2.	References for Chapter two .....	198
10.3.	References for Chapter three.....	204
10.4.	References for Chapter Four .....	213
10.5.	References for Chapter Five.....	216
10.6.	References for Chapter Six .....	218
10.7.	References for Chapter Seven .....	220
10.8.	References for Chapter Eight .....	224
10.9.	Bibliography for Chapter Eight.....	229
10.10.	References for Chapter 9.....	232
11.	Appendices .....	233
11.1.	Appendix 1: Publications .....	233
a.	Reviewed Papers .....	233
b.	Books.....	233
c.	Conference Papers.....	233
11.1.1.	Centrality of ‘Common Language’ to problem solving. Trends of evolution case study: The development of heat induction system.....	235
11.1.2.	Innovation management methods and tools for sustainable product service systems (With a Case Study).....	247
11.1.3.	Knowledge representation and the correlation between problem analysis and the solution knowledge domain: Research and recommendation for standards in the TRIZ methodology.....	261
11.1.4.	Simulation services: Load behaviour lab model demonstrator for simulation services .....	276
11.1.5.	Benchmarking TRIZ in the field of Product Service systems “PSS” .....	279
11.1.6.	Innovation management methods and tools and their relevance in meeting the determinants of innovation.....	293
11.1.7.	Measurement Criteria of the relevance of the Innovation management methods and tools .....	308
11.1.8.	Innovation Management in SMEs – experience of successful European companies.....	327
11.1.9.	Innovation Studio and Exemplary Developments for Product Service Engineering “INNOPSE” .....	339
11.2.	Appendix 2: TRIZ based Methodologies .....	343
11.2.1.	IWB Algorithm .....	343
11.2.2.	SIT.....	349
11.2.3.	USIT.....	351
11.2.4.	ASIT.....	357
11.3.	Appendix 3: Summaries of the analysed case studies.....	359
	Case study one.....	359
	Case study two .....	360
	Case study three .....	362
	Case study four.....	362
	Case study Five .....	364
	Case study Six .....	365

Case study Seven.....	366
Case study Eight.....	367
Case study Nine.....	368
Case study Ten .....	369
Case study Eleven .....	371
Case study Twelve .....	372
Case study Thirteen.....	373
Case study Fourteen .....	374
Case study Fifteen .....	375
Case study Sixteen .....	376
Case study Seventeen.....	378
Case study Eighteen .....	379
Case study Nineteen .....	380
Case study Twenty .....	381
Case study Twenty one .....	382
Case study Twenty two .....	383
Case study Twenty three .....	384
Case study Twenty four.....	385
Case study Twenty Five .....	387
Case study Twenty Six.....	389
Case study Twenty Seven .....	390
Case study Twenty Eight.....	391
Case study Twenty Nine .....	393
Case study Thirty .....	394
Case study Thirty one.....	395
Case study Thirty Two .....	397
Case study Thirty Three .....	397
Case study Thirty Four.....	398
Case study Thirty Five .....	399
Case study Thirty Six .....	400
Case study Thirty Seven.....	402
Case study Thirty Eight.....	404
Case study Thirty Nine.....	405
Case study Forty .....	406
Case study Forty one.....	407
Case study Forty Two .....	408
Case study Forty Three .....	409
Case study Forty Four .....	410
Case study Forty Five.....	411
Case study Forty Six .....	412
Case study Forty Seven.....	413
Case study Forty Eight .....	415
Case study Forty Nine .....	416
Case study Fifty.....	417
Case study Fifty one .....	418
Case study Fifty Two .....	419
Case study Fifty Three .....	421
Case study Fifty Four .....	422
Case study Fifty Five.....	423
Case study Fifty Six .....	424
Case study Fifty Seven.....	425

Case study Fifty Eight .....	426
Case study Fifty Nine .....	428
Case study Sixty .....	429
Case study Sixty one .....	430
Case study Sixty Two.....	432
Case study Sixty Three.....	434
Case study Sixty Four .....	435
Case study Sixty Five.....	437
Case study Sixty Six.....	438
Case study Sixty Seven .....	439
Case study Sixty Eight .....	440
Case study Sixty Nine .....	441
Case study Seventy.....	442
Case study Seventy One.....	443
Case study Seventy Two .....	444
Case study Seventy Three .....	446
Case study Seventy Four.....	447
Case study Seventy Five .....	448
Case study Seventy Six .....	450
Case study Seventy Seven.....	450
Case study Seventy Eight.....	451
Case study Seventy Nine.....	452
Case study Eighty.....	453
Case study Eighty One .....	454
Case study Eighty Two .....	455
Case study Eighty Three .....	456
Case study Eighty Four .....	457
Case study Eighty Five.....	458
Case study Eighty Six .....	458
Case study Eighty Seven:.....	459
Case study Eighty Eight:.....	460
Case study Eighty Nine:.....	461
Case study Ninety: .....	462
Case study Ninety One:.....	463
Case study Ninety Two: .....	464
Case study Ninety Three: .....	465
11.4.    Appendix 4: Steering language Terms and Symbols .....	475
11.5.    Appendix 5: A case study included as a sample from the work done by the innovation management students. ....	483
11.6.    Appendix 6: Designing Eco-efficient Services (DES) Methodology and its Tools 495	
11.6.1.    The DES Methodology.....	495
11.6.2.    META Matrix Tool .....	499
11.6.3.    ViP approach.....	501
11.6.4.    Blueprinting.....	503
11.6.5.    LiDs Wheel .....	505
11.6.6.    The Eco-compass .....	506