



TECHNOLOGY AND INNOVATION REPORT **2018**

Harnessing Frontier Technologies for Sustainable Development



CONTENTS

FOREWORD	iii
ACKNOWLEDGEMENTS	iv
ABBREVIATIONS	v
OVERVIEW	xi
CHAPTER I FRONTIER TECHNOLOGIES AND SUSTAINABLE DEVELOPMENT	1
A. INTRODUCTION	2
B. FRONTIER TECHNOLOGIES: UNPRECEDENTED POSSIBILITIES, INTRACTABLE CHALLENGES	3
C. DISTINGUISHING FEATURES OF FRONTIER TECHNOLOGIES	4
1. Technologies building on each other	4
2. Moore’s Law	4
3. Technology convergence	6
4. Declining costs	6
5. Multiple platforms	6
6. Reduced entry costs	7
D. KEY TECHNOLOGIES AND THEIR POTENTIAL CONTRIBUTIONS TO SUSTAINABLE DEVELOPMENT	7
1. Big data, the Internet of Things and artificial intelligence	7
2. 3D printing	13
3. Biotechnology and health tech	16
4. Advanced materials and nanotechnology	17
5. Renewable energy technologies	18
6. Satellites and drones	20
7. Blockchain	20
E. KEY CONSIDERATIONS FOR HARNESSING FRONTIER TECHNOLOGIES FOR SUSTAINABLE DEVELOPMENT	21
1. Artificial intelligence could create – and destroy – jobs	21
2. Frontier technologies present challenges for privacy, security and algorithmic transparency	26
3. Frontier technologies have an unclear relationship to productivity growth and other development indicators	26
F. CONCLUSIONS	27
REFERENCES	30

CHAPTER II	BENEFITING FROM FRONTIER TECHNOLOGIES: GAPS AND CAPABILITIES	37
A.	INTRODUCTION	38
B.	THE INTERNATIONAL DIVIDE IN RESEARCH AND DEVELOPMENT CAPABILITIES	38
C.	BUILDING SKILLS FOR COMPLEMENTARITY WITH NEW TECHNOLOGIES IS CRITICAL	42
D.	TECHNOLOGICAL AND DIGITAL GENDER DIVIDES	44
	1. Women in science and technology	44
	2. Gender divides in manufacturing employment, including ICTs	45
	3. The gender gap in mobile ownership and Internet use	46
E.	THE ENERGY GAP AND THE DIGITAL DIVIDE	47
F.	CONCLUSIONS	48
REFERENCES		50
CHAPTER III	FOUNDATIONS OF STI POLICY FOR SUSTAINABLE AND INCLUSIVE DEVELOPMENT	53
A.	INNOVATION SYSTEMS: BUILDING AN ENABLING ENVIRONMENT FOR STI	54
	1. Capabilities of actors in the innovation system	54
	2. Connections in the innovation system	55
	3. The innovation system as an enabling environment	55
	4. Financing innovation	57
	5. Patent protection and incentives for innovation and investment	60
B.	POLICY COHERENCE: INTEGRATING STI POLICIES IN DEVELOPMENT STRATEGIES	62
	1. Aligning STI policy with national development plans	62
	2. Steps towards building synergies between STI policy and national development plans	64
C.	REDIRECTING INNOVATION TOWARDS INCLUSIVENESS AND SUSTAINABILITY	66
	1. STI policies for inclusiveness and sustainability	66
	2. Intellectual property rights and the Sustainable Development Goals	68
	3. Technological change, employment and the social contract: Is this time different?	71
D.	CONCLUSIONS	75
REFERENCES		77

CHAPTER IV FRONTIER TECHNOLOGIES, EMERGING APPROACHES AND OPPORTUNITIES	83
A. LEAPFROGGING: LOOK BEFORE YOU LEAP?	84
B. EXTENDING BENEFICIARIES: ALTERNATIVE MODES OF INNOVATION	86
C. SMART SPECIALIZATION: INNOVATION AS A STRATEGY FOR COMPETITIVE ADVANTAGE	89
1. The S3 approach	89
2. S3 as a vertical policy approach.....	89
3. Establishing priorities	90
4. Developing transformative activities.....	90
5. S3 as experimental policy	91
6. Experience with S3 to date	91
7. Further development possibilities	92
D. PLATFORMS FOR ECONOMIC DISCOVERY	92
1. Technology, innovation and economic discovery	92
2. Platforms for economic discovery as a tool for innovation and cooperation policy	93
3. Designing platforms for economic discovery to achieve key innovation objectives.....	94
4. Platforms for economic discovery as an opportunity for international cooperation	94
E. INNOVATIVE FINANCING	95
1. Venture capital and business angels	95
2. Impact investment	96
3. Crowdfunding.....	97
4. Innovation and technology funds	98
5. New types of bonds.....	99
F. INCUBATORS, ACCELERATORS AND TECHNOLOGY PARKS.....	100
G. SHAPING INTERNATIONAL COLLABORATIVE RESEARCH NETWORKS TO SERVICE THE SUSTAINABLE DEVELOPMENT GOALS	101
1. The growth of global research collaboration	101
2. Drivers of global collaboration	103
3. Implications of global collaboration for STI governance and policy	104
4. Fostering participation in global research collaboration towards the Sustainable Development Goals.....	105
5. Maximizing development impact	106
H. CONCLUSIONS	107
REFERENCES	109