

## Contents

Streszczenie.....	8
Summary .....	9
<b>1. Introduction.....</b>	<b>13</b>
<b>2. <i>The Invisible Hand of the Market</i> paradigm.....</b>	<b>18</b>
2.1. <i>The Invisible Hand of the Market</i> mechanism in the historical perspective .....	18
2.2. Criticism of the <i>Invisible Hand of the Market</i> concept.....	23
2.3. The contemporary perspective of the <i>Invisible Hand of the Market</i> .....	25
<b>3. Collective Intelligence .....</b>	<b>27</b>
3.1. Origins of Collective Intelligence.....	27
3.2. Symptoms of Collective Intelligence in nature.....	30
3.2.1. Social structure of bacterial colonies .....	32
3.2.2. Social structure of insects: ants, termites and bees .....	33
3.2.3. Social structure of birds .....	39
3.2.4. Social structures among mammals.....	41
3.2.5. Collective Intelligence manifestations in nature – summary .....	42
3.3. Collective Intelligence computational model .....	43
3.3.1. Molecular model of computation.....	43
3.3.2. Formal description .....	45
3.3.3. Collective Intelligence Quotient – IQS .....	49
3.4. Designing a molecular model of computation.....	50
3.4.1. A proposal to generalise the ACO algorithm in the molecular computational model.....	53
3.5. Random Prolog Processor, implementing the molecular computation model .....	53
<b>4. Market simulation models.....</b>	<b>56</b>

4.1.	Analysis of previous and current approaches and solutions .....	58
4.2.	An attempt at a synthesis of market simulation models.....	63
4.2.1.	Merchants as market players.....	63
4.2.2.	Producers as market participants.....	64
4.2.3.	Government as a market participant .....	65
4.2.4.	Market modelling .....	65
4.2.5.	Method of running simulations .....	66
<b>5.</b>	<b>Market model concept for the purposes of <i>ASIHM</i> processes simulation</b>	<b>68</b>
5.1.	Agent based systems.....	69
5.1.1.	Agent definitions .....	70
5.1.2.	Agent classifications .....	72
5.1.3.	Multi-agent systems .....	72
5.2.	Modelling an agent – the M-Agent architecture.....	74
5.3.	Basic elements of the CIMAMSS system .....	78
5.3.1.	Environment.....	78
5.3.2.	Environment space.....	80
5.3.3.	The agent in the CIMAMSS system – the market participant ...	83
5.3.4.	Resources, goods and commodities .....	86
5.3.5.	Decision-making .....	88
5.4.	Market modelling.....	89
5.4.1.	Budgetary limitation .....	92
5.4.2.	Utility theory .....	93
5.4.3.	Conclusions for agent modelling .....	98
5.4.4.	Transaction modelling.....	99
5.4.5.	Agent migration .....	104
5.4.6.	Production in the CIMAMSS system.....	105
5.5.	CIMAMSS model – final conclusions.....	106
5.5.1.	Agent types and structure.....	107
5.5.2.	The design of the computational layer.....	108
<b>6.</b>	<b>Pilot implementations of <i>ASIHM</i> process simulations</b> .....	<b>110</b>
6.1.	CIMAMSS model characteristics .....	110
6.2.	Comments on implementing the CIMAMSS model .....	111

6.2.1.	System architecture .....	112
6.2.2.	Transaction implementation .....	114
6.2.3.	The JESS rule system.....	117
6.2.4.	World editor and visualisation .....	124
6.3.	Defining the <i>IQS</i> quotient for the market.....	129
6.3.1.	GDP definition in the CIMAMSS model.....	130
6.4.	Simulating the <i>ASIHM</i> process in a barter economy .....	131
6.4.1.	Experiment preparation.....	131
6.4.2.	Dynamics of the parameters of the world in <i>ASIHM</i> simulations	135
6.4.3.	The <i>IQS</i> study and results from the <i>ASIHM</i> study .....	140
<b>7.</b>	<b>Conclusions</b> .....	<b>143</b>
	References.....	147