## Table of contents

Foreword ......................................................................................................................... 3
Acknowledgements .......................................................................................................... 5
Abbreviations and acronyms .......................................................................................... 17
Executive summary .......................................................................................................... 19
  What is the *Oslo Manual*? ......................................................................................... 19
  Why a manual for measuring innovation? ................................................................. 19
  What is innovation? ...................................................................................................... 20
  Why and how was the manual revised? ..................................................................... 21
  What are the main novelties of this edition? .............................................................. 21
  How are the guidelines intended to be used? ............................................................. 23
  Where to find additional relevant resources? .............................................................. 23

**Part I. Introduction to the measurement of innovation** .............................................. 25

**Chapter 1. Introduction to innovation statistics and the *Oslo Manual*** ..................... 27
  1.1. Objectives and background of the *Oslo Manual* ............................................. 28
    1.1.1. The origins of the Oslo Manual .................................................................... 28
    1.1.2. Main objectives of the fourth edition ......................................................... 29
    1.1.3. Scope and approach of the fourth edition .................................................. 30
    1.1.4. The Oslo Manual and other statistical standards ......................................... 31
  1.2. Structure and contents of the *Oslo Manual 2018* ............................................ 32
    1.2.1. Introduction to the measurement of innovation (Part I) .............................. 32
    1.2.2. Framework and guidelines for measuring business innovation (Part II) ...... 32
    1.2.3. Methods for collecting, analysing and reporting statistics on business innovation (Part III) 36
    1.2.4. Cross-cutting issues covered within this manual .......................................... 37
    1.2.5. Digitalisation and innovation .................................................................... 37
    1.2.6. Globalisation and innovation .................................................................... 39
  1.3. Implementing the guidance in this manual ........................................................... 39
    1.3.1. Nature of the guidance in this manual ........................................................ 39
    1.3.2. Transition and implementation .................................................................... 40

References ....................................................................................................................... 41

**Chapter 2. Concepts for measuring innovation** ....................................................... 43
  2.1. Introduction ........................................................................................................... 44
  2.2. The concept of innovation .................................................................................... 45
    2.2.1. Conceptual foundations .............................................................................. 45
    2.2.2. Knowledge ................................................................................................ 46
    2.2.3. Novelty with respect to potential uses ....................................................... 46
2.2.4. Implementation and actual use ................................................................. 47
2.2.5. Value creation .................................................................................. 47
2.3. User needs and relevance of statistical evidence on innovation .................. 48
  2.3.1. Research academics ..................................................................... 48
  2.3.2. Business managers ...................................................................... 49
  2.3.3. Innovation and other public policy makers ..................................... 49
2.4. Elements of an innovation measurement framework .................................. 50
  2.4.1. Scope of innovation measurement: SNA sectors and jurisdictions .... 50
  2.4.2. Innovation phenomena for measurement ....................................... 53
2.5. General strategies for measuring innovation ............................................ 56
  2.5.1. Subject- versus object-based approaches ...................................... 56
  2.5.2. Qualitative and quantitative data .................................................. 57
  2.5.3. Sources of innovation data ............................................................. 57
  2.5.4. Responsibility for primary source data collection ......................... 58
  2.5.5. Summary of the measurement approach in this manual .................. 59
2.6. Measuring innovation beyond the Business sector .................................... 60
  2.6.1. Innovation in the General government sector ............................... 60
  2.6.2. Innovation and non-profit institutions .......................................... 61
  2.6.3. Innovation, households and individuals ....................................... 61
References ................................................................................................. 62

Part II. Framework and guidelines for measuring business innovation .................. 65

Chapter 3. Concepts and definitions for measuring business innovation ............... 67
  3.1. Introduction ....................................................................................... 68
  3.2. Innovation in the Business enterprise sector ...................................... 68
    3.2.1. Definition of innovation activities and innovation ......................... 68
    3.2.2. Division of innovation effort and responsibilities ......................... 70
  3.3. Taxonomies of innovation .................................................................. 70
    3.3.1. Innovation types by object: Product and business process innovations 70
    3.3.2. Types of innovation according to novelty and impacts .................. 77
  3.4. Changes that are not innovations ....................................................... 78
  3.5. Innovation and business profiling ....................................................... 80
    3.5.1. Innovative and innovation-active firms ........................................ 80
  3.6. Use of innovation definitions in data collection .................................. 81
    3.6.1. Use of the term “innovation” in surveys ...................................... 81
    3.6.2. Innovation profiles .................................................................... 82
    3.6.3. Priorities for data collection about innovations .......................... 82
References ................................................................................................. 83

Chapter 4. Measuring business innovation activities ........................................... 85
  4.1. Introduction and main features of innovation activities .......................... 86
  4.2. Types of activities of relevance to innovation ...................................... 87
    4.2.1. Research and experimental development activities ....................... 87
    4.2.2. Engineering, design and other creative work activities .................. 87
    4.2.3. Marketing and brand equity activities .......................................... 88
    4.2.4. Intellectual property related activities ........................................ 89
    4.2.5. Employee training activities ...................................................... 89
    4.2.6. Software development and database activities .............................. 89
    4.2.7. Activities related to the acquisition or lease of tangible assets ....... 90
    4.2.8. Innovation management ............................................................ 91
Chapter 6. Business innovation and knowledge flows

6.1. Introduction ................................................................. 128
6.2. Knowledge flows and innovation: Key concepts and definitions ........................................... 129
  6.2.1. Diffusion of innovation ........................................... 129
  6.2.2. Knowledge flows ................................................... 129
  6.2.3. Open innovation .................................................... 132
6.3. Collecting data on knowledge flows and their relationship to innovation ................................ 134
  6.3.1. General issues ..................................................... 134
  6.3.2. Data on knowledge flows from innovation activities ....................................................... 135
  6.3.3. Sources of ideas or information for innovation ............................................................... 139
  6.3.4. Interactions with higher education and public research institutions ............................... 140
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.3.1. Question design</td>
<td>207</td>
</tr>
<tr>
<td>9.3.2. Questionnaire design</td>
<td>208</td>
</tr>
<tr>
<td>9.3.3. Short-form questionnaires</td>
<td>209</td>
</tr>
<tr>
<td>9.3.4. Combining innovation and other business surveys</td>
<td>210</td>
</tr>
<tr>
<td>9.3.5. Questionnaire testing</td>
<td>211</td>
</tr>
<tr>
<td>9.4. Sampling</td>
<td>212</td>
</tr>
<tr>
<td>9.4.1. The survey frame</td>
<td>213</td>
</tr>
<tr>
<td>9.4.2. Census versus sample</td>
<td>214</td>
</tr>
<tr>
<td>9.4.3. Longitudinal panel data and cross-sectional surveys</td>
<td>215</td>
</tr>
<tr>
<td>9.5. Data collection methods</td>
<td>216</td>
</tr>
<tr>
<td>9.5.1. Postal surveys</td>
<td>217</td>
</tr>
<tr>
<td>9.5.2. Online surveys</td>
<td>218</td>
</tr>
<tr>
<td>9.5.3. Telephone and face-to-face interviews</td>
<td>219</td>
</tr>
<tr>
<td>9.5.4. Combined survey methods</td>
<td>220</td>
</tr>
<tr>
<td>9.6. Survey protocol</td>
<td>221</td>
</tr>
<tr>
<td>9.6.1. Respondent identification</td>
<td>222</td>
</tr>
<tr>
<td>9.6.2. Support for respondents</td>
<td>223</td>
</tr>
<tr>
<td>9.6.3. Mandatory and voluntary surveys</td>
<td>224</td>
</tr>
<tr>
<td>9.6.4. Non-response</td>
<td>225</td>
</tr>
<tr>
<td>9.6.5. Conducting non-response surveys</td>
<td>226</td>
</tr>
<tr>
<td>9.7. Post-survey data processing</td>
<td>227</td>
</tr>
<tr>
<td>9.7.1. Error checks</td>
<td>228</td>
</tr>
<tr>
<td>9.7.2. Imputation of missing data</td>
<td>229</td>
</tr>
<tr>
<td>9.7.3. Calculating weights</td>
<td>230</td>
</tr>
<tr>
<td>9.8. Publication and dissemination of results</td>
<td>231</td>
</tr>
<tr>
<td>9.8.1. Metadata and quality reports</td>
<td>232</td>
</tr>
<tr>
<td>9.8.2. Data access</td>
<td>233</td>
</tr>
<tr>
<td>References</td>
<td>234</td>
</tr>
<tr>
<td>Chapter 10. The object method for innovation measurement</td>
<td>198</td>
</tr>
<tr>
<td>10.1. Introduction</td>
<td>199</td>
</tr>
<tr>
<td>10.2. Including an “object module” in an innovation survey</td>
<td>200</td>
</tr>
<tr>
<td>10.2.1. Identifying a focal innovation within surveys</td>
<td>201</td>
</tr>
<tr>
<td>10.2.2. Non-innovative firms</td>
<td>202</td>
</tr>
<tr>
<td>10.3. Questions on a focal innovation</td>
<td>203</td>
</tr>
<tr>
<td>10.3.1. Characteristics of the focal, most important innovation</td>
<td>204</td>
</tr>
<tr>
<td>10.3.2. Innovation activities contributing to the focal innovation</td>
<td>205</td>
</tr>
<tr>
<td>10.3.3. Business capabilities contributing to the focal innovation</td>
<td>206</td>
</tr>
<tr>
<td>10.3.4. Knowledge flows contributing to and generated by the focal innovation</td>
<td>207</td>
</tr>
<tr>
<td>10.3.5. External factors influencing the focal innovation</td>
<td>208</td>
</tr>
<tr>
<td>10.3.6. Objectives and outcomes of the focal innovation</td>
<td>209</td>
</tr>
<tr>
<td>10.4. Summary of recommendations</td>
<td>210</td>
</tr>
<tr>
<td>References</td>
<td>211</td>
</tr>
<tr>
<td>Chapter 11. Use of innovation data for statistical indicators and analysis</td>
<td>187</td>
</tr>
<tr>
<td>11.1. Introduction</td>
<td>188</td>
</tr>
<tr>
<td>11.2. Data and indicators on business innovation</td>
<td>189</td>
</tr>
<tr>
<td>11.2.1. What are innovation indicators and what are they for?</td>
<td>190</td>
</tr>
<tr>
<td>11.2.2. Desirable properties of innovation indicators</td>
<td>191</td>
</tr>
<tr>
<td>11.2.3. Recommendations and resources for innovation indicators</td>
<td>192</td>
</tr>
</tbody>
</table>
11.3. Methodologies for constructing business innovation indicators ................................................................. 217
  11.3.1. Aggregation of statistical indicators ........................................................................................................ 217
  11.3.2. Indicator development and presentation for international comparisons .................................................... 219
  11.3.3. Firm-level innovation rankings ................................................................................................................. 221
11.4. A blueprint for indicators on business innovation ............................................................................................ 222
  11.4.1. Choice of innovation indicators ................................................................................................................ 222
  11.4.2. Breakdown categories, scaling, and typologies ............................................................................................ 227
  11.4.3. Choice of statistical data for innovation indicators ...................................................................................... 228
11.5. Using data on innovation to analyse innovation performance, policies and their impacts ............................. 229
  11.5.1. Modelling dependencies and associations .................................................................................................. 230
  11.5.2. Inference of causal effects in innovation analysis .......................................................................................... 230
  11.5.3. Analysing the impact of public innovation policies ...................................................................................... 233
  11.5.4. Co-ordinated analysis of innovation microdata across countries ................................................................. 236
11.6. Conclusions ......................................................................................................................................................... 237
References .................................................................................................................................................................. 237

Glossary of terms ......................................................................................................................................................... 241

Tables
Table 3.1. Functional categories for identifying the type of business process innovations .................. 73
Table 3.2. Comparing types of innovation in the current and previous *Oslo Manual* editions .......... 75
Table 3.3. Innovative and innovation-active firms ...................................................................................... 81
Table 4.1. Collection of qualitative data on activities relevant to innovation .............................................. 93
Table 4.2. Collecting expenditure data on specific activities of relevance to innovation ............................... 95
Table 4.3. Accounting method for collecting expenditure data on activities for innovation .................... 97
Table 5.1. Types of intellectual property protection for data collection ......................................................... 114
Table 6.1. Typology and examples of mechanisms for intentional knowledge flows .................................. 131
Table 6.2. Measuring the contribution of inbound knowledge flows to innovation ..................................... 135
Table 6.3. Sources of inbound knowledge flows for innovation ................................................................. 137
Table 6.4. Measuring direct mechanisms for outbound knowledge flows ..................................................... 138
Table 6.5. Types of collaboration partners for innovation ............................................................................... 138
Table 6.6. Measurement of sources of ideas and information for innovation .................................................. 139
Table 6.7. Measuring channels for knowledge-based interactions between firms and HEIs/PRIs ............ 140
Table 6.8. Potential questions on the use of IP rights for knowledge flows .................................................. 141
Table 6.9. Measuring barriers and unintended outcomes of knowledge interactions ............................... 142
Table 7.1. Business activities by location ............................................................................................................ 148
Table 7.2. Competition and product market characteristics that can influence innovation .................. 152
Table 7.3. Types of finance for general and specific innovation activities .................................................... 155
Table 7.4. Possible approaches for classifying government policy instruments in innovation surveys .. 157
Table 7.5. Main types of policy instruments to support innovation ............................................................. 158
Table 7.6. Types of public infrastructure of potential relevance to innovation in firms ............................. 158
Table 7.7. Collecting information on characteristics of the firm’s social environment ............................ 159
Table 7.8. Proposal for integrated collection of data on external drivers of innovation .............................. 160
Table 8.1. Innovation objectives and outcomes for measurement, by area of influence ............................ 166
Table 8.2. Measurement of innovation objectives and outcomes for business strategies ....................... 167
Table 8.3. Measurement of potential market impacts from business innovation ....................................... 168
Table 9.1. Economic activities for inclusion in international comparisons of business innovation ....... 183
Table 11.1. Desirable properties of business innovation indicators .......................................................... 215
Table 11.2. Descriptive statistics and methods for constructing innovation indicators ......................... 218
Table 11.3. Thematic areas for business innovation indicators ........................................ 222
Table 11.4. Indicators of innovation incidence and characteristics ..................................... 223
Table 11.5. Indicators of knowledge-based capital/innovation activities ............................... 224
Table 11.6. Indicators of potential or actual innovation capabilities .................................... 224
Table 11.7. Indicators of knowledge flows and innovation .................................................. 225
Table 11.8. Indicators of external factors influencing innovation ......................................... 226
Table 11.9. Indicators of innovation objectives and outcomes ............................................ 226

Figures

Figure 1.1. General representation of the relationship between chapters in Part II .................. 33
Figure 7.1. Main elements of the external environment for business innovation .................... 147
Figure 9.1. From innovation theory to innovation data ......................................................... 187
Figure 11.1. Logic model used in evaluation literature applied to innovation ....................... 231
Figure 11.2. The innovation policy evaluation problem to identifying causal effects ............. 234

Boxes

Box 6.1. Uses of the “open” concept in science and innovation ......................................... 133
Box 11.1. Major resources for international innovation data using Oslo Manual guidelines .... 217
Box 11.2. Examples of innovation scoreboards and innovation indexes .............................. 221