

TABLE OF CONTENTS

1 Introduction	10
2 Trends in biomimetics	14
2.1 Definition	14
2.2 The three main strands of development in biomimetics	19
2.3 The three levels of learning from nature	24
2.4 The exceptional scientific and technological nature of biomimetics	27
2.5 Tentative conclusion about trends in biomimetics	31
3 Technological aspects of learning from nature	34
3.1 Biomimetics and its technology foresight	35
<i>National technology foresight studies</i>	37
<i>Supranational technology foresight study: EU-Foresight</i>	40
<i>Technology foresight studies by companies</i>	42
3.2 Results of the case studies	43
<i>Sensorics</i>	46
<i>Robotics</i>	50
<i>The material sciences</i>	52
<i>Bioceramics</i>	55
<i>Information and communication technology (ICT)</i>	58
<i>Prosthetics</i>	60
<i>Tissue engineering</i>	63
<i>Nanobiotechnology</i>	64
<i>Converging technologies</i>	65
3.3 Biomimetics and technomimetics – opportunities and risks in converging technologies	68
3.4 Tentative conclusion regarding technological prospects	73
4 Topics, actors, and research networks – results of literature and patent analyses	76
4.1 The national biomimetics R&D landscape	77
4.2 The German research networks “BioKoN” and “Kompetenznetz Biomimetik”	77
4.3 GTBB, conferences, and expert interviews	85
4.4 Networking activities and intensity among biomimetics actors	100
4.5 Analysis and description of the German R&D landscape on the basis of literature reviews	105
<i>Biomimetics in the narrow sense</i>	107
<i>Learning from nature</i>	111

4.6 International Biomimetics R&D landscape	114
<i>Patent and literature analyses of biomimetics in the narrow sense and learning from nature</i>	115
<i>Network analysis</i>	125
4.7 Biomimetics in education and training	132
<i>Current state of biomimetics training and education</i>	132
<i>What form should biomimetics education and training take?</i>	135
4.8 Tentative conclusions about topics, actors, and research networks	139
 5 Biomimetics and innovation	 144
5.1 Biomimetics and systems of innovation	144
5.2 Biomimetic innovations	147
5.3 Driving forces and obstacles in biomimetic innovation – two examples: optimisation processes and artificial photosynthesis	152
5.4 Biomimetics-specific driving forces and obstacles	156
5.5 Prospective classification of biomimetics	159
5.6 Tentative conclusion with respect to biomimetics and innovation	161
 6 Conclusion	 170
6.1 Trends in biomimetics	170
6.2 Technology potential of learning from nature	173
6.3 Biomimetic topics, stakeholders, and research networks – results of the literature and patent analyses	176
6.4 Biomimetics and innovation	178
<i>Driving forces for biomimetic innovation</i>	182
 7 References	 186
 8 Annex	 200
8.1 List of illustrations	200
8.2 List of tables	202