

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION





Nature-like and Convergent Technologies Driving the Fourth Industrial Revolution



Nature-like and Convergent Technologies Driving the Fourth Industrial Revolution

© UNIDO 2019. All rights reserved.

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as "developed", "industrialized" or "developing" are intended for statistical convenience and do not necessarily express a judgement about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

For reference and citation, please use: United Nations Industrial Development Organization, 2019. *Nature-like and Convergent Technologies Driving the Fourth Industrial Revolution*. Vienna.

CONTENTS

Ak Ac	breviations knowledgments	v vi	
Int	troduction	1	
1.	Nature-like and convergent technologies as a response to global challenges	4	
	Sustainable economic development opportunities for nature-like and convergent technologies	11	
	Convergetics and synergetics	15	
	Convergence of life, bio- and medical sciences	16	
	Convergent or nature-like technologies in medicine	20	
2.	Frontier technologies driving the fourth industrial revolution	22	
	The 4IR and Industry 4.0	23	
	Convergence drives divergence	28	
	Potential impacts of the 4IR on the Sustainable Development Goals	30	
	Challenges	33	
	Preparedness for 4IR	34	
	Moving towards Industry 5.0 and Society 5.0	36	
3.	Megascience and international collaboration as a basis for the		
	development of nature-like technologies	39	
4.	Readiness to develop and implement convergent technologies—NBICS	44	
	Recommendations on potential mechanisms for minimizing and removing barriers	47	
5.	Resolution of the Forum	61	
	Global Forum on Nature-Like and Convergent Technologies	61	
No	otes	63	
Re	References		
Bi	Biographies of speakers		

ABBREVIATIONS

4IR	Fourth industrial revolution	OECD	Organisation for Economic Co-
AI	Artificial intelligence		operation and Development
AR	Augmented reality	PaaS	Products-as-a-service
CRISPR	Clustered regularly interspaced short	R&D	Research and development
	palindromic repeat	R&D&I	Research, development and
GMIS	Global Manufacturing and		innovation
	Industrialization Summit	SDG	Sustainable development goal
IAI	Industrial artificial intelligence	SLM	Selective layer melting
ICNR	International Centre for Neutron	SMEs	Small and medium-sized enterprises
	Research	SSRS	Specialized synchrotron radiation
IDC	International Data Corporation		source
IFR	International Federation of Robotics	STEAM	Science, technology, engineering, arts
IIoT	Industrial Internet of things		and mathematics
ІоТ	Internet of things	TVET	Technical and vocational education
NBICS	Nano-, bio-, info-, cogno-, and		and training
	socio-technologies	UNDESA	United Nations Department of
NTI	National Technology Initiative of		Economic and Social Affairs
	Russia	VR	Virtual reality
		WHO	World Health Organization

ACKNOWLEDGMENTS

This report was prepared by Olga Memedovic, Chief of the Business Environment, Cluster and Innovation Division (BCI) in the UNIDO Department of Trade, Investment and Innovation (TII).

Oliver Authried, Brigitt Roveti, Christi Thomas, Iana Iakovleva, Linda Lampel, Svetlana Erkenova, Ekaterina Seteykina and Jun Yamashita provided background research and support.

The report benefited from the research papers prepared by Mikhail Kovalchuk, President, Oleg Naraikin, Vice-president, and Ekaterina Yatsishina, Deputy Director, National Research Centre (Kurchatov Institute); and Oleg Movsesyan, Director, Moscow State University Science Park.

The publication has benefited from the contributions of keynote speakers and panellists during the Global Forum on Naturally-based and Convergent Technologies held in Sochi, Russia, 28–29 September 2018. The Forum was organized by UNIDO in cooperation with the Ministry of Industry and Trade of the Russian Federation and the National Research Centre (Kurchatov Institute), and funded from the Voluntary Contribution of the Russian Federation to UNIDO Industrial Development Fund. The main spokespersons and moderators of the Forum were Andrey Fursenko, Assistant to the President, Vladimir Kalamanov, Deputy Minister of Industry and Trade, Mikhail Kovalchuk, President of the National Research Centre (Kurchatov Institute), Hiroshi Kuniyoshi, Deputy Director General of UNIDO, and Alexander Sergeev, President of the Russian Academy of Science.

We are grateful to the team at Communications Development Incorporated—led by Bruce Ross-Larson and including Joe Brinley, Joe Caponio, Mike Crumplar, Peter Redvers-Lee, Christopher Trott and Elaine Wilson—for editing and designing this publication.

While human ingenuity may devise various inventions to the same ends, it will never devise anything more beautiful, nor simpler, nor more to the purpose than nature does, because in her inventions nothing is lacking and nothing is superfluous.

Leonardo da Vinci

INTRODUCTION

Today we are faced with a crucial challenge of realizing sustainable development in the face of an ever-increasing demand for energy and natural resources, primarily water, food and other bio resources. As Kovalchuk et al. observe, the primary cause of the current crisis lies in the antagonism between biosphere (natural capital) and technosphere (manufactured capital) formed over the past 300 years.1 Creating our civilization and interacting with nature, humanity behaved not as an integral part but as a dominant force, exploiting natural resources in unsustainable ways. Over the course of the industrial revolutions, people have perfected industry, which benefited from technological advancements. The scale of production increased, but its harm to the biosphere also increased, today approaching a critical threshold. The deep-seated contradiction between nature and the technosphere caused the ever-growing threat of natural resource depletion and of environmental, climatic and technological disasters.

The history of science, primarily physics, shows that the end result of an ever-deeper penetration into the properties of matter was the discovery of new types of energy: thermodynamics, steam energy (steam engines): electrodynamics and electricity Nature-like and convergent technologies promise unprecedented and previously unimaginable possibilities. The basis of convergent technology is connecting the capabilities of modern digital technologies, such as microelectronics, with the creations of nature. Advances in electronics, nanoscience, bioscience, information technology, cognitive science, social sciences and humanities, and their integration, will allow us to develop previously unachievable human-centred utilities and services to improve our lives and leapfrog traditional impediments. These technologies are also referred to as frontier technologies because they are innovative, fast-growing, deeply interconnected and interdependent and are driving the fourth industrial revolution (4IR) forwards.

In industry, emerging technology trends, such as big data, cloud computing, industrial artificial intelligence, additive manufacturing, industrial internet of things, blockchain and new materials are changing the face of manufacturing, manufacturing-related services and the future of work and industrial skills. Nature-like and convergent technologies are being used to create new values by designing new materials, products and processes in industry and to pursue circular economy, thus

预览已结束, 完整报告链接和二维码如下:

https://www.yunbaogao.cn/report/index/report?reportId=5_23120

