

## UvA-DARE (Digital Academic Repository)

### Making and breaking with science and conscience

*The human rights-compatibility of information security governance in the context of quantum computing and encryption*

van Daalen, O.

#### Publication date

2022

[Link to publication](#)

#### Citation for published version (APA):

van Daalen, O. (2022). *Making and breaking with science and conscience: The human rights-compatibility of information security governance in the context of quantum computing and encryption*. [Thesis, fully internal, Universiteit van Amsterdam].

#### General rights

It is not permitted to download or to forward/distribute the text or part of it without the consent of the author(s) and/or copyright holder(s), other than for strictly personal, individual use, unless the work is under an open content license (like Creative Commons).

#### Disclaimer/Complaints regulations

If you believe that digital publication of certain material infringes any of your rights or (privacy) interests, please let the Library know, stating your reasons. In case of a legitimate complaint, the Library will make the material inaccessible and/or remove it from the website. Please Ask the Library: <https://uba.uva.nl/en/contact>, or a letter to: Library of the University of Amsterdam, Secretariat, Singel 425, 1012 WP Amsterdam, The Netherlands. You will be contacted as soon as possible.

# MAKING AND BREAKING WITH SCIENCE AND CONSCIENCE

THE HUMAN RIGHTS-COMPATIBILITY OF  
INFORMATION SECURITY GOVERNANCE IN THE CONTEXT OF  
QUANTUM COMPUTING AND ENCRYPTION

OT VAN DAALEN

# MAKING AND BREAKING WITH SCIENCE AND CONSCIENCE

THE HUMAN RIGHTS-COMPATIBILITY OF  
INFORMATION SECURITY GOVERNANCE IN THE CONTEXT OF  
QUANTUM COMPUTING AND ENCRYPTION

Ot van Daalen



*Cover design* Ot van Daalen  
*Lay-out* Ot van Daalen, with the help of L<sup>A</sup>T<sub>E</sub>X  
Images Randall Munroe, published under a Creative Commons Attribution-NonCommercial 2.5 License. All images can be found at [xkcd.com](http://xkcd.com).

© Ot van Daalen, Amsterdam 2022.

ISBN 978-9-4036-5876-6

This PhD is supported by the Dutch Research Council (NWO) through the Gravitation-grant Quantum Software Consortium (no. 024.003.037).

# MAKING AND BREAKING WITH SCIENCE AND CONSCIENCE

THE HUMAN RIGHTS-COMPATIBILITY OF  
INFORMATION SECURITY GOVERNANCE IN THE CONTEXT OF  
QUANTUM COMPUTING AND ENCRYPTION

## ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor  
aan de Universiteit van Amsterdam  
op gezag van de Rector Magnificus  
prof. dr. ir. P.P.C.C. Verbeek

ten overstaan van een door het College voor Promoties ingestelde commissie,  
in het openbaar te verdedigen in de Agnietenkapel  
op woensdag 5 oktober 2022, te 16.00 uur

door Otto Lodewijk van Daalen  
geboren te Amsterdam

### **Promotiecommissie**

<b>Promotores</b>	prof. dr. mr. M.M.M. van Eechoud dr. J.V.J. van Hoboken	Universiteit van Amsterdam Universiteit van Amsterdam
<b>Overige leden</b>	prof. dr. M.R.F. Senftleben dr. J. Ausloos prof. dr. Y.M. Donders prof. dr. H.M. Buhrman prof. dr. B. van den Berg dr. N. Ní Loideáin prof. dr. A.M. Matwyshyn	Universiteit van Amsterdam Universiteit van Amsterdam Universiteit van Amsterdam Universiteit van Amsterdam Universiteit Leiden Institute of Advanced Legal Studies Penn State Law

Faculteit der Rechtsgeleerdheid

To Louk and Max



# Contents

<b>Acknowledgements</b>	<b>i</b>
<b>1 Introduction</b>	<b>1</b>
1.1 Research choices, terminology and limitations . . . . .	4
1.2 Methodology and sources . . . . .	6
1.3 Structure of the book . . . . .	10
1.4 Relevance of this thesis . . . . .	11
<b>I The landscape</b>	<b>17</b>
<b>2 The technological and societal landscape</b>	<b>19</b>
2.1 The information security cycle . . . . .	19
2.2 The encryption landscape . . . . .	47
2.3 Quantum computing: crypto-killer app or vapourware? . . . . .	56
2.4 Summing up . . . . .	77
<b>3 The governance landscape</b>	<b>81</b>
3.1 Governance of the information security cycle . . . . .	82
3.2 Governance of the encryption landscape . . . . .	115
3.3 Governance of quantum computing . . . . .	135
3.4 Summing up . . . . .	137
<b>II The human rights framework</b>	<b>141</b>
<b>4 Human rights in context</b>	<b>143</b>
4.1 The early years of human rights . . . . .	144
4.2 The Universal Declaration of Human Rights . . . . .	146
4.3 Human rights protection in Europe . . . . .	147

4.4	The application of the Convention and the Charter . . . . .	152
4.5	Different typologies of states' duties . . . . .	162
<b>5</b>	<b>The right to privacy and data protection</b>	<b>165</b>
5.1	Concepts of privacy . . . . .	166
5.2	The right to privacy under the Convention . . . . .	176
5.3	The rights to privacy and data protection under the Charter . . .	190
5.4	Conclusion . . . . .	196
<b>6</b>	<b>The right to communications freedom</b>	<b>199</b>
6.1	Three perspectives on communications freedom . . . . .	202
6.2	Communications freedom and the information security cycle .	210
6.3	Communications freedom and the application of information security . . . . .	221
6.4	Conclusion . . . . .	226
<b>7</b>	<b>The right to science</b>	<b>231</b>
7.1	Relevant provisions . . . . .	232
7.2	Interpretation of the right to science . . . . .	234
7.3	Relation between the right to science and communications free- dom . . . . .	239
7.4	Limitations on the right to science . . . . .	242
7.5	Conclusion: a marriage of science and conscience . . . . .	244
<b>III</b>	<b>Synthesis</b>	<b>247</b>
<b>8</b>	<b>Human rights-compatible information security cycle governance</b>	<b>249</b>
8.1	The information security cycle landscape . . . . .	249
8.2	Human rights requirements for information security cycle gov- ernance . . . . .	257
8.3	Recommendations for human rights-compatible governance .	265
8.4	Topics for further research . . . . .	276
<b>9</b>	<b>Human rights-compatible encryption governance</b>	<b>279</b>
9.1	The encryption landscape . . . . .	280
9.2	Human rights requirements for encryption governance . . . .	289
9.3	Recommendations for human-rights compatible governance .	302
9.4	Topics for further research . . . . .	303
<b>10</b>	<b>Human rights-compatible quantum computing governance</b>	<b>307</b>
10.1	The quantum computing landscape . . . . .	307

10.2 Human rights requirements for quantum computing governance	311
10.3 Recommendations for human rights-compatible governance . . .	314
10.4 Topics for further research . . . . .	318
<b>11 Conclusion and summary</b>	<b>321</b>
11.1 The information security cycle . . . . .	322
11.2 The human rights framework . . . . .	324
11.3 Human rights-compatible governance of the information security cycle . . . . .	329
11.4 Human rights-compatible governance of encryption . . . . .	332
11.5 Human rights-compatible governance of quantum computers . .	336
11.6 Peering into the future . . . . .	339
11.7 Making and breaking with science and conscience . . . . .	340
<b>Summary in Dutch</b>	<b>345</b>
<b>Bibliography</b>	<b>353</b>