Adoption of National Electronic Prescribing Services in Primary Care in Europe - Policy Lessons for Ireland

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Abstract

A growing body of evidence over the past twenty years suggests that electronic prescribing (ePrescribing) can bring a host of benefits to the health sector, and some policy makers now view ePrescribing as a desirable national service that can improve the safety, quality and efficiency of healthcare. Consequently, national ePrescribing and electronic health record (EHR) projects have been launched in many countries in recent years, but success is elusive as ePrescribing in primary care is still unavailable in over 90% of countries worldwide. Progress has been limited to a small number of countries, with a significant cluster in Europe.

Why is the adoption of ePrescribing and EHRs slow and uneven? What are the factors that influence the development and adoption of ePrescribing? What are the building blocks for a national ePrescribing service? What are the lessons from the leading countries? What are the policy lessons for countries where national ePrescribing services are not yet developed?

This research addresses these questions. Qualitative methods were used, including a comparative analysis of case studies in thirty one European countries and interviews with national ePrescribing experts in the leading countries. A cross-domain comparison was undertaken with a leading eGovernment service in Ireland - the Revenue On-Line Service (ROS) – and interviews were held with national Revenue experts. The context, content and process framework from Pettigrew and Whipp’s model of strategic change and Roger’s diffusion of innovations model provide the conceptual frameworks for analysis and comparison.

The research found that ePrescribing services in primary care are now available on a national basis in eleven countries in different regions of Europe. A model for national ePrescribing is emerging over time, which includes local EHR integration, interoperability between prescribers and pharmacists through a national ePrescription database, and a trend towards on-line patient access to medication data using the Internet.

In many other European countries ePrescribing and in particular the electronic transmission of prescriptions (ETP) is underdeveloped due to a range of organisational, legal, technical or other barriers. In these countries, the absence of a developed national ETP service is the greatest barrier to adoption. The adoption patterns of recent years suggest that a technical-legal ePrescribing divide exists in Europe between the leading and the following countries.

The comparative analysis discovered that a strong inner context is the cornerstone of success in the leading countries and ROS. A strong inner context can shape the outer context, develop quality content and create a supportive process for adoption and diffusion. The findings suggest that this can be achieved through a complex process of continuous stakeholder management.

Building blocks were also identified in the outer context in the legal and technological areas, where the national health model in operation emerged as the key contextual factor. The quality of the content was found to be a key adoption factor, including the interoperability, security and usability of ePrescribing systems and ETP services.

The key critical success factor for the adoption of ePrescribing and ROS was found to be stakeholder management in the adoption process over a long period. Supporting factors included social marketing strategies, incremental implementation methods, quality user support and the judicious management of consent, incentives and mandates.

The overall approach used by the leading countries emerges as a balance of central control and direction from the inner context, coupled with widespread permanent stakeholder management across the domain including the outer context and the private sector, leading to a complex process of development and adoption over a long period. This equates to a combination of the traditional top-down and bottom-up approaches, which Coiera has described as middle-out.

The findings in this research may contribute to policy in this area, Irish policy in particular.
Declaration

I declare that the work described in this thesis is, except where otherwise stated, entirely my own work, and has not been submitted for any other purpose at this university or any other university.

Signed: [Signature]

[Date: 18/11/2015]
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This research journey has taken almost five years and there are many to thank.

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There is an African proverb that it takes a whole village to raise a child. It also takes a whole village to complete a thesis. From the bottom of my heart, thank you villagers one and all.
# Table of Contents

Abstract ........................................................................................................... ii

Declaration ..................................................................................................... iii

Acknowledgements ........................................................................................ iv

List of Appendices .......................................................................................... viii

List of Tables .................................................................................................. ix

List of Figures .................................................................................................. x

List of Abbreviations ....................................................................................... xi

Glossary of Terms and Abbreviations ............................................................. xiii

PART ONE: Introduction to ePrescribing ....................................................... 1

1. Introduction ................................................................................................. 2
   1.1. The Development of ePrescribing ......................................................... 2
   1.2. The Promise of ePrescribing ................................................................. 2
   1.3. The Spread of ePrescribing .................................................................. 4
   1.4. Objectives and Scope of Research ....................................................... 4
   1.5. Research Question .............................................................................. 7
   1.6. Structure of Thesis ............................................................................... 7
   1.7. Motivation ........................................................................................... 9
   1.8. Summary ............................................................................................. 9

2. The ePrescribing Domain ........................................................................... 11
   2.1. The Risks of Medication .................................................................... 11
   2.2. Definitions of ePrescribing ................................................................. 12
   2.3. Can ePrescribing Make a Difference? ................................................ 14
   2.4. Different Generations of ePrescribing ................................................ 18
   2.5. Technical Components of ePrescribing ............................................. 22
   2.6. Content of an ePrescription ............................................................... 22
   2.7. ePrescribing Stakeholder Groups ....................................................... 24
   2.8. ePrescribing as a Core Component of the EHR .............................. 26
   2.9. National Models of ePrescribing ......................................................... 27
   2.10. International Developments in ePrescribing ................................... 31
   2.11. Summary .......................................................................................... 32

3. Research Design and Methods .................................................................. 33
   3.1. Background and Prior Research ......................................................... 33
   3.2. National Perspective .......................................................................... 33
   3.3. Search Strategy and Sources of Data and Literature ....................... 34
   3.4. Analysis of Data and Literature .......................................................... 37
   3.5. Research Design - Case Studies and Comparative Analysis ........... 39
   3.6. Cross-Domain Comparison ................................................................ 41
   3.7. Interviews ......................................................................................... 42
   3.8. Summary ........................................................................................... 42
PART TWO: ePrescribing in Europe ......................................................... 45

4. ePrescribing in Primary Care in Europe ............................................ 46
   4.1. Data Sources and the Role of the EU .................................... 46
   4.2. The Spread of ePrescribing in Europe since 2000 ..................... 48
   4.3. Adoption Groups ................................................................ 49
   4.4. Regional Variations ............................................................. 53
   4.5. Population Variations ............................................................ 53
   4.6. North-South Digital Divide ..................................................... 53
   4.7. Correlation between EHRs and ePrescribing ......................... 54
   4.8. Summary ............................................................................. 55

5. Theoretical Framework .................................................................... 57
   5.1. Introduction ......................................................................... 57
   5.2. Conceptual Frameworks ........................................................ 57
   5.3. Context, Content and Process Framework ............................. 58
   5.4. Diffusion of Innovations Framework ..................................... 61
   5.5. Summary ............................................................................. 62

6. Comparative Analysis of ePrescribing in Primary Care in Europe ........ 63
   6.1. Introduction ......................................................................... 63
   6.2. Comparative Analysis – External Context ............................. 68
   6.3. Comparative Analysis – Internal Context ............................... 75
   6.4. Comparative Analysis - Content .......................................... 77
   6.5. Comparative Analysis – Process ........................................... 80
   6.6. Summary ............................................................................. 82

PART THREE: The Irish Context .............................................................. 83

7. ePrescribing – the Irish Context ......................................................... 84
   7.1. Introduction ......................................................................... 84
   7.2. Background to the Irish Health Service ................................. 84
   7.3. ICT and eHealth Developments in the Irish Health Service .... 85
   7.4. ePrescribing in Ireland ......................................................... 88
   7.5. Summary ............................................................................. 91

8. eGovernment Case Study- the Irish Revenue On-Line Service .......... 93
   8.1. ROS Case Study - Research Overview .................................. 93
   8.2. ROS Case Study – Background ............................................. 94
   8.3. 2000 – 2002: The Launch of ROS ....................................... 100
   8.4. 2003 – 2005: The Tipping Point .......................................... 105
   8.5. 2006 – 2008: Trial, Error and Redesign ............................... 110
   8.6. 2009 – 2012: Mandatory eFiling and Maturity .................... 111
   8.7. Outcomes of the ROS Project ............................................. 113
   8.8. Benefits of ROS ................................................................. 117
   8.9. Cost of ROS ....................................................................... 118
   8.10. ROS Stakeholder Analysis ................................................ 119
   8.11. Summary of the ROS Project ............................................ 122

9. Cross-Domain Comparative Analysis – Ireland .................................. 123
   9.1. Introduction ......................................................................... 123
   9.2. Comparative Analysis – Context ......................................... 123
   9.3. Comparative Analysis – Content ........................................ 129
   9.4. Comparative Analysis – Process ......................................... 132
   9.5. Comparison of Stakeholder Groups ..................................... 135
   9.6. Cross-Domain Comparison – Emerging Themes .................... 137
   9.7. Summary ............................................................................. 138
## PART FOUR: Comparative Analysis and Reflections

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.</td>
<td>Comparative Analysis – ePrescribing Leaders in Europe</td>
<td>142</td>
</tr>
<tr>
<td>10.1</td>
<td>Introduction</td>
<td>142</td>
</tr>
<tr>
<td>10.2</td>
<td>ePrescribing Leaders: Comparative Analysis – External Context</td>
<td>144</td>
</tr>
<tr>
<td>10.3</td>
<td>ePrescribing Leaders: Comparative Analysis – Internal Context</td>
<td>147</td>
</tr>
<tr>
<td>10.4</td>
<td>ePrescribing Leaders: Comparative Analysis – Content</td>
<td>149</td>
</tr>
<tr>
<td>10.5</td>
<td>ePrescribing Leaders: Comparative Analysis - Process</td>
<td>152</td>
</tr>
<tr>
<td>10.6</td>
<td>Summary</td>
<td>156</td>
</tr>
</tbody>
</table>

### 11. Findings, Discussion and Policy Lessons

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.1</td>
<td>Introduction</td>
<td>159</td>
</tr>
<tr>
<td>11.2</td>
<td>Emerging Topics and Challenges in ePrescribing</td>
<td>160</td>
</tr>
<tr>
<td>11.3</td>
<td>Development of a Positive Context for Adoption</td>
<td>165</td>
</tr>
<tr>
<td>11.4</td>
<td>Building Blocks, Critical Success and Critical Failure Factors</td>
<td>167</td>
</tr>
<tr>
<td>11.5</td>
<td>Application of the Model</td>
<td>170</td>
</tr>
<tr>
<td>11.6</td>
<td>Recommendations for ePrescribing Policy</td>
<td>172</td>
</tr>
<tr>
<td>11.7</td>
<td>Summary</td>
<td>179</td>
</tr>
</tbody>
</table>

### 12. Conclusions

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.1</td>
<td>Review of Research Question and Research Design</td>
<td>181</td>
</tr>
<tr>
<td>12.2</td>
<td>Review of Findings</td>
<td>181</td>
</tr>
<tr>
<td>12.3</td>
<td>Conclusions and Contributions to Policy</td>
<td>183</td>
</tr>
<tr>
<td>12.4</td>
<td>Contribution to Theory</td>
<td>185</td>
</tr>
<tr>
<td>12.5</td>
<td>Areas for Future Research</td>
<td>185</td>
</tr>
<tr>
<td>12.6</td>
<td>Limitations of Research</td>
<td>185</td>
</tr>
<tr>
<td>12.7</td>
<td>Final Thoughts</td>
<td>186</td>
</tr>
</tbody>
</table>

References                                                                                   188
List of Appendices

Appendix A: Data Sources and Data Analysis Categories _____________207

Appendix B: Interview Questions (ePrescribing) ______________________211

Appendix C: Interview Questions (ROS) ______________________________213

Appendix D: The Functions of Public Key Infrastructure (ROS) __________217

Appendix E: Overview of Local Property Tax System (ROS) ______________221

Appendix F: Stakeholder Analysis (ROS) ______________________________223

Appendix G: ePrescribing References by European Country ______________227

Appendix H: ROS Reference Material _________________________________241

Appendix I: Bibliography___________________________________________245
List of Tables

Table 1-1: Research areas ........................................................................................................... 5
Table 1-2: Structure of thesis .................................................................................................... 8
Table 2-1: Areas of strategic concern in medication management ........................................... 16
Table 2-2: Recorded benefits of ePrescribing technologies in medication management .......... 16
Table 2-3: The six stages of ePrescribing ................................................................................ 21
Table 2-4: Technical components of a national ePrescribing infrastructure ........................... 22
Table 2-5: EC ePrescription dataset – core mandatory data elements - 2014 ............................. 24
Table 2-6: Functions of an EHR ............................................................................................. 26
Table 2-7: National EHR projects. .......................................................................................... 28
Table 3-1: Results of on-line search for ePrescribing journal articles (2000-2014) ................. 34
Table 3-2: Total research material ......................................................................................... 35
Table 3-3: ROS research material ......................................................................................... 36
Table 3-4: Key categories for literature and data analysis ....................................................... 38
Table 4-1: Themes of published ePrescribing data ................................................................. 47
Table 6-1: Adoption of ePrescribing in Europe - 2014 ............................................................ 63
Table 6-2: Link between the key data analysis categories and the CCP framework ................. 66
Table 6-3: National health model groups .............................................................................. 69
Table 6-4: Legislation of eHealth and ePrescribing ................................................................. 74
Table 6-5: National ePrescribing strategies and national eHealth competence centres ........... 76
Table 6-6: Common technical standards in eHealth ............................................................... 78
Table 6-7: Unique identification of patients and health professionals .................................... 79
Table 6-8: National ePrescribing implementation approach .................................................. 81
Table 7-1: List of interviewees for national eHealth services in Ireland ................................. 84
Table 8-1: Research objectives for ROS case study ............................................................... 93
Table 8-2: List of interviewees for ROS project .................................................................... 94
Table 8-3: Legal framework prior to ROS ............................................................................ 97
Table 8-4: Legislation required for ROS ................................................................................ 98
Table 8-5: ROS security requirements ................................................................................... 99
Table 8-6: ROS developments and releases 2003-2005 ......................................................... 107
Table 8-7: Benefits of ROS to taxpayers .............................................................................. 118
Table 8-8: ROS stakeholder groups ..................................................................................... 120
Table 9-1: External context - comparison of factors ............................................................... 124
Table 9-2: Inner context - comparison of factors ................................................................... 127
Table 9-3: Content - comparison of factors ........................................................................... 130
Table 9-4: Process of adoption - comparison of factors ......................................................... 133
Table 10-1: List of countries selected for comparative analysis ............................................. 142
Table 10-2: List of interviewees for national ePrescribing services ....................................... 143
Table 10-3: External context - comparison by leading countries and ROS ............................. 146
Table 10-4: Internal context - comparison by leading countries and ROS .............................. 149
Table 10-5: National EHR projects ....................................................................................... 151
Table 10-6: Content - comparison by leading countries and ROS ........................................... 152
Table 10-7: Adoption Process - comparison by leading countries and ROS ........................... 155
Table 12-1: Summary of policy recommendations ............................................................... 184
Table A-1: EC reports on eHealth 2007-2014 ....................................................................... 207
Table A-2: Relevant reports from other organisations 2009-2014 ......................................... 207
Table A-3: Organisations that publish data on eHealth and ePrescribing ............................ 208
Table A-4: ePrescribing data analysis: Key categories and sub-categories ............................ 209
Table A-5: ROS data analysis: Key categories and sub-categories .......................................... 209
Table A-6: Relevant conferences attended .............................................................................. 210
Table F-1: ROS stakeholder types, classes and roles .............................................................. 223
Table F-2: ROS knowledge class and involvement ............................................................... 224
Table F-3: ROS stakeholder analysis - score by stakeholder class and role ............................ 225
Table F-4: ROS stakeholder groups ranked by total score ..................................................... 226
List of Figures

Figure 1-1: Example of unclear handwritten prescription ......................................................... 3
Figure 2-1: The medication management process in primary care ........................................... 12
Figure 2-2: Stakeholder map - English primary care ePrescribing ........................................... 25
Figure 2-3: Flowchart of the Swedish ePrescribing model ......................................................... 29
Figure 2-4: Overview of national ePrescribing model – Stage 6 ePrescribing ............................. 30
Figure 3-1: Research design ....................................................................................................... 44
Figure 4-1: Growth of ePrescribing in primary care in Europe: 2002-2013 .................................. 48
Figure 4-2: Adoption patterns of ePrescribing in primary care by country: 2002-2013 ............ 49
Figure 4-3: Tipping point for ePrescriptions in primary care in Sweden ................................. 50
Figure 4-4: ePrescribing and EHR use with population indicators - 2013 ............................... 54
Figure 5-1: CCP Framework 1 .................................................................................................. 59
Figure 5-2: CCP Framework 2 .................................................................................................. 60
Figure 6-1: National ePrescribing services – Key CCP factors ............................................... 67
Figure 6-2: Map of national health models ............................................................................... 70
Figure 6-3: Adoption of eHealth by national health model ...................................................... 71
Figure 6-4: Adoption of ePrescribing by national health model ............................................... 72
Figure 7-1: EHR use by Irish GPs (2000 and 2003) ................................................................... 89
Figure 8-1: Advertisement for ROS in 2001 ............................................................................. 104
Figure 8-2: Overview of the ROS transaction journey .............................................................. 106
Figure 8-3: Total ROS tax returns 2001-2005 ........................................................................ 109
Figure 8-4: eFiling by tax type 2012 v 2011 ............................................................................ 113
Figure 8-5: Visits to Revenue website 2002-2012 .................................................................... 114
Figure 8-6: ROS pay and file transactions 2002-2012 .............................................................. 115
Figure 8-7: Income tax returns filed through ROS 2002-2012 ............................................... 115
Figure 8-8: Uptake of PAYE Anytime 2007-2012 ................................................................... 116
Figure 8-9: Pattern of gross tax receipts 1999-2012 ............................................................... 117
Figure 8-10: ICT cost as a proportion of total cost of Irish tax administration ......................... 119
Figure 8-11: Stakeholders within CCP dimensions in onion model ......................................... 121
Figure 9-1: Stakeholder map - ROS ....................................................................................... 135
Figure 9-2: Stakeholder map – Irish primary care prescribing ............................................... 136
Figure 11-1: Overview of Findings ......................................................................................... 159
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADR*</td>
<td>Adverse Drug Reaction</td>
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<td>ATC*</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>LAETx</td>
<td>Life Assurance Exit Tax</td>
</tr>
<tr>
<td>LPTx</td>
<td>Local Property Tax</td>
</tr>
<tr>
<td>MPS*</td>
<td>Medical Protection Society (International)</td>
</tr>
<tr>
<td>NCTS*</td>
<td>New Computerised Transit System</td>
</tr>
<tr>
<td>NIMIS*</td>
<td>National Integrated Medical Imaging System (Ireland)</td>
</tr>
<tr>
<td>NPIT</td>
<td>National Program for Information Technology (UK)</td>
</tr>
<tr>
<td>OECD*</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>PAYE*</td>
<td>Pay As You Earn</td>
</tr>
<tr>
<td>PCRS*</td>
<td>Primary Care Reimbursement Service (Ireland)</td>
</tr>
<tr>
<td>PGEU*</td>
<td>Pharmacy Group of the European Union</td>
</tr>
<tr>
<td>PIN</td>
<td>Personal Identification Number</td>
</tr>
<tr>
<td>PKI*</td>
<td>Public Key Infrastructure</td>
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<tr>
<td>PPARS</td>
<td>Personnel, Payroll and Related Systems (Ireland)</td>
</tr>
<tr>
<td>PPSN*</td>
<td>Personal Public Service Number (Ireland)</td>
</tr>
<tr>
<td>PRSI*</td>
<td>Pay Related Social Insurance</td>
</tr>
<tr>
<td>PSI</td>
<td>Pharmaceutical Society of Ireland</td>
</tr>
<tr>
<td>PSWTx</td>
<td>Professional Services Withholding Tax</td>
</tr>
<tr>
<td>RAN</td>
<td>ROS Access Number</td>
</tr>
<tr>
<td>RCTX</td>
<td>Relevant Contracts Tax</td>
</tr>
<tr>
<td>RDI</td>
<td>ROS Debit Instruction</td>
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<tr>
<td>Revenue</td>
<td>Revenue Commissioners (Ireland)</td>
</tr>
<tr>
<td>RIS-PACS</td>
<td>Radiology Information System – Picture Archive Communication System</td>
</tr>
<tr>
<td>ROS</td>
<td>Revenue On-Line Service</td>
</tr>
<tr>
<td>ROS CA</td>
<td>ROS Certification Authority</td>
</tr>
<tr>
<td>ROS CIS</td>
<td>ROS Customer Information Service</td>
</tr>
<tr>
<td>SCA</td>
<td>State Claims Agency (Ireland)</td>
</tr>
<tr>
<td>SIMI</td>
<td>Society of the Irish Motor Industry</td>
</tr>
<tr>
<td>SNOMED CT*</td>
<td>Systematized Nomenclature of Medicine – Clinical Terms</td>
</tr>
<tr>
<td>SSIA</td>
<td>Special Savings Incentive Account (Ireland)</td>
</tr>
<tr>
<td>SSL*</td>
<td>Secure Sockets Layer</td>
</tr>
<tr>
<td>TAIN*</td>
<td>Tax Advisor Identification Number (Ireland)</td>
</tr>
<tr>
<td>TALC</td>
<td>Tax Advisory Liaison Committee (Ireland)</td>
</tr>
<tr>
<td>TEMPEST*</td>
<td>Technology, Economic, Market, Political, Evaluation, Social &amp; Transformational</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>VATx</td>
<td>Value Added Tax</td>
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<tr>
<td>VIES*</td>
<td>Value Added Tax Information Exchange System</td>
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<tr>
<td>VRTx</td>
<td>Vehicle Registration Tax</td>
</tr>
<tr>
<td>iXBRL</td>
<td>Inline eXtensible Business Reporting Language</td>
</tr>
<tr>
<td>XML</td>
<td>Extensible Markup Language</td>
</tr>
<tr>
<td>WHO*</td>
<td>World Health Organisation</td>
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</tbody>
</table>

* Definition is included in glossary of terms and abbreviations
# Glossary of Terms and Abbreviations

<table>
<thead>
<tr>
<th>Term/Abbreviation</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADR</td>
<td>Adverse Drug Reaction (ADR) is a harmful reaction resulting from the use of medication.</td>
</tr>
<tr>
<td>ATC Codes</td>
<td>Anatomical Therapeutic Chemical (ATC) Classification codes - a standard coding system for national drug databases (also known as Nordic ATC codes in Sweden and Denmark).</td>
</tr>
<tr>
<td>Antilope Project</td>
<td>Antilope is an EU project (2013-15) to promote eHealth interoperability.</td>
</tr>
<tr>
<td>Apoteket AB</td>
<td>Swedish organisation responsible for ICT infrastructure and national ePrescribing systems in the pharmacy domain.</td>
</tr>
<tr>
<td>CALLIOPE Project</td>
<td>Call for Interoperability (CALLIOPE) was an EU project (2008-2011) to promote interoperability in eHealth.</td>
</tr>
<tr>
<td>CF</td>
<td>Commonwealth Fund (CF) is a private foundation founded in the USA in 1918 that aims to promote high performing healthcare systems by supporting and undertaking health research.</td>
</tr>
<tr>
<td>Confidentiality</td>
<td>Confidentiality in eHealth and eGovernment is defined as protecting data, either in files on a computer, or in transmission between computers, from unauthorised access and disclosure.</td>
</tr>
<tr>
<td>CONTAX Project</td>
<td>Consolidated Taxes (CONTAX) Project was a computer project undertaken in the 1980s by the Irish Revenue Commissioners to integrate a customer’s tax data into one integrated record.</td>
</tr>
<tr>
<td>eHealth Initiative</td>
<td>An independent, non-profit affiliated organization in the USA whose mission is to drive improvement in the quality, safety and efficiency of healthcare through information and information technology.</td>
</tr>
<tr>
<td>EPSOS Project</td>
<td>European Patients Smart Open Services (EPSOS) project was the primary eHealth interoperability project of the EU (2008-2014) to promote the transfer of patient summaries and ePrescriptions between European countries.</td>
</tr>
<tr>
<td>European Commission</td>
<td>Executive body of the EU that represents the interests of the EU as a whole, and not the interests of individual countries.</td>
</tr>
<tr>
<td>G-Codes</td>
<td>Coding system used for Dutch national drug database.</td>
</tr>
<tr>
<td>Generic Compliance Rate</td>
<td>The rate of compliance in dispensing prescribed generic drugs.</td>
</tr>
<tr>
<td>HSE</td>
<td>Health Service Executive (HSE) is the statutory organisation responsible for health services in Ireland.</td>
</tr>
<tr>
<td>Healthlink</td>
<td>National electronic communications project funded by the HSE and available free of charge to all Irish GPs.</td>
</tr>
<tr>
<td>HL7</td>
<td>Health Level Seven (HL7) is an international technical standard for supporting interoperability in eHealth. Version 3 supports semantic interoperability.</td>
</tr>
<tr>
<td>ITIF</td>
<td>Information Technology and Innovation Foundation (ITIF) is a non-profit public policy organisation founded in the USA in 2006 which focuses on public policies that spur technology innovation.</td>
</tr>
<tr>
<td>IOM</td>
<td>Institute of Medicine (IOM) is an organisation that provides national advice on medical issues in the USA.</td>
</tr>
<tr>
<td>IMB</td>
<td>Irish Medicines Board (IMB) is the regulatory authority for the pharmaceutical market in Ireland.</td>
</tr>
<tr>
<td>ITU</td>
<td>International Telecommunications Union (ITU) - originally the International Telegraph Union (1865) became a special agency of the United Nations in 1947 and is responsible for issues that concern information and communication technologies.</td>
</tr>
<tr>
<td>Interoperability</td>
<td>Interoperability is defined by the Institute of Electrical and Electronics Engineers (IEEE) as the ability of two or more systems or components to exchange information and to use the information that has been exchanged.</td>
</tr>
<tr>
<td>Intrastat</td>
<td>Intra-EU Statistics (Intrastat) is the system for collecting information and producing statistics on the trade in goods between countries of the EU.</td>
</tr>
<tr>
<td>InterPARES</td>
<td>International Research on Permanent Authentic Records in Electronic Systems (InterPARES) is a research project into electronic records, managed by the University of British Columbia, Canada.</td>
</tr>
<tr>
<td>MedCom</td>
<td>Danish national healthcare institute responsible for ICT standards and project organisation.</td>
</tr>
<tr>
<td>Acronym</td>
<td>Description</td>
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<tr>
<td>MPS</td>
<td>Medical Protection Society (MPS) is an international organisation which provides professional indemnity insurance for doctors and other healthcare professionals.</td>
</tr>
<tr>
<td>NCTS</td>
<td>New Computerised Transit System (NCTS) is a European wide system, based upon electronic declaration and processing of both community and common transit, and involves customs in all EU Member States and the European Free Trade Association.</td>
</tr>
<tr>
<td>Nictiz</td>
<td>Dutch national institute for eHealth.</td>
</tr>
<tr>
<td>NIMIS Project</td>
<td>National Integrated Medical Imaging System is a project of the Irish HSE to implement RIS-PACS systems into 52 acute public hospitals in Ireland.</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development (OECD) is an international economic organisation of 34 countries founded in 1961 to stimulate economic progress and world trade.</td>
</tr>
<tr>
<td>Parapharmaceuticals</td>
<td>Products based on medicinal plants, such as vitamins and dietary products.</td>
</tr>
<tr>
<td>PAYE/PRSI (Ireland)</td>
<td>PAYE is income tax deducted from employees; PRSI is a social insurance charge which Revenue collects from employers on behalf of employees and remits to the Department of Social Protection; both are filed and paid on a monthly basis using the P30 Form.</td>
</tr>
<tr>
<td>PGEOU</td>
<td>Pharmacy Group of the EU (PGEU) is the European association representing community pharmacists.</td>
</tr>
<tr>
<td>Polypharmacy</td>
<td>The use of multiple medications, such as the use of multiple drugs in a single prescription, or the use of multiple drugs to treat multiple concurrent disorders in the same patient.</td>
</tr>
<tr>
<td>PPSN</td>
<td>Personal Public Service Number (PPSN) is a unique number provided to all Irish citizens for authentication and record management purposes for certain state services such as taxation and social welfare services.</td>
</tr>
<tr>
<td>Primary Care</td>
<td>First contact point for medical services (e.g. GPs or pharmacists).</td>
</tr>
<tr>
<td>PCRS</td>
<td>Primary Care Reimbursement Service (PCRS) is an Irish health service organisation that manages public health schemes in Ireland, such as the national drug payment schemes.</td>
</tr>
<tr>
<td>PKI</td>
<td>Public-Key Infrastructure (PKI) is a set of hardware, software, people, policies, and procedures needed to create, manage, distribute, use, store, and revoke digital certificates; technically, PKI is a cryptographic technique that enables users to securely communicate on an insecure public network, and reliably verify the identity of a user with a digital signature which binds public keys with user identities by means of a certificate authority.</td>
</tr>
<tr>
<td>Secondary Care</td>
<td>Second contact point for medical services (e.g. acute hospitals or medical specialists).</td>
</tr>
<tr>
<td>SSL</td>
<td>Secure Sockets Layer (SSL) is the standard security technology for establishing an encrypted link between a web server and a browser.</td>
</tr>
<tr>
<td>SNOMED CT</td>
<td>Systematized Nomenclature of Medicine: Clinical Terms (SNOMED CT) is an international clinical terminology standard.</td>
</tr>
<tr>
<td>State Claims Agency</td>
<td>Statutory authority which manages claims against the Irish State.</td>
</tr>
<tr>
<td>TAIN</td>
<td>Tax Agent Identification Number (TAIN) is a unique number issued to all registered Irish tax agents who use ROS.</td>
</tr>
<tr>
<td>Tax Briefing</td>
<td>Technical publication issued by the Irish Revenue Commissioners on a quarterly basis to all registered Tax Agents and Accountants since 1990; it was supplemented in 2004 by a weekly eMail briefing titled eBrief.</td>
</tr>
<tr>
<td>TEMPEST Project</td>
<td>Technology, Economic, Market, Political, Evaluation, Social and Transformational (TEMPEST) is an independent academic research project that began in 2009; is co-ordinated by the John Hopkins University and provides health data from multiple sources for comparative research.</td>
</tr>
<tr>
<td>Tertiary Care</td>
<td>Specialist medical services provided in technically advanced hospitals.</td>
</tr>
<tr>
<td>VIES</td>
<td>Value Added Tax Information Exchange System (VIES) was established by the EU to deter abuse of the zero-rating provisions for goods traded in the EU, and introduced the requirement on each member state to collect and store specific information about traders and their trades.</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation (WHO) is a special agency of the United Nations, founded in 1948 concerned with international public health.</td>
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</table>
PART ONE: Introduction to ePrescribing

In which we introduce the subject, the domain and the methods of enquiry.
1. Introduction

“The beginning is the most important part of the work.”(Plato)

1.1. The Development of ePrescribing

Prescribing medicine is one of the most universal medical treatments, and a prescription is one of the most common medical records. Until recent years this record was a paper prescription in most countries, but as computer technology continues to spread to most sectors of society, the prescription is becoming digital. Electronic prescribing (ePrescribing) is beginning to make an impact in the health sector, and is now included in the electronic health (eHealth) strategies of many countries.

Many variations of ePrescribing have come to light in the last decade. These include stand-alone systems used by prescribers to create and print prescriptions, point-to-point systems between prescriber and pharmacy, and regional and national services managed by health authorities and government initiatives. ePrescribing is now beginning to gain broad acceptance in both the primary and acute sectors similar to the widespread adoption of Radiology Information Systems and Picture Archiving Communication Systems (RIS-PACS) in secondary care in recent decades (Sutton 2011, Van De Wetering and Batenburg 2009).

The Centres for Medicare & Medicaid Services in the United States of America (USA) suggest ePrescribing is “a prescriber’s ability to electronically send an accurate, error-free and understandable prescription directly to a pharmacy from the point of care” (CMS 2014). By this definition, ePrescribing is not simply sending prescriptions by fax, telex or eMail, but the permanent replacement of the written, printed or barcode prescription with an electronic prescription file that is transmitted digitally. This suggests that ePrescribing requires a prescriber to create and transmit an electronic file to a pharmacy, where the electronic transfer of prescription (ETP) is an intrinsic element in the ePrescribing process. This transaction is an example of interoperability between electronic health record (EHR) systems (Sihna et al. 2013).

1.2. The Promise of ePrescribing

In the primary care setting, most prescriptions are handwritten or printed by the prescriber, and then carried to the pharmacy by the patient. This arrangement carries some risks: the prescription may be lost; the handwriting may be unclear and the wrong medicine may be dispensed; incorrect instructions may be given to the patient; or the
patient may amend or copy the prescription for fraudulent reasons. An example of an unclear handwritten prescription is shown in Figure 1-1 (Bridell 2010).

Figure 1-1: Example of unclear handwritten prescription

Source: (Bridell 2010)

ePrescribing is a relatively new service where a prescriber generates an ePrescription in an EHR system, and then transmits it to a pharmacy electronically. The patient no longer handles or carries the prescription, but simply presents identification at the pharmacy to obtain the medication. This development helps to overcome the problems inherent in the handwritten prescription, and a growing body of evidence suggests that the introduction of ePrescribing can improve patient safety, reduce medication errors, prevent fatalities and eliminate fraud (Fincham 2009, Finkelstein 2006, IOM 2011, Pagliari et al. 2011, Van Ornum 2009).

These improvements have created a vision of a national ePrescribing service, which has raised expectations in the healthcare community, as Hyppönen et al. (2006, p134) note:
“Electronic prescribing systems are expected to solve several challenges in healthcare: rationalizing the medication practices of physicians, providing up-to-date information on the cheapest medication available, reducing overlapping medication, reducing medication errors and adverse drug interactions, decreasing prescription handling costs and increasing efficiency in several organizations. Furthermore, electronic prescriptions are expected to provide more accurate and up-to-date statistical information about medication practices in relation to these issues and hence increase the efficiency of pharmaceutical distribution and improve the planning of national health policy in the long run”.

1.3. The Spread of ePrescribing
National ePrescribing strategies are now included in the national eHealth strategies of many countries, and many pilot projects have started in recent years. Some of these projects are now bearing fruit and ePrescribing is becoming more widespread. In the USA for example, 10% of family physicians in the primary care sector were actively ePrescribing in 2008, but by 2014 this increased to 73%, when this cohort transmitted 1.2 billion ePrescriptions or 67% of all USA primary care prescriptions (Surescripts 2012, Surescripts 2015).

In Europe, several national ePrescribing projects started in the last decade, but a survey of community pharmacy associations of the 27 European Union (EU) members in 2010 concluded that the “nationwide use of ePrescriptions was not more common than in 2002” (Mäkinen et al. 2011, p217). The study found that only Denmark and Sweden reported nationwide use, adoption was progressing slowly, progress appeared to be uneven among countries and the challenges were numerous. Has the situation in Europe improved in recent years at a rate similar to the USA?

1.4. Objectives and Scope of Research
From a brief review of the literature it is clear that wide variations exist between countries in the adoption of ePrescribing. The exploration of these variations provides the background context for this thesis.

1.4.1. Objectives of Research
The key research objective is to gain an understanding of the nature, development and adoption of ePrescribing systems and services at a national level. This includes ePrescribing systems adopted by prescribers and pharmacists nationwide, and the provision of ETP and other support services by national authorities. This commences
with an enquiry into national projects and develops into a study of the history, status, adoption, barriers, enablers, building blocks and critical success factors for national level ePrescribing. This objective suggests enquiry into the areas listed in Table 1-1.

<table>
<thead>
<tr>
<th>Table 1-1: Research areas</th>
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<tbody>
<tr>
<td>1. Explore the history and development of ePrescribing</td>
</tr>
<tr>
<td>2. Establish the adoption of ePrescribing across countries</td>
</tr>
<tr>
<td>3. Identify the status, models and paradigms of ePrescribing</td>
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<tr>
<td>4. Identify barriers and enablers to the adoption of ePrescribing</td>
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<tr>
<td>5. Explore the role and status of national EHRs</td>
</tr>
<tr>
<td>6. Explore the impact of different national health models on ePrescribing</td>
</tr>
<tr>
<td>7. Review the Irish ePrescribing context</td>
</tr>
<tr>
<td>8. Identify building blocks in the development and adoption of ePrescribing</td>
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<tr>
<td>9. Identify critical success/failure factors in ePrescribing</td>
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</table>

1.4.2. Scope of Research

ePrescribing potentially extends to the entire health sector of a country. This includes the primary care sector with actors such as General Practitioners (GPs) and community pharmacists, and the secondary and tertiary care sectors with actors such as medical consultants in acute and specialist hospital settings. However, ePrescribing in primary care is a different proposition to secondary or tertiary care.

In primary care, a wide range of routine services are provided by a variety of healthcare professionals (GPs, dentists, pharmacists, physiotherapists, public health nurses, and so forth) in a variety of outpatient settings which vary from country to country (Donaldson et al. 1996, Kringos et al. 2015, WHO 2008). Primary care services are geographically widespread and fragmented, and ePrescribing in this environment explicitly demands the electronic transmission of prescriptions from GPs and other prescribers to community pharmacists over regional or national networks. These transactions are supported by complex ETP infrastructures and technical, legal and professional relationships between prescribers, pharmacists and patients.

On the other hand, secondary/tertiary care is a unique environment, and ePrescribing in hospitals is a different challenge, with special requirements, technologies and regulations. Some authors have noted differences in ePrescribing and medication management between primary and secondary care, although there is a similar degree of uncertainty and risk in both settings. Professor Nick Barber, an authority on ePrescribing in the United Kingdom (UK) observed: “In primary care we’re talking about order to supply and in secondary care we’re talking about order to administer –
and they're quite different things” (Hayes et al. 2008, p2). ePrescribing in hospitals usually takes place within a single institution on a secure private network, with a more complex urgent medical need and a higher clinical risk than the primary care sector. Paradoxically, in hospitals there is often a lower degree of technical interoperability and legal regulation required than in primary care.

Some authors suggest that there is a higher risk of prescribing errors in primary care as more steps are involved, more interoperability required, and less control of dispensing and administration (Barber et al. 2007, Barber et al. 2013, Van Ornum 2009). The interoperability challenges in hospitals are different to those encountered in the primary care sector, and it has been suggested that hospitals are more likely to attain “the gold standard which is a closed loop medication administration system which may include medication reconciliation and adverse drug event monitoring” (Empirica 2011, p25).

ePrescribing in primary care touches many research areas in the health informatics (HI) field such as clinical efficacy and safety, clarity and accuracy of medical records, patient consent, data privacy, system security, legal accommodation, technical and semantic interoperability, standard clinical codes, interface with national services, and so forth. Most national ePrescribing projects and strategies take place within the primary care sector, and for these reasons this area is considered within the scope of the research objectives.

Hospitals are individual institutions with a different focus and a different model of organisation to primary care, and ePrescribing developments in hospitals do not occur at national level in the same way as in the primary care sector. For these reasons ePrescribing in hospitals was considered outside the scope of the research objectives.

Preliminary research established that national ePrescribing developments are under way in many countries worldwide. However, in order to make valid comparisons between countries, it was necessary to limit the scope of the research to a particular region where the economic, social and health development contexts are comparable. While it may be possible to compare ePrescribing developments in all states in the USA for example, Mackenbach and McKee (2013, Foreword, pxxi) in their work on health policy suggest that “the diversity of Europe offers a remarkable natural laboratory for health policy. There are many examples of how countries have learnt from the experiences of others, with innovations first tried in one, and subsequently being adopted in others, such as compulsory seat-belt wearing, bans on smoking in public places, and the use of taxation
to reduce hazardous drinking”. As Ireland is part of Europe, the scope of this research was limited to the countries of the European region.

As limited research has been conducted on ePrescribing in Ireland, this domain was selected as a case study to explore in detail. In order to gain insights into this domain, a similar national service was sought for comparison purposes. A suitable eGovernment case was identified (cf. Section 3.6) – the Irish electronic tax system known as the Revenue On-line Service (ROS). A cross-domain comparison was included in the scope, both for the Irish domain and for comparable European domains.

1.5. Research Question
The research objectives and research scope are concerned with the development and adoption of national ePrescribing systems and services in primary care in Europe. The key objective is to identify and analyse successful models in order to glean knowledge and identify policy lessons. The research objectives cover several inter-related concepts, such as: the context and organisation of national health services; primary care services and eHealth services; the development, adoption and spread of ePrescribing; the models and paradigms of ePrescribing; and the role of EHRs in ePrescribing. The research attempts to establish the prevalence of ePrescribing in Europe, identify the successful models and explore how and why they worked. This exploration includes the concepts of building blocks, critical success factors and policy lessons. The research question, therefore, can be expressed as follows:

What are the building blocks and critical success factors for the development and adoption of national ePrescribing systems and services in primary care in Europe, and what are the policy lessons for countries such as Ireland?

1.6. Structure of Thesis
This thesis is divided into four Parts and twelve Chapters. Part One (Chapters 1-3) introduces the subject and the research question, explores the development of ePrescribing and describes the research design and research methods. Chapter 1 outlines the background context and the research question. Chapter 2 explores the literature on the development and adoption of ePrescribing, and identifies the evolving paradigms and stages of ePrescribing. Chapter 3 describes the research design and the research methods used to explore the subject of national ePrescribing systems and services.
Part Two (Chapters 4-6) presents findings on the development and adoption of ePrescribing in Europe, and appropriate theoretical frameworks are selected and applied. Chapter 4 presents an analysis of ePrescribing over 15 years in 31 countries in the European region, and the leaders and followers are identified. Chapter 5 explores appropriate conceptual frameworks for this study and two frameworks are chosen as appropriate for qualitative comparative analysis. Chapter 6 employs these frameworks to identify the patterns and groups behind the adoption data for the 31 countries.

Part Three (Chapters 7-9) explores the Irish context for ePrescribing. Chapter 7 presents findings on the Irish ePrescribing and eHealth environments. Chapter 8 explores an Irish eGovernment service as an example of a successful national solution. Chapter 9 compares this service to the Irish ePrescribing domain using the conceptual frameworks.

Part Four (Chapters 10-12) explores more detailed comparisons of the ePrescribing domain in Europe and the Irish eGovernment domain, findings are discussed and conclusions are reached. Chapter 10 compares the findings between the European ePrescribing services and the Irish eGovernment service where similarities and differences are explored. Chapter 11 identifies building blocks and critical success/failure factors for the development and adoption of ePrescribing, which are discussed in the context of the literature. Chapter 12 presents the conclusions drawn from the research, and explores the contributions and limitations of the research. The structure of the thesis is presented in Table 1-2.

<table>
<thead>
<tr>
<th>Part</th>
<th>Chpt</th>
<th>Subject</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Introduction</td>
<td>Introduction of the research problem and the research question</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>ePrescribing Review</td>
<td>Literature review of national ePrescribing developments</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>Research Design</td>
<td>Explanation of the research design and methods</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>ePrescribing in Europe</td>
<td>Analysis of ePrescribing developments and adoption in Europe</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Theoretical Framework</td>
<td>Exploration of conceptual frameworks</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>ePrescribing Analysis</td>
<td>Analysis of ePrescribing adoption patterns and leading groups</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>The Irish Context</td>
<td>Exploration of the Irish ePrescribing and eHealth contexts</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>eGovernment Domain</td>
<td>Analysis of an Irish eGovernment case study (ROS)</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
<td>Irish Comparison</td>
<td>Comparative analysis of the Irish domains</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>European Comparison</td>
<td>Comparative analysis of ePrescribing and eGovernment</td>
</tr>
<tr>
<td>4</td>
<td>11</td>
<td>Findings/Discussion</td>
<td>Presentation of the findings, discussion and policy lessons</td>
</tr>
<tr>
<td>4</td>
<td>12</td>
<td>Conclusions</td>
<td>Presentation of conclusions, contribution and limitations</td>
</tr>
</tbody>
</table>
1.7. Motivation
I have been involved in the HI field for over 24 years in my capacity as a partner in a firm of management consultants who specialise in the Irish health sector. Our clients include statutory healthcare bodies, acute hospitals, specialist clinics, medical professionals, and providers in the disability sector. I have been directly involved in several national HI projects in the following areas: national hospital patient administration; national hospital in-patient case-mix register; national radiology management system; national disability register; and national finance and payroll.

National eHealth and ePrescribing services have begun to appear in recent years, and there is an increasing body of peer-reviewed research available on the subject, but limited research from Ireland. This is a niche research area in the HI field, and there is an historic opportunity to examine the innovators in the field, as Fincham (2009, p73) suggests: “What will shorten the timeline between the reality of today and the inevitability of tomorrow is studious examination of the work of pioneers in adapting and implementing IT solutions in healthcare settings”. In following this advice, I hope that this thesis will contribute to closing this research gap.

1.8. Summary
This chapter has introduced the research area, the research question and described the structure of the thesis. The development and adoption of national ePrescribing systems and services is the subject of enquiry, and the scope is limited to the primary care sector in Europe. The research also includes a detailed case study of the Irish domain. The enquiry begins with an overview of the ePrescribing domain in Chapter 2.
2. The ePrescribing Domain

“Any doctor will admit that any drug can have side effects, and that writing a prescription involves weighing the potential benefits against the risks.” (Mark Udall)

2.1. The Risks of Medication

Delivering healthcare involves risk. Coiera (2003) found that medication errors causing an adverse drug reaction (ADR) account for the highest rate (almost 20%) of all adverse clinical events. Following a review of death certificates in the USA in 1993 which found that “drug errors killed nearly 7,400 patients” (Fincham 2009, p65), it has been estimated by the Institute of Medicine (IOM) that up to 7,000 people die in the USA each year from medication errors and this situation may be similar in other countries (Cunningham et al. 2008, Fincham 2009, IOM 2000). In the UK for example, Donyai et al. (2008) estimated that over 25,000 people die each year as a direct result of patient safety incidents, of which almost 9% are medication errors in the acute sector. In Sweden, Koch (2011) estimated that 3,000 deaths each year are the result of medication errors, while in Australia, Royle et al. (2013) estimated that between 5,000 and 10,000 deaths between 2012 and 2020 could be avoided in medication management by digitising the health sector.

A textbook by Kumar and Clark (2002, pp 960-961) in use for medical education worldwide describes the extent of the medication risk as follows: “Overall, approximately 10-20% of hospital inpatients suffer an adverse drug reaction. Up to 5% of hospital admissions are directly due to adverse drug reactions and about 0.25-0.5% of deaths are attributable to treatment rather than the disease for which the drugs were being used”. They also note that the risk of an ADR increases significantly with age and with the number of drugs administered concurrently (known as polypharmacy).

In Ireland, a Government report (Oireachtas 2007) into the adverse side effects of pharmaceuticals reported studies which found prescribing errors for 31% of in-patients and 25% of out-patients in a Dublin hospital, and a survey of 600 geriatric patients in a Cork hospital found that 52% were given inappropriate medicines. The report suggests that as the volume of prescribing and medication errors is high, the ADR rate may be “fairly high” (Oireachtas 2007, pp 19-20).

The medication management process (cf. Figure 2-1) is one of the most universal, complex and information-intensive transactions in medicine. It also may be one of the most dangerous. The five stages of the process are: diagnosing the problem; prescribing
the drug; procuring, preparing and dispensing it; administering and using it; and monitoring the impact. It appears that the root cause of ADRs are medication errors that can occur throughout the medication management process, but most frequently during the prescribing and administering stages (Castro 2009, Feldman et al. 2011, Kaushal et al. 2010, Van Ornum 2009).

Figure 2-1: The medication management process in primary care

The central record in this transaction has traditionally been the written prescription, which is the formal communication of medication therapy from prescriber to pharmacist (Astrand 2007). Another crucial record is the dispensed drug record maintained by the pharmacist. This record is critical in primary care as the medication prescribed is not always dispensed in full (DoH&C 2008a).

2.2. Definitions of ePrescribing
Traditionally, most prescriptions were handwritten, typed or printed and carried to a pharmacy by the patient (Hellstrom et al. 2009). ePrescribing is a new paradigm where the prescription is created in digital format and is transmitted electronically. ePrescribing is a broad term with many definitions and terminologies which vary from country to country. Some definitions focus on the medical purpose only, such as the former English national eHealth project (Connecting for Health) which defined ePrescribing as “the utilisation of electronic systems to facilitate and enhance the communication of a prescription or medicine order, aiding the choice, administration
and supply of a medicine through knowledge and decision support, and providing a robust audit trail for the entire medicines use process” (Goundrey-Smith 2008, pp 3-4). In some countries, the patient’s choice of pharmacy is an important factor, such as the Canadian definition: “e-Prescribing is the secure electronic creation and transmission of a prescription between an authorized prescriber and a patient’s pharmacy of choice, using clinical Electronic Medical Record (EMR) and pharmacy management software” (CMA and CPA 2013, p1).

However, the Centre of Medicare and Medicaid Services in the USA define the ePrescribing process as: “the transmission, using electronic media, of prescription or prescription-related information between a prescriber, dispenser, pharmacy benefit manager, or health plan, either directly or through an intermediary, including an ePrescribing network. ePrescribing includes, but is not limited to, two-way transmissions between the point of care and the dispenser” (HIQA 2012, p5). And in Australia, the Department of Health and Ageing define ePrescribing as: “the process by which a prescription is electronically generated by a prescriber, authenticated (electronically signed), securely transmitted (either directly or indirectly) for dispensing and supply, seamlessly integrated into the pharmacy dispensing software and, in the case of Pharmaceutical Benefits Scheme (PBS) prescriptions, is available to be electronically sent to Medicare Australia for claiming purposes. This definition does not preclude the use of paper-based processes to support ePrescribing activity” (KPMG 2008, p7). These definitions from the USA and Australia suggest that there are at least two functions of an ePrescription: a medical purpose and a financial reimbursement purpose. This is not surprising, as GPs and pharmacists in primary care in many countries are reimbursed on foot of a prescription by national health authorities or insurance companies for providing medical services.

Other concepts related to ePrescribing have appeared in the literature such as Computerised Provider Order Entry Systems (CPOE), which Goundrey-Smith (2008) defines as a term used broadly in the USA to describe systems used when ordering different services such as radiology examinations and laboratory tests as well as medication. He also notes that CPOE systems do not usually include decision support functions considered essential to ePrescribing. The terms eMedicine, eMedication and ePharmacy (Empirica 2007b, HIQA 2012, Kernan 2011, Stoicu-Tivadar et al. 2009) have appeared in recent years to describe national projects in some countries which includes ePrescribing, electronic dispensing (eDispensing), and medication
reconciliation between prescribed and dispensed records. These terms assume that the medication process includes both prescribing and dispensing (cf. Figure 2-1).

This view was adopted in a large EU eHealth project – the European Patients Smart Open Services (EPSOS). The objective of this project (2008-2014) was to promote the transfer of patient summaries and ePrescriptions between European countries. Both prescribing and dispensing were included by EPSOS (2010, p10) when defining ePrescription as “A service made up of electronic prescribing and electronic dispensing. ePrescribing is defined as the prescribing of medicines in software by the healthcare professional legally authorised to do so, for dispensing, once it has been electronically transmitted, at the pharmacy. eDispensing is defined as the act of electronically retrieving a prescription and giving out the medicine to the patient as indicated in the corresponding ePrescription. Once the medicine is dispensed, the dispenser shall report via software the information of the dispensed medicine(s).”

In all definitions, it is assumed that a prescriber generates a prescription using a computer system (stand-alone ePrescribing system or an integrated EHR), and transmits the prescription file to a pharmacy electronically using ETP technology. It is also assumed that the patient no longer carries a paper prescription, but presents identification at the pharmacy to obtain the medication. The key difference from traditional prescribing is the replacement of the written, typed or printed prescription with an electronic file.

ePrescribing therefore requires the prescriber to create and transmit an electronic file to a pharmacy, in a format that is clear, unambiguous and can uniquely identify the prescriber, the patient and the medication with absolute accuracy. Using more recent definitions such as that provided by EPSOS, ePrescribing also includes eDispensing, which is a development of the original concept in the literature. In this case, the pharmacy also transmits an electronic file of dispensed medicine to the prescriber, to national reimbursement services or other national databases or registries. As the EPSOS definition has become the standard terminology for the EU, it is chosen for the purpose of this research.

2.3. Can ePrescribing Make a Difference?
In recent years many policy makers in healthcare view ePrescribing as the “low hanging fruit among information technologies that could improve the quality and efficiency of

However, other studies suggest that ePrescribing may also introduce new types of errors such as selecting the wrong drug or the wrong dose (Barber 2010, Barber et al. 2006, Feldman et al. 2011, Flebbe et al. 2009). The key safety and quality factor in prescribing is the delivery of clear and unambiguous information in a prescription. Many handwritten, printed or faxed prescriptions can be unclear or illegible, and as they are handled and carried by a patient there is the risk of the prescription being copied or amended for fraudulent reasons. In the situation where some details are unclear, the pharmacist may have to contact the prescriber for clarification, and some studies have observed that regular pharmacist intervention is required for written prescriptions (Donyai et al. 2008, Small et al. 2008, Warholak and Rupp 2009, Woan et al. 2009).

Astrand (2007, p3) suggested that a significant benefit of ePrescribing is the ability of a prescriber to submit a “clean prescription directly to a pharmacy from the point of care.” This highlights the quality issue of delivering accurate, unambiguous, correct prescription information, because a computer screen and a printed prescription are easier to read than handwriting, and consequently there is a lower risk of misreading an ePrescription. This factor can improve the process of prescribing and medication management across the entire domain, and recent studies have suggested that many different strategic areas of concern in medication management may be improved through the adoption of ePrescribing (Conrick 2006, Corley 2003, Cornell 2001, Fincham 2009, Protti et al. 2008c, Robeznieks 2007, Tellinger and Salmivalli 2006, Van Ornum 2009). The key areas of concern are collated in Table 2-1.
Table 2-1: Areas of strategic concern in medication management

<table>
<thead>
<tr>
<th>Domain area</th>
<th>Strategic concern</th>
<th>How ePrescribing makes a difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical</td>
<td>Patient medication record</td>
<td>Establishes a single medication record per patient for clinical purposes.</td>
</tr>
<tr>
<td>Clinical</td>
<td>Medication errors</td>
<td>Reduces medication errors.</td>
</tr>
<tr>
<td>Clinical</td>
<td>Drug interactions</td>
<td>Provides decision support system for prescribers and pharmacists concerning drug interactions.</td>
</tr>
<tr>
<td>Societal</td>
<td>Access to medication record</td>
<td>Provides patients with on-line access to their medication records.</td>
</tr>
<tr>
<td>Societal</td>
<td>Prescription fraud</td>
<td>Eliminates fraud in written prescriptions.</td>
</tr>
<tr>
<td>Financial</td>
<td>Cost of medication</td>
<td>Controls costs by facilitating use of generic drugs.</td>
</tr>
<tr>
<td>Planning</td>
<td>Information analysis</td>
<td>Collects medication data in useable format.</td>
</tr>
<tr>
<td>Administration</td>
<td>Unwieldy paper system</td>
<td>Efficient electronic system.</td>
</tr>
<tr>
<td>Technical</td>
<td>Low technical base in the</td>
<td>Increases the use of technology by prescribers, pharmacists and patients.</td>
</tr>
<tr>
<td></td>
<td>medical profession/domain</td>
<td></td>
</tr>
</tbody>
</table>

2.3.1. The benefits of ePrescribing

There is a large body of research describing the benefits arising from the implementation of ePrescribing. These benefits generally fall into three categories - clinical benefits (cf. Section 2.3.1), administration gains (cf. Section 2.3.2), and social benefits (cf. Section 2.3.3).

2.3.2. Clinical benefits

Whetton (2005) discussed a variety of different clinical benefits recorded in the literature arising from the use of EHRs and eHealth. For example, an eHealth study across six EU countries into the adoption of ePrescribing, ETP and EHRs recorded a wide range of benefits, outlined in Table 2-2 (Gartner 2009).

Table 2-2: Recorded benefits of ePrescribing technologies in medication management

| Recorded Benefits of Introducing ePrescribing Technologies in Medication Management |
|---------------------------------|------------------------------------------------------------------------------------|
| 84% reduction in missing dose medication errors                          |
| 83% reduction in medication errors due to mistaken identity               |
| 83% achievement in the generic compliance rate with the recommended drug orders|
| 75% reduction in cases of medicines running out                           |
| 60% reduction in potential adverse drug events (near misses)              |
| 41% reduction in drug interaction errors                                  |
| 39% increase in formulary drug compliance                                  |
| 25% reduction in prescribed medication costs                              |
| 17% reduction in adverse drug events                                      |
| 15% reduction in prescription error                                       |
| 7% reductions in cost per prescription as a result of increase in generic fill rates |

Source: (Gartner 2009)

Single studies in various countries, and in different settings including primary and secondary care, provide more granular evidence of clinical benefits. For example, a study in the Netherlands by Van Doormaal et al. (2009, p816) on the influence of
ePrescribing on medication errors and preventable ADRs in two hospital wards found that the introduction of ePrescribing led to a “significant immediate absolute reduction of 40.3% in medication orders with one or more errors”. In the USA, a hospital study found medication orders placed using ePrescribing were significantly more compliant and delivered faster than paper-based orders, with a 75% reduction in transcription errors, 30% reduction in wrong medication, 85% reduction in unsigned orders and a 40% reduction in turnaround delivery time (Cunningham et al. 2008). Another study in the primary care setting in the USA by Figge (2009) showed an increased adherence to guideline-based care, enhanced surveillance, improved monitoring and decreased medication errors after ePrescribing was implemented.

Donyai et al. (2008) found in a UK hospital study that prescribing errors were reduced by 49% and pharmacist interventions reduced by 38% after implementing an ePrescribing system. In a study in Singapore, 70% of medical and pharmacy staff in the primary care setting found that ePrescribing reduced the number of prescription errors and pharmacist interventions (Woan et al. 2009), while in Sweden doctors reported that using ePrescribing with ETP in primary care was 83% safer than the traditional method (Hellstrom et al. 2009). Some studies have reported new types of prescribing errors as a result of implementing ePrescribing such as wrong drug selection, incorrect digital signature if log-off is incomplete, difficulty with non-standard prescription items, and so forth (Flebbe et al. 2009, Koppel et al. 2005, Redwood et al. 2011, Savage et al. 2010). However, most evidence in studies since the year 2000 suggests that there are many additional clinical benefits arising from ePrescribing when compared to the written prescription. Many non-clinical benefits are also recorded, and these are presented in the remainder of this section.

2.3.3. Administration gains
In Denmark since 2003, physicians have been required by law to prescribe the lowest-cost drug possible, which has been facilitated by the almost universal use of ePrescribing in primary care, thus enforcing the national Government policy on low-cost drugs (Protti et al. 2009b). In England, the national prescription service processed approximately 550 million paper prescriptions in 2002, and the introduction of ePrescribing was expected to reduce duplication of records with savings to the National Health Service (Mundy and Chadwick 2002). However, in an evaluation of the English primary care ePrescribing project in 2013 (Barber et al. 2014, p46) found claims for savings but noted that benefits are “a quite complex picture, with many potential
advantages that may be seen by a number of stakeholders. No one benefit alone offers the ‘killer punch’, and each remains today as more a conjecture than an established fact”. Other countries have reported efficiencies in the administration burden and savings in cost of processing national drug schemes (Protti et al. 2009b, Protti and Smit 2006, Woan et al. 2009).

In medical practice, efficiency gains have also been widely reported. In the UK, repeat prescriptions account for 70% of primary care prescriptions, and efficiencies reported in ePrescribing for repeat prescriptions have encouraged widespread use (Barber et al. 2014, Mundy and Chadwick 2004). In Sweden, doctors reported a 91% time saving and a 92% improvement in service from using ePrescribing (Hellstrom et al. 2009), while in Norway, GPs in primary care reported “a profound impact from the use of EHRs and ePrescribing on the quality and efficiency of their work” (Christensen et al. 2009, p813). Finally in the UK, a reduction in the need to check prescription legibility with GPs was found by Mundy and Chadwick (2002).

2.3.4. Social benefits
Broader benefits to society have also been recorded. In Sweden, all ePrescriptions are stored on a central on-line repository, which supports research; for example, to analyse prescriptions that were not filled, and the occurrence of duplicate prescriptions (Ax and Ekedahl 2009). Patients can also access this repository for both clinical and financial information, and almost five million people (60% of the population) have accessed this system (Bridell 2010). Protti et al. (2009b) found a similar patient-centred system exists in Denmark, where a national health portal allows patients to access their own health records, including access to personal medication and financial profiles, and by 2009 almost one million people had applied to receive a digital signature to access the national medication portal. In the UK, a key benefit to society is the elimination of fraud from altered prescriptions or prescription-pad theft as a result of introducing ePrescribing (Mundy and Chadwick 2002); and in Northern Ireland, the target fraud savings were STG£8 million over five years arising from the implementation of a national ePrescribing system using barcode technology (Davis 2006).

2.4. Different Generations of ePrescribing
Several authors have discussed different stages or generations of ePrescribing, but there does not seem to be agreement in the literature on these definitions. For example, a Danish study by Johansen et al. (1999) discussed third-generation ePrescribing in which
the standardisation of prescription data and guaranteed electronic transmission times were the subject of the article. In a report by the USA based eHealth-Initiative (2004), six graduated levels of ePrescribing were described. At the lower levels, the definition includes the creation of an ePrescription using previous medication history, decision support for drug interactions and allergies, and supporting patient and financial data. The more advanced levels include ETP and integration with an EHR. In recent years, further studies from the USA define stand-alone ePrescribing technology as first-generation, and ePrescribing that is integrated with an EHR as next-generation (DesRoches et al. 2010).

A Canadian study by Motulsky et al. (2013, p474) suggests that there have been two generations of ePrescribing: “those used to ‘enter, modify and review’ and those used to ‘communicate’. The first is focused on decision support for physicians and generates a printed prescription, with a paper copy given to the patient. This is a stand-alone technology that uses local electronic information (e.g. the physician’s patient record or medication databases) to improve prescription quality. The second and latest generation has focused on networking various stakeholders so that they can communicate electronically”.

Other authors identify the use of advanced features such as decision support systems or the inclusion of the diagnosis on the prescriptions as second-generation or next-generation systems (Motulsky et al. 2015, Peikari et al. 2015, Warholak et al. 2014). An international review of ePrescribing and ETP in ten countries was undertaken by the Health Information and Quality Authority (HIQA) of Ireland in 2012. This report observed differences in ePrescribing models between countries, such as three specific levels of ETP in Australia and two specific releases of ETP in England (HIQA 2012). It also noted different approaches to the question of national ePrescribing in the UK where national ETP services are provided by printed barcode prescriptions in Wales and Northern Ireland, but Scotland and (recently) England are taking the more advanced ETP route (HIQA 2012). Finally, some hospitals, regional authorities and software vendors describe their software releases as second-generation or third-generation, which are terms that also appear in the literature (Digitalhealth 2006).

It may not be possible to reconcile these different concepts, but an analysis of the progressive but different ways to achieve the task of prescribing may illuminate the different models, as follows:
• The first method – the written prescription - is the most universal and historical model. The prescriber (doctor, dentist or prescribing nurse) writes a prescription, gives it to the patient, who carries it to the pharmacy, and obtains the medication, as: “for hundreds of years, the written prescription has been the method of choice for physicians to communicate decisions on drug therapy and for pharmacists to dispense medication” (Astrand 2007, p3).

• As a progression from the written prescription, the prescriber creates a prescription using a computer system (a GP practice management system or stand-alone prescribing system), then prints the prescription (on paper or barcode), and gives it to the patient, who carries it to the pharmacy, and obtains the medication. This is the simplest electronic method where most prescribers begin the ePrescribing journey using an EHR (Carter 2008, Conrick 2006, Fincham 2009, Van Ornum 2009, Wager et al. 2009, Whetton 2005).

• In a technical advance from printing prescriptions, the prescriber creates a prescription using an EHR, sends (pushes) the prescription electronically to a specific pharmacy using ETP, the patient presents at the pharmacy, produces identification, and obtains the medication. In this model, the patient has limited choice in the decision regarding which pharmacy to attend. This is known as the direct-push model (IHE 2010).

• In the more advanced model, the prescriber creates a prescription using an EHR, sends the prescription electronically to a central repository (such as a national ePrescription server) using ETP, the patient presents at the pharmacy and produces identification, the pharmacist then downloads the ePrescription from the central repository, and dispenses the medication. In this model, the patient has a greater choice of which pharmacy to attend. This is known as the publish-and-pull model (IHE 2010).

• In the technically advanced models, a record of dispensed medicine (known as an eReceipt) may be transmitted electronically from the pharmacist to the prescriber after the prescription has been dispensed, containing details of the dispensed medication. The pharmacist can also transmit an eReceipt to the relevant authorities such as national health payment schemes, insurance companies and national patient
portals, for clinical, administration, financial, research and information purposes. This model is closest to the EPSOS definition of ePrescribing.

In practice there are many variations on the ePrescribing models outlined here, including the provision of clinical decision support systems (CDSS) for both prescribers and pharmacists. It is clear that there are also variations in the paradigms between countries - for example, some national models include the use of barcode prescriptions. For the purposes of this research, six different stages (generations) of ePrescribing are identified, as shown in Table 2-3.

Table 2-3: The six stages of ePrescribing

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Handwritten prescriptions only.</td>
</tr>
<tr>
<td>1</td>
<td>Prescriptions created in an EHR/stand-alone system and printed (no ETP).</td>
</tr>
<tr>
<td>2</td>
<td>Direct push ETP to a pharmacy (uni-directional).</td>
</tr>
<tr>
<td>3</td>
<td>Publish and pull ETP to a national broker or database (uni-directional).</td>
</tr>
<tr>
<td>4</td>
<td>Publish and pull ETP with dispensed record electronically transmitted from a pharmacy to a prescriber (bi-directional).</td>
</tr>
<tr>
<td>5</td>
<td>Publish and pull ETP national system with on-line access to prescription and dispensed records available to prescribers, pharmacists and patients (multi-directional).</td>
</tr>
<tr>
<td>6</td>
<td>Publish and pull ETP national system with on-line access to prescription and dispensed records, and EHR integration with advanced features such as a common national drug catalogue, decision support systems for prescribers and pharmacist, diagnosis information, and so forth (multi-directional), with national registries for planning and clinical research.</td>
</tr>
</tbody>
</table>

Stage 0 is the manual prescription, while Stage 1 is where prescriptions are created in an EHR and the printed (or barcode) prescription is given to the patient. In this stage there is no electronic communication with the pharmacy (no ETP). Stages 2 to 6 are progressive versions of ETP. Stage 2 is direct-push, while Stage 3 is publish-and-pull. Stage 4 includes transmission of the dispensed record, while Stage 5 includes access to prescriptions and dispensed records by interested parties including patients.

Stand-alone or integrated ePrescribing systems are not distinguished from Stages 1 to 5 as they exist at all these stages in practice. Stage 6 includes EHR integration and advanced features, as it is clear from the literature that these factors are mutually dependant, and that stand-alone systems are gradually being replaced by integrated EHRs over time. Stage 6 is close to the EPSOS definition of ePrescribing.
2.5. Technical Components of ePrescribing

It is clear that there are many different components of a national ePrescribing service, all of which need to work together (to interoperate) to create and transmit a prescription correctly (Benson 2010, HIQA 2012, Johansen 2015, Sprenger 2012, Surescripts 2012). The key technical components of ePrescribing are presented in summary form in Table 2-4.

<table>
<thead>
<tr>
<th>Table 2-4: Technical components of a national ePrescribing infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>• An EHR that a prescriber uses to create and record a prescription.</td>
</tr>
<tr>
<td>• Unique identification numbers for patients, prescribers, pharmacies, healthcare institutions, insurance companies and national drug administration bodies.</td>
</tr>
<tr>
<td>• A common standard database of medication information including drug and administration data.</td>
</tr>
<tr>
<td>• A CDSS within the prescriber’s EHR system.</td>
</tr>
<tr>
<td>• An ePrescription file in a standard format understood by all systems.</td>
</tr>
<tr>
<td>• A secure technical method of transmitting an ePrescription file to a pharmacy (direct-push or publish-and-pull). This may include a national prescription server or database.</td>
</tr>
<tr>
<td>• A pharmacy EHR system with the facility to import and interpret an ePrescription file with absolute precision (semantic interoperability).</td>
</tr>
<tr>
<td>• A CDSS within the pharmacy EHR system.</td>
</tr>
<tr>
<td>• A facility in the pharmacy EHR system to create an eReceipt of dispensed medication, which contains exactly the same information that the patient receives in a printed receipt, and/or a printed drug payment scheme form.</td>
</tr>
<tr>
<td>• A secure method of transmitting an eReceipt to the prescriber (and also to other parties, such as national prescription registers and national re-imbursement authorities).</td>
</tr>
</tbody>
</table>

As can be seen from Table 2-4, the core technical building blocks of ePrescribing are: the use of EHRs by prescribers and dispensers; a national standard medicine catalogue or national drug database; a secure established ETP method to transmit ePrescription and eReceipt files; a national prescription server and/or national database; and technical content which supports semantic interoperability with absolute precision from prescriber to dispenser.

2.6. Content of an ePrescription

In most developed countries, prescribing is regulated and a prescription can only be written by a qualified medical professional such as a doctor or prescribing nurse, and a prescription must identify at a minimum the prescriber, the patient and the medication (Barber et al. 2014). Several authors have discussed elements for the content of an ePrescription, including data from external sources in an integrated environment including patient data, drug data and prescriber data (Fincham 2009, Goundrey-Smith 2008, Van Ornum 2009). However, the nomenclature, synonyms, product name, pharmaceutical form, and route of administration of a drug can be different between
countries, although international standards have been proposed to address this issue (European-Commission 2014a).

The EPSOS project analysed the ePrescription content in 12 European countries in 2008 (EPSOS 2009). In this study, ePrescriptions were found to contain information about the patient, the prescriber, medication data and drug administration data, insurance data, the reason for the prescription, the repeat status, the validity period and the issue date. While all countries recorded the identity of the patient and the prescriber, many variations existed between countries regarding the exact content of the remaining data, although the drug name (brand and/or generic), quantity and frequency of use were the areas of most agreement. No country recorded all the elements, which suggested that there was no international agreement on the content of an ePrescription at that time.

In 2014, the European Commission (EC) published guidelines on a dataset for ePrescriptions which are based on the findings of the EPSOS project (European-Commission 2014a). This contains 23 core data elements (of which 19 are deemed mandatory) and 11 optional elements. This dataset defines the mandatory elements in an ePrescription as: the patient; the prescriber; the prescribed product; prescription information; and prescription authentication information. This represents a key step on the road to international agreement on the content of an ePrescription. The core data elements, including the mandatory elements, are listed in Table 2-5. This table includes additional references to definitions of data elements by the International Organization for Standardization (ISO) and the EU that EPSOS have chosen to use.
Table 2-5: EC ePrescription dataset – core mandatory data elements - 2014

<table>
<thead>
<tr>
<th>A.1 Core data elements</th>
<th>Mandatory</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1.1 Identification of the patient</td>
<td></td>
</tr>
<tr>
<td>A.1.1.1 Surname [ISO TS 22220]</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.1.2 Given name [ISO TS 22220]</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.1.3 Date of birth [ISO TS 22220]</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.1.4 Personal identifier</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.1.5 Gender</td>
<td></td>
</tr>
<tr>
<td>A.1.2 Authentication of the prescription</td>
<td></td>
</tr>
<tr>
<td>A.1.2.1 Prescription ID</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.2.2 Issue date</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.3 Identification of the prescribing health professional</td>
<td></td>
</tr>
<tr>
<td>A.1.3.1 Surname</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.3.2 Given name</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.3.3 Professional qualifications</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.3.4 Details of direct contact</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.3.5 Work address</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.3.6 (Digital or electronic) signature</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.3.7 Healthcare provider identifier (HCPI)</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.4 Identification of the prescribed product</td>
<td></td>
</tr>
<tr>
<td>A.1.4.1 Name of the item [+ identifier as described in ISO IS 11615]</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.4.2 Identifier of the item [with name/id as described in ISO IS 11616]</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.4.3 Strength of the item [Article 1 of Directive 2001/83/EC]</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.5 Prescription information</td>
<td></td>
</tr>
<tr>
<td>A.1.5.1 Pharmaceutical dose form</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.5.2 Quantity</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.5.3 Dose regimen</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.5.4 Duration of treatment (start and/or stop time)</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.5.5 Directions for use</td>
<td>✔</td>
</tr>
<tr>
<td>A.1.5.6 Pharmaceutical preparation description</td>
<td>✔</td>
</tr>
</tbody>
</table>

Source: (European-Commission 2014a, pp 12-13)

2.7. ePrescribing Stakeholder Groups

ePrescribing at national level is a complex process, and involves many different stakeholders. There are many ways to analyse stakeholder groups in healthcare (Roberts et al. 2002), and some authors have discussed this issue in the ePrescribing domain (Bridell 2010, Lee et al. 2014, Shores et al. 2010). A report by the USA based Agency for Healthcare Research and Quality (Van Dijk et al. 2011) identified general stakeholder groups in eHealth as: patients; healthcare providers; the ICT health industry; and policymakers. Regarding ePrescribing, the report identified specific groups as: patients and patient groups; GPs and GP organisations; pharmacies and pharmacist organisations; ICT suppliers; health insurance companies; the government and other regulatory bodies; departments of health and other funding bodies; and national eHealth organisations responsible for ETP and ePrescribing business services.

In a more detailed evaluation study of the English National Health Service (NHS) primary care ePrescribing service, Barber et al. (2010, p1224) identified and mapped 26 groups of stakeholders (cf. Figure 2-2). This illustrates the complexity of ePrescribing,
and the ways in which different groups inter-relate and contribute as follows: “The map shows strongly how implementation and adoption of systems in healthcare takes place in a distributed landscape. In relation to our research topic this implies that electronic transmission of prescriptions does not start with a prescribing authority and end with a dispensing authority. Rather the EPS (Electronic Prescribing Service) draws in a great number of stakeholders who mediate between prescribing and dispensing, each of whom has distinctive interests and a role in making this initiative work (or not). Understanding stakeholders and their interests as part of evaluating the adoption of EPS2, ultimately means capturing this distributed network of interests and relations”.

The map that was created is shown in Figure 2-2.

![Stakeholder map - English primary care ePrescribing](image)

**Figure 2-2: Stakeholder map - English primary care ePrescribing**

This map shows three key groups which are labelled **prescribers**, **dispensers**, and **patients/carers**, and the transactional and professional relationships that exist in an ePrescribing transaction. The **prescribers** group contains hospitals, nurse prescribers (NP), GPs, dispensing GPs (GPD) and prescribing community pharmacists (CP.pr). The **dispensers** group contains community pharmacists (CP), community pharmacy stores (CP.st), dispensing appliances contractors (DAC), and Internet pharmacies (IP); and also dispensing GPs (GPD) and prescribing community pharmacists (CP.pr) who both prescribe and dispense, and who overlap with the **prescribers** group. The map also shows related stakeholder groups such as the NHS prescription services (PS) and NHS connecting for health (CfH); health authorities such as the department of health (DH), strategic health authorities (SHA) and primary care trusts (PCT); regulators such as the information commissioner (IC) and the national pharmacy association (NPA); software suppliers (SWpr and SWd), professional bodies, the pharmaceutical industry, and so
forth. The mapping technique highlights the high number of stakeholder groups, the complexity of relationships in ePrescribing, and also provides a useful way to analyse groups (cf. Section 9.5). These stakeholder groups comprise the national authorities that provide the national ETP and ePrescribing service (PS and CfH) and the actual users of the service – the groups of prescribers, dispensers and patients/carers. The map also shows many stakeholder groups with an interest in ePrescribing. As there are clearly a high number of different groups, the relationships between these groups at the operational, technical, professional and legal levels can be extremely complex (Barber et al. 2010).

2.8. ePrescribing as a Core Component of the EHR

Many early ePrescribing systems in primary care were stand-alone and were not integrated with the prescriber’s EHR (Castro 2009). However, during the medication process, detailed information is created and used by many parties in the clinical context, such as GPs, dentists, prescribing nurses, specialists, hospital medical staff, pharmacists, and paramedical staff. The demand to share information has continued to increase, and access to medical information via interoperable information systems (IS) to other interested stakeholders such as patients, hospitals, other GPs or specialists, other pharmacists, national drug payment administrators and insurance companies is now considered best practice (Villalba et al. 2013). Consequently, the more recent ePrescribing systems in primary care are embedded in EHRs as core components, with technical interoperability to share prescription information as a standard feature. The medication information that is created and used is generally part of a subset of a broader suite of medical information such as: patient summaries; diagnostic information; pathology and radiology results; patient identification data; allergies; demographics; financial and insurance data; and so forth. This information forms the EHR of a patient. In the USA, the IOM suggested all EHR systems possess the four core functions shown in Table 2-6 (Wager et al. 2009).

<table>
<thead>
<tr>
<th>Table 2-6: Functions of an EHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functions of an EHR</td>
</tr>
<tr>
<td>1 Health information and data, such as demographics, blood type, allergies, diagnoses and medication records.</td>
</tr>
<tr>
<td>2 Order entry and support, particularly in ordering medications.</td>
</tr>
<tr>
<td>3 Results management, especially for managing laboratory and radiology results, and dispensed medication.</td>
</tr>
<tr>
<td>4 Decision support, including clinical support for drug interactions, alerts, and diagnosing.</td>
</tr>
</tbody>
</table>
The most common order entry transaction in primary care EHRs is an ePrescription (Coiera 2003), and ePrescriptions and eReceipts are key pieces of information which support most other EHR functions (AHMAC 2008). The creation of an ePrescription is supported by the decision support function, which is designed to highlight many types of potentially dangerous interactions at the order entry stage such as drug-drug, drug-allergy, drug-diagnosis, drug-food, and so forth. In advanced EHRs, an eReceipt may be imported when the medication is dispensed from the pharmacy, and these records are also stored in the EHR. In these EHRs, ePrescriptions and eReceipts are a central part of the information flow in the EHR environment.

In 2008, the Australian Department of Health and Ageing commissioned a report on national ePrescribing (KPMG 2008). This report discussed the development of building blocks which may support future eHealth initiatives, and observed that “ePrescribing shares the same requirements as other eHealth initiatives” (KPMG 2008, p26). It identified building blocks as fundamental requirements for both EHRs and ePrescribing as: electronic connectivity between health providers; information and communications technology (ICT); security and data integrity; technical standards for health data collection and transmission; and unique identifiers. Other authors have also observed that ePrescribing shares many common building blocks with EHRs (Amatayakul 2007, Carter 2008, Fincham 2009, Hamilton 2009, Sterling 2008, Van Ornum 2009), and in this context, a transition from stand-alone ePrescribing systems to integrated EHRs has been observed in the literature. For example, in 2004, 95% of ePrescriptions in the USA were created using stand-alone ePrescribing applications, but by 2008, this figure had fallen to 40% (Castro 2009).

2.9. National Models of ePrescribing
The development of national information services for use in healthcare is a well-established concept. Countries with well-developed national health services have also developed a variety of national health information services. These services were traditionally concerned with health administration and financing, as countries established systems for identification and entitlements for patients, and financing systems for providers such as hospitals, GPs and pharmacists. Over time, many countries have developed national systems and techniques to collect clinical information for the purposes of disease management, public health planning, reimbursement of
providers, and so forth, but sharing clinical information between institutions at national level has always been difficult with paper records (Conrick 2006, Wager et al. 2009).

In recent decades, the gradual development of computer technology in the health sector and in particular the development of the Internet has provided an opportunity for sharing clinical information on-line. The concept of national on-line information services for clinical, administrative and patient information purposes is a recent phenomenon, and EHRs, Electronic Patient Records (EPRs) and Electronic Medical Records (EMRs) have appeared as models and concepts of health records which can be shared electronically. Several countries have launched national eHealth and EHR projects in the previous 15 years as shown in Table 2-7.

<table>
<thead>
<tr>
<th>Year</th>
<th>Country</th>
<th>National eHealth Organisation</th>
<th>National EHR Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999</td>
<td>Singapore</td>
<td>Ministry of Health</td>
<td>NEHR</td>
</tr>
<tr>
<td>2001</td>
<td>Canada</td>
<td>Infoway Canada</td>
<td>EHRS</td>
</tr>
<tr>
<td>2002</td>
<td>UK</td>
<td>NHS</td>
<td>NPFIT/Connecting for Health</td>
</tr>
<tr>
<td>2003</td>
<td>Australia</td>
<td>National eHealth Transition Authority</td>
<td>Healthconnect</td>
</tr>
<tr>
<td>2003</td>
<td>Denmark</td>
<td>MedCom</td>
<td>Basic EHR Project</td>
</tr>
<tr>
<td>2005</td>
<td>Austria</td>
<td>Ministry of Health</td>
<td>ELGA</td>
</tr>
<tr>
<td>2006</td>
<td>Sweden</td>
<td>National Board of Health &amp; Welfare</td>
<td>National Patient Summary</td>
</tr>
<tr>
<td>2007</td>
<td>Netherlands</td>
<td>Nictiz</td>
<td>AORTA</td>
</tr>
<tr>
<td>2009</td>
<td>USA</td>
<td>National Coordinator for Health IT</td>
<td>EHR Meaningful Use Program</td>
</tr>
<tr>
<td>2010</td>
<td>New Zealand</td>
<td>National Health IT Board</td>
<td>National Health IT Plan</td>
</tr>
</tbody>
</table>

Source: (Sihna et al. 2013)

Archie Cochrane, one of the key figures in the development of evidence based medicine, in his seminal report *Effectiveness and Efficiency: Random Reflections on Health Services* (Cochrane 1971) predicted that computers would be essential to the delivery of national healthcare programmes and services into the future. This view has been discussed by many authors in recent times. For example, Whetton (2005, p168) discussed EHR developments in Australia, Canada, the UK, the USA, and New Zealand, and observed the “general belief that the EHR is the best thing since penicillin and we should all be jumping on the bandwagon”. The IOM’s publication *Crossing the Quality Chasm* (IOM 2001) also discussed the need for a national health information infrastructure. It outlined the need to overcome technological, legal, societal, organisational and cultural barriers in developing a national infrastructure.

Other writers have also commented on this trend and many studies have been published in the last decade on the challenges, successes, failures and lessons learnt from national EHR projects (Bratan et al. 2010, Coiera 2003, Conrick 2006, Greenhalgh et al. 2011,

The trend towards nationally organised information systems and services has also surfaced in the ePrescribing domain. In some cases this has occurred as a result of a national EHR project (e.g. England, Estonia, Norway) while in other cases it has occurred separately (e.g. Croatia, Netherlands, Sweden). A recent trend has been observed where national prescription registers are populated by ePrescribing transactions, which are then available on-line for patient access. This trend is a paradigm shift which has brought about new benefits for a wider range of stakeholders in some countries. This new national model of ePrescribing corresponds to Stage 6 ePrescribing (cf. Table 2-3), and provides information that can be shared on-line by many different parties, including patients, for different purposes.

Examples of this new model are found in Sweden (cf. Figure 2-3) and Denmark, where one of the most important clinical benefits is the ability of any prescriber or pharmacist to view the most recent medication history of a patient in the previous 15 months (Sweden) or 24 months (Denmark) (Tellinger 2005). These rolling time periods were agreed in both countries as optimum for clinical reasons. This particular feature reduces the risk of inappropriate prescribing, double prescribing and the dangers of polypharmacy (Hellstrom et al. 2009).

Figure 2-3: Flowchart of the Swedish ePrescribing model
The more advanced models of ePrescribing include national registries of ePrescriptions and dispensed medication records that are automatically created as a by-product of normal ePrescribing transactions, as illustrated in Figure 2-3 from Sweden. In this model, prescription and dispensed information is available on-line to other medical professionals, and personal medication and associated financial information is available to patients in a personal medication portal.

In a further development of this model, these registries could be used for additional purposes such as the management of clinical safety (e.g. on-line decision support, polypharmacy), financial, administration, research, planning and other purposes. The model could support clinical research, as it appears that the re-use of de-identified clinical data for research purposes is “*a largely neglected domain in national eHealth roadmaps*” (Empirica 2011, p45). This patient-centric model is an example where the data follows the patient from the prescriber to the pharmacist, and subsequently to other medical professionals or institutions on their journey of care, and is also available for research purposes. This model may also be viewed as an example of informationeering, which like engineering is defined as the ability to build “*core processes and organisations around information flows*” (Ball et al. 1999, p114). The model corresponds to Stage 6 ePrescribing (cf. Table 2-3), and is illustrated in Figure 2-4.

**Figure 2-4: Overview of national ePrescribing model – Stage 6 ePrescribing**
The concept of data following the patient has appeared in the literature (Coiera 2003, Conrick 2006, Goundrey-Smith 2008, Whetton 2005), and new terminology is also beginning to appear which describes the concept from the patient’s viewpoint – for example eMedicine, eMedication and ePharmacy (Empirica 2007b, HIQA 2012, Kernan 2011, Stoicu-Tivadar et al. 2009). This terminology includes both ePrescribing and eDispensing, and also medication reconciliation activities between prescribed and dispensed records. For example in Austria and Australia, national projects are described as eMedication projects, while in New Zealand and Scotland the term used is ePharmacy (Ammenwerth et al. 2014, HIQA 2012).

The conceptual model of ePrescribing has progressed over time, and the paradigm has shifted from stand-alone single institution models to multi-institutional, regional, and national models integrated with EHRs. Projects have also been under way in Europe to develop an international model (EPSOS 2010, European-Comission 2009). These developments are leading to the convergence, consolidation and availability of shared medication information in the national EHR context, primarily to support improved clinical practice and medication management at a national level.

Future models of ePrescribing are difficult to predict, but may include a single national on-line prescription database covering both primary and secondary sectors, which prescribers, pharmacists and patients could access. This could eliminate the need to send enormous volumes of prescriptions between different parties, and might help to maintain a single prescription record per patient. Work is already under way on this concept in Sweden (Bridell 2010).

2.10. International Developments in ePrescribing
Interest and activity in ePrescribing is increasing in many countries and many national ePrescribing projects have started in recent years. In the USA for example, it is estimated that the total number of primary care ePrescriptions rose from 13 million in 2006 to almost 100 million in 2008 (AMA 2008, Rupp et al. 2009) when 10% of family physicians in the primary care sector were using ePrescribing services, but as the total number of annual prescriptions is approximately 3 billion, the rate of progress was slow (Finkelstein 2007).

However, it has dramatically increased in the subsequent six years following two major Government initiatives. The first initiative was the completion in 2006/2007 of number
of large ePrescribing pilot projects in Florida, Minnesota, Massachusetts, New Jersey, Nevada, Ohio, Rhode Island and Tennessee (AHRQ 2011). The second initiative was the fiscal stimulus bill (the 2009 American Recovery and Reinvestment Act) which allocated about $19 billion over five years to advance the push for EHRs across the USA. This included a statutory ePrescribing incentive programme between 2009 and 2013, which provided financial incentives to prescribers and doctors who met certain conditions for the “meaningful use of qualified ePrescribing systems” (Gabriel et al. 2013, p760). By 2014, 73% of family physicians were actively ePrescribing, and transmitted approximately 1.2 billion ePrescriptions accounting for 67% of all primary care prescriptions in the USA (Surescripts 2015).

Technology adoption typically occurs in an S curve, as described in the Diffusion of Innovation theory (Rogers 2003). The tipping point is where the S curve is steepest and is often considered to be the critical turning point in the adoption of an innovation such as a new technology. Based on the recent data, ePrescribing in primary care in the USA may now have passed the tipping point (Surescripts 2015).

Have similar developments occurred in other countries? National ePrescribing projects have commenced in recent years in Australia, Canada, New Zealand and Singapore, but these projects are at the early stages. The most activity in recent years has been in Europe, but the extent of the diffusion of ePrescribing and the factors behind the diffusion are not clear from the literature. This is the gap that this research attempts to address.

2.11. Summary

ePrescribing is a complex transaction in primary care. Six stages of ePrescribing from stand-alone systems to complex ETP services were identified in this chapter. A paradigm shift has occurred in the last decade from stand-alone systems to integrated ePrescribing services as a core component of the EHR, and more recently towards the development of national ePrescribing models in some countries.

The development and adoption of these national ePrescribing models in primary care in Europe is the subject of the research. The research scope, research objectives and research question present many challenges in the research design. These challenges are addressed in Chapter 3, where the research design and research methods are described.
3. Research Design and Methods

“If we knew what it was we were doing, it would not be called research, would it?”
(Albert Einstein)

3.1. Background and Prior Research

I completed an MSc in Health Informatics at the University of Limerick in 2009/2010 and during that time carried out research to identify the leading countries in the ePrescribing domain in Europe, and prepared a dissertation as part of the course (Brennan 2010). The methods used were case studies and semi-structured interviews with national experts responsible for the implementation and management of national ePrescribing services in Sweden, Denmark, the Netherlands and Ireland. I also observed live demonstrations of primary care ePrescribing in Stockholm, Sweden and Odense, Denmark.

In 2011, I was invited to continue this research to doctorate level, and to expand the scope of the research to explore the reasons behind the adoption of national ePrescribing services. This expanded scope includes more countries, and also a more detailed review of the national ePrescribing environment in Ireland. This doctoral research is a continuation of the MSc research, which provides the basis and the starting point.

3.2. National Perspective

Medication management is a national issue, governed by national laws and regulations, and medication is provided nationwide in the primary care setting. ePrescribing is a complex phenomenon, and the services required to support primary care ePrescribing – organisational, legal, technical, infrastructure and professional - can only be provided and managed at a regional or national level in most countries, where several different stakeholder groups and organisations are involved (cf. Section 2.7). These ePrescribing services are typically provided by national eHealth institutes to support ETP between prescriber and pharmacist, and also other stakeholder organisations, with agreed interoperability conventions according to national laws. Access to national ETP services to support ePrescribing was described by Landberg (2010, p4) as “the tip of the iceberg”, because a complex range of inter-related services are required simply to provide and maintain ETP, such as national organisations, databases, agreements, cooperation, testing, quality assurance, implementation, technical support, and so forth. For all of these reasons a national perspective was used in the exploratory research of ePrescribing developments in primary care in Europe.
3.3. Search Strategy and Sources of Data and Literature
I carried out a search for relevant, published, reliable, accurate data and literature for ePrescribing and ROS. Both of these topics are subsets in the broader categories of eHealth and eGovernment, so the search strategy included these concepts. Information about ePrescribing was found embedded in literature classified under eHealth or EHRs, and information about ROS was found in eGovernment literature. Because I found a wide variety of relevant material from many sources, the most effective strategy was to combine searches in academic peer-reviewed databases and journals with published research, reports and statistics from national health authorities, national governments, the EU, and other stakeholders.

3.3.1. ePrescribing Sources
An on-line search for peer-reviewed journal articles relating to the subject of national ePrescribing between the years 2000-2014 was carried out using PubMed, Medline, Web of Science, Academic Search Premier, Business Source Premier, Google Scholar, and the on-line research repository of the Irish health service (www.lenus.ie). The search results are shown in Table 3-1.

<table>
<thead>
<tr>
<th>No</th>
<th>Search Term</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>e-prescribing</td>
<td>261</td>
</tr>
<tr>
<td>2</td>
<td>e-prescribing AND National</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>ePrescribing</td>
<td>23</td>
</tr>
<tr>
<td>4</td>
<td>ePrescribing AND National</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Electronic prescribing</td>
<td>196</td>
</tr>
<tr>
<td>6</td>
<td>Electronic prescribing AND National</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>e-prescription(s)</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>ePrescription(s)</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>Electronic Prescription(s)</td>
<td>80</td>
</tr>
<tr>
<td>10</td>
<td>Electronic Transmission of Prescription</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>ETP</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>eMedication</td>
<td>5</td>
</tr>
<tr>
<td>13</td>
<td>eMedicine</td>
<td>4</td>
</tr>
<tr>
<td>14</td>
<td>ePharmacy</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td><strong>Total Number of Journal Articles</strong></td>
<td><strong>590</strong></td>
</tr>
</tbody>
</table>

In addition, a search for relevant non-academic articles, published reports, books, research reports, academic theses and websites was carried out on-line using the same search engines. Over 3,000 relevant items were found in total. These were filtered by using the inclusion criteria that and any published data could be verified, and the subject
matter was directly relevant to the topic of national ePrescribing systems and services. All research material was recorded in a database (EndNote X6) as outlined in Table 3-2.

<table>
<thead>
<tr>
<th>Type</th>
<th>Criteria</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Journal Articles</td>
<td>Peer reviewed, full text, about ePrescribing, 2000-</td>
<td>590</td>
</tr>
<tr>
<td>2 Conference Proceedings</td>
<td>Peer reviewed, full text, about ePrescribing, 2000-</td>
<td>13</td>
</tr>
<tr>
<td>3 Newspaper Articles</td>
<td>Non-peer reviewed, full text, about ePrescribing, 2000-</td>
<td>22</td>
</tr>
<tr>
<td>4 Textbooks</td>
<td>About ePrescribing, health informatics and eHealth, 1980-</td>
<td>91</td>
</tr>
<tr>
<td>5 Published Reports</td>
<td>About ePrescribing, health informatics and eHealth, 2000-</td>
<td>93</td>
</tr>
<tr>
<td>6 Academic Theses</td>
<td>About ePrescribing, health informatics and eHealth, 2000-</td>
<td>8</td>
</tr>
<tr>
<td>7 Websites</td>
<td>About ePrescribing, health informatics and eHealth, 2000-</td>
<td>30</td>
</tr>
<tr>
<td>8 Presentations</td>
<td>About ePrescribing, 2000-</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total number of items</strong></td>
<td></td>
<td><strong>859</strong></td>
</tr>
</tbody>
</table>

The journal articles cover a wide variety of topics, such as early experiences with ePrescribing, pilot projects, patient safety, clinical benefits, new problems, data security, regulations, technology, cost and so forth. However, a limited number cover national systems or services, which indicates that many countries are still grappling with the adoption of ePrescribing, and that there are few success stories to relate. Three textbooks deal specifically with ePrescribing (Fincham 2009, Goundrey-Smith 2008, Van Ornum 2009), and some references are made to the topic in other books. Again, the requirements for national ePrescribing services are difficult to find, although these are covered in the EHR sections, of which ePrescribing is an integral part.


The richest and most up-to-date sources of material are international eHealth reports and surveys, national eHealth strategies, and commissioned research. Many international cross-country reports have been published in recent years on the topics of eHealth and ePrescribing by various interested bodies, such as the Commonwealth Fund (CF), the Information Technology and Innovation Foundation (ITIF), and the International Telecommunication Union (ITU), the Organisation for Economic Co-operation and
Development (OECD), the Pharmacy Group of the EU (PGEU) and the World Health Organisation (WHO).

The EC has published many reports on eHealth, some which include ePrescribing in the context of national eHealth developments, with surveys and case studies the most common research methods used. Appendix A(1) contains a sample list of reports from the EC and other European sources over the last decade, and a sample list of the organisations that publish research data on eHealth and ePrescribing.

3.3.2. ROS Sources

A search was carried out for ROS material using the University of Limerick library and on-line databases including Academic Search Premier, Business Source Premier, Science Direct and the Google Scholar search engine. Both academic and non-academic articles, published reports, books, research reports, academic theses and websites were found. Further material was also found in the Revenue Museum, Dublin Castle. All research material was recorded in a database (EndNote X6). A summary is found in Table 3-3.

<table>
<thead>
<tr>
<th>Type</th>
<th>Criteria</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Journal Articles</td>
<td>Peer reviewed, full text, about ROS, 2000-</td>
<td>17</td>
</tr>
<tr>
<td>2 Conference Proceedings</td>
<td>Peer reviewed, full text, about ROS, 2000-</td>
<td>19</td>
</tr>
<tr>
<td>3 Newspaper Articles</td>
<td>Non-peer reviewed, full text, about ROS, 2000-</td>
<td>4</td>
</tr>
<tr>
<td>4 Textbooks</td>
<td>About ROS and eGovernment 1980-</td>
<td>10</td>
</tr>
<tr>
<td>5 Published Reports</td>
<td>About ROS and eGovernment 2000-</td>
<td>53</td>
</tr>
<tr>
<td>6 Research Theses</td>
<td>About ROS and eGovernment 2000-</td>
<td>5</td>
</tr>
<tr>
<td>7 Websites</td>
<td>About ROS and eGovernment 2000-</td>
<td>5</td>
</tr>
<tr>
<td>8 Presentations</td>
<td>About ROS and eGovernment 2000-</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total number of items</strong></td>
<td></td>
<td>119</td>
</tr>
</tbody>
</table>

This search revealed that relatively few academic research articles have been published about ROS. Most journal articles address aspects of ROS in the context of eGovernment, while most conference papers were prepared by staff from the Revenue Commissioners (referred to as Revenue throughout this thesis) on specific aspects of the project. One textbook covers the early history of computerisation in Revenue (Reamonn 1981), while the others mention aspects of ROS in eGovernment. The theses refer to different aspects of ROS, again in the context of eGovernment. Since 2001, the proceedings of the annual European Conference on eGovernment (an academic conference which brings together academics and practitioners in the field of
eGovernment) have included papers on various aspects of ROS, which also provided good material.

Some case studies on ROS were found in international reports published on eGovernment in recent years by interested bodies such as the EC, and the consultancy firms Accenture, PriceWaterhouseCoopers and Cap Gemini. A Canadian academic research project into electronic records (InterPARES) carried out a detailed evaluation of the ROS project between 2003 and 2005, and this research provides a clear insight into the technical and legal framework of ROS (McDonough et al. 2007).

The richest and most accurate sources of material are reports published by Revenue. These include annual reports, surveys, business reviews, statements of strategy and regular Revenue publications for the tax community Tax Briefing and eBrief. Accenture, who developed the ROS system with Revenue, applied for a patent for ROS, and a study of the patent (US7603301) provides a microscopic level of technical detail (Regan 2009). A complete list of reference material for ROS is found in Appendix H.

3.4. Analysis of Data and Literature

I carried out a wide ranging, iterative search between 2010 and 2014 (cf. Section 3.3) for published literature and other relevant information about ePrescribing and ROS. This search yielded over 3,000 items which were both quantitative and qualitative in nature. This included journal articles, conference papers, government reports, commissioned research, published statistics, academic theses, textbooks, websites and other grey literature. This material covered national systems and services in the areas of ePrescribing, eHealth, eGovernment and ROS. I selected quantitative data using the criteria that it could be independently verified, and I selected qualitative literature using the criteria that it was directly relevant to the subject areas of national ePrescribing and ROS. This selection yielded 978 pieces of research material (cf. Tables 3-2 and 3-3).

I collated all quantitative data related to the adoption of national eHealth, ePrescribing and ROS in computer files (Microsoft Excel). The quantitative data came from many sources, and the measures used to gather the data, such as surveys and published statistics were not always consistent. Consequently, I only used data which was comparable across countries that was gathered using reliable consistent measures. For ePrescribing, published statistical data on ETP transactions was the most reliable measure. There were no such problems in relation to ROS, as all data on the ROS
The qualitative literature was analysed to check, support, complement and challenge the quantitative results, and to identify central themes, patterns and trends. The analysis of the literature was a challenge as it covered a wide range of themes and perspectives, and several authors on this topic note that an analysis of qualitative literature and data using a large number of variables/factors may reduce the validity of the findings (Corbin and Strauss 2008, Crabtree and Miller 1999, Green and Thorogood 2014, Mays and Pope 1999). Other researchers in this area such as Cresswell and Sheikh (2013), Greenhalgh et al. (2004), Pagliari et al. (2011), and Protti (2007) also encountered this issue, and used various strategies to reduce the number of variables/factors to a small number of key themes or categories.

From a practitioner’s viewpoint, and from the research undertaken for the MSc dissertation, I had previously identified key themes in national ePrescribing systems and services. These were in the general areas of politics/organisation, legislation, technology, project management, adoption, and actors/stakeholders. I continued with these general themes, and analysed the literature and other qualitative data within each of these key categories, as shown in Table 3-4.

<table>
<thead>
<tr>
<th>Organisation &amp; Environment</th>
<th>Legislation &amp; Regulation</th>
<th>ICT &amp; Technology</th>
<th>Projects &amp; Adoption</th>
<th>Actors &amp; Stakeholders</th>
</tr>
</thead>
</table>

I categorised the literature using qualitative methods suggested by Dey (1993). The literature was ordered by region and country, and then categorised and sub-categorised according to Table 3-4. For the reasons just described, the number of sub-categories was limited to the top ten in each category, which became apparent as the literature was analysed. A full list of the categories and sub-categories for ePrescribing and ROS are listed in Appendix A(2).

As the research progressed and themes became apparent and converged, further analysis was carried out to confirm findings and observations and to identify new patterns. This was an iterative process and new ideas revealed further insights and patterns. For example, the mandatory introduction of ePrescribing in some countries, or specific legal barriers to ePrescribing such as the law on the prescribing of controlled substances.
The nature of the research was the iterative discovery, analysis, and comparison of data. The analysis involved comparing, checking, and triangulating the literature from a wide range of sources. As most of the data was qualitative, I was aware at all times of the hazards of qualitative research - such as the danger of bias and of selective evidence (Dey 1993, Mays and Pope 1999). It is easy to be selective in the choice of evidence; to ignore evidence that does not fit emerging patterns; to select data which may be subject to confirmation bias; and to reach conclusions on the basis of limited data (Brender et al. 2013).

The strategies used to counter the dangers were: to select published peer-reviewed data where possible; to confirm quantitative data with published statistics from health authorities; to validate and confirm all data from at least three sources; to confirm impressions with domain experts wherever possible; to take into account all evidence; to always challenge initial impressions; to identify and challenge emerging patterns; to explore similarities and differences between and within groups; and to develop a continuous iterative cycle of research, validation, analysis, documentation, and reflection.

3.5. Research Design - Case Studies and Comparative Analysis
An appropriate research design was required to approach the subject in a coherent way, and to make sense of the literature and the data. It was clear that qualitative methods were most suitable, and a review of the qualitative research tradition revealed over 40 types of qualitative research each with a distinct approach, method and rationale (Crabtree and Miller 1999, Tesch 1990). Appropriate research approaches included several overlapping methods: case study, comparative analysis, cross-domain study, descriptive research, document study, multi-case qualitative research and qualitative evaluation.

The case study method is widely used in qualitative research, and as the steps are closely related to the approach that I followed, this method was selected. The work begins with the data collection phase, where many sources of data are used to build a chain of evidence, which is confirmed and validated by other methods such as interviews. The data analysis phase follows, where patterns are identified, models are built and explanations begin to surface. A critical evaluation of the findings is carried out, and after this stage the case may have established internal validity, and the case
may also be compared to established cases and knowledge to test for external validity (Kim et al. 2014).

The data analysis phase provided many challenges as the subject matter of ePrescribing and eGovernment in different countries is wide-ranging and multi-disciplinary. To address these challenges, the comparative analysis method was selected. Comparative analysis is concerned with two inter-related goals: evaluation, which is what works; and explanation, which is why it works (Freeman 2000). There are many variables for example, countries have different national health models; ICT developments; national EHRs; prescribing regulations; and a variety of other factors; and the research carried the risk that some details would not be available in particular countries. I was aware of the limitations of conventional comparative analysis, as Freeman (2000, p (ix)) suggests, the researcher should be “wary of expecting too much from comparative analysis. Its value lies in its generation of mid-range theory, of the form which explains why A is more like B and less like C”.

I chose the case study and comparative analysis methods. Strategies from the literature suggested that the study of a wide range of cases over a long period of time improves the robustness of the research, and grounds the findings in a wide-ranging body of evidence (Dey 1993, Easton 2010, Eisenhardt 1989, Freeman 2000, Marmor et al. 2005, Mays et al. 2005, McPake and Mills 2000, Miles and Huberman 1994). In light of this information, all 28 EU countries plus 3 non-EU countries (Norway, Iceland and Turkey) where comparable data was available are included in the research to cover as wide a range of cases as practicable. I had established that national ePrescribing projects in the pioneering countries commenced around the year 2000 (Brennan 2010), so this was chosen as the starting point, which provided a 15 year time period for analysis.

The qualitative research literature also suggests that if the method is widely used elsewhere in the same research field, then it is likely to be a reliable and repeatable method. Eisenhardt (1989) proposed a process to undertake case study research, and suggested that theory can be built from case study research using multiple cases. While this may be possible, this thesis is not concerned with building theory per se, but it is concerned with policy development in the national ePrescribing domain. By using the case study and comparative analysis methods, this research design exploits the value and depth of case study research, as Greenhalgh et al. (2011, p553) noted: “The complexity of contemporary health care, combined with the multiple stakeholders and
perspectives in large technology initiatives, means that national eHealth programs require considerably more thinking through than has sometimes been the case to date. This article argued that the rich descriptions made possible by in-depth case study are the key to understanding the dynamic complexities of such programs”.

3.6. Cross-Domain Comparison

Another design strategy to strengthen the research is a comparison of a similar case from a different domain over the same time period - a cross-domain comparison. As the core research is concerned with the development and adoption of national ePrescribing systems and services, I searched for a similar case from a different domain. In order to be comparable, a case with a similar time period was desirable, and a national system with similar functionality, sensitive data, privacy and security requirements, and national data transmission services was sought.

In the case of Ireland, I had found that the development of national ePrescribing and eHealth services was in the early stages (Brennan 2010), and initial research confirmed this had not materially changed in recent years. Therefore, I searched for a similar case from a different domain in Ireland for two purposes – to provide a detailed case study for a cross-domain comparison, and also to explore national electronic information services in Ireland in order to establish if any unique barriers exist for ePrescribing in Ireland.

A natural arena for such cases is the eGovernment domain. There has been a great deal of interest and activity in eGovernment services in Ireland over the last two decades but there are not many genuine successful cases that have achieved widespread adoption (C&AG 2007, Haitjema 2006). However, a suitable case was identified – the Irish national electronic taxation (eTax) system known as the Revenue On-line Service (ROS). This project commenced in the year 2000, and has many similarities to national ePrescribing services. In both cases, a small number of professionals serve the entire population (prescribing doctors and pharmacists; accountants and tax advisors), the data is personally sensitive (health/medication and income/tax), and this data is transmitted electronically between organisations. ROS has been cited as an example of a successful eGovernment service in operation in Ireland (C&AG 2007), and consequently is selected as a comparable case study. The objective of the ROS case study is to explore the development and adoption of an eGovernment service in order to compare the
domains of eGovernment and ePrescribing in Ireland, and also in Europe where possible.

3.7.  Interviews
I used the notes from the interviews undertaken for the MSc dissertation (cf. Section 3.1) for this research, as the time period between both was short and the interview data was directly relevant to this research. This included interviews with the national experts, managers and leading authorities of national ePrescribing projects in Sweden (Apoteket AB), Denmark (MedCom), the Netherlands (Nictiz) and Ireland (HSE). The interview questions are listed in Appendix B. I sought to consolidate this research by meeting other leading authorities over the course of this research project. Informal discussions took place at conferences where the subjects of national ePrescribing, eHealth and eGovernment services were included on the programmes (cf. Appendix A(3) for a list of conferences attended).

I also arranged interviews with key members of staff from Revenue involved in the ROS project. Following approval from Revenue, interviews were arranged in 2012 with key staff, both from the early days of the ROS project and also from more recent times. These included a former ROS Strategy Manager, two members of the Planning Division responsible for ROS and national systems, and two members of the current ROS Development and Operations team. I also attended workshops on the new ROS national technical standard Inline eXtensible Business Reporting Language (iXBRL) in 2012, where subject matter experts were consulted. The ROS interview questions are listed in Appendix C.

All interview notes were analysed using similar categories and sub-categories described for analysing the qualitative literature (cf. Appendix A(2)). The interviews were essential to provide insights into the centre of the organisations responsible for national projects, and to explain, confirm or challenge the quantitative and qualitative findings.

3.8.  Summary
When the nature of the subject and the research question were considered and explored, an appropriate research design was found with suitable research methods: case study, comparative analysis and cross-domain comparison. These methods have both value and limitations, and the research was designed with these in mind, to explore the subject as broadly and comprehensively as possible. The case study method combined with the
comparative analysis approach allows for comparison of national ePrescribing and eGovernment services at many levels. This should help to explain why “A is more like B and less like C” (Freeman 2000, p (ix)). The cross-domain comparison serves the purpose of strengthening the research and provides external validation.

The ePrescribing and eGovernment domains are different, but national services in these domains are similar. It is the similarities within the differences that are the most interesting aspects and most likely to provide insights into the development and adoption of national ePrescribing services. Green and Thorogood (2014) suggested that in the last decade, the place of qualitative methods in health research has been established, and qualitative research findings are now more likely to be used to inform healthcare practice and policy.

The evidence for this research comes from three sources:

- Quantitative data for ePrescribing and ROS extracted from national and EC reports.
- Qualitative literature including peer reviewed and grey literature.
- Interview notes from interviews with national experts in the respective domains.

As the picture becomes clear in the case studies, the evidence from all three sources is used to confirm and triangulate the ePrescribing evidence in each country (cf. Appendix G) and for ROS (cf. Appendix H). Consequently a picture builds that is supported by the qualitative and quantitative data.

The objectives of this research are to explore the development and adoption of ePrescribing systems and services in primary care in Europe, and to contribute to policy in this area. The research was designed to explore the subject in a broad yet robust way, with appropriate methods employed. Figure 3-1 shows an illustration of the research design.
The second Part of the thesis – ePrescribing in Europe - follows in the next three chapters. Chapter 4 begins by presenting the most recent ePrescribing adoption data in 31 countries.
PART TWO: ePrescribing in Europe

*In which we reveal the facts of the subject of enquiry, introduce the theoretical aspect, and apply the theory to the facts.*
4. ePrescribing in Primary Care in Europe

“It is easy to get a thousand prescriptions, but hard to get one single remedy.” (Anon)

4.1. Data Sources and the Role of the EU

There has been increasing activity in the development of eHealth and ePrescribing in many European countries in recent years, and the adoption of eHealth in Europe is an area of interest to many stakeholders. A review of the literature to identify the spread of ePrescribing in Europe from 2000-2014 reveals published data from a wide variety of sources, and a significant body of research on many aspects of ePrescribing (cf. Section 3.3, Appendices A, G and I).

The EU, through its executive body the EC, has been a very active stakeholder in promoting the digital agenda in health in recent decades (Currie and Seddon 2014, Piha 2014). Since 1989, the EC has invested over €1 billion in over 450 eHealth projects (Piha 2014). This work includes action plans for eHealth (European-Commission 2012), directives and guidelines related to eHealth (European-Commission 2011, European-Commission 2014a), sponsored eHealth projects such as EPSOS, CALLIOPE and Antilope (EPSOS 2009, EPSOS 2010, Johansen 2015), benchmarking activities (European-Commission 2003) and commissioned research (Codagnone and Lupiañez-Villanueva 2011, Codagnone and Lupiañez-Villanueva 2013, Deloitte and Ipsos 2011, Empirica 2009, Sabes-Figuera and Maghiros 2013). A list of EC research reports into various relevant aspects of eHealth is provided in Appendix A(1).

The primary care sector has been a particular focus of interest for the EC as it is where most patients have routine encounters with the health system, and where the greatest volume of health services are delivered (WHO 2008). The EC commissioned three large scale surveys into the adoption of eHealth in primary care in 2002 (European-Commission 2003), 2007 (Empirica 2008) and 2013 (Codagnone and Lupiañez-Villanueva 2013) in 15, 29 and 31 countries respectively. When this qualitative and quantitative data is reviewed over that period, a rich and complex picture of the development and adoption of eHealth in Europe in primary care over the past two decades comes to light. This data is a key source of relevant material.

The EPSOS project was an EU funded project (2008-2014) to promote the transfer of patient summaries and ePrescriptions between European countries, and published reports from this project are included in this research (EPSOS 2009, EPSOS 2012).

A significant body of academic research has been published in recent years on many aspects of ePrescribing such as errors, safety, technology, cost, impact, and so forth. For example, a qualitative review of 108 systematic reviews on the impact of eHealth interventions by Pagliari et al. (2011) found that ePrescribing was the most commonly studied intervention, in a study which included RIS-PACS, EHRs, CDSS and CPOE.


From all of these sources a large body of data was gathered and verified on the adoption of ePrescribing in primary care in the 28 EU countries, and three other countries where comparable data on ePrescribing was published: Iceland, Norway and Turkey.

I reviewed and analysed (cf. Section 3.4) this literature to identify trends in ePrescribing in Europe at this time, and ordered these trends thematically as outlined in Table 4-1.

Table 4-1: Themes of published ePrescribing data

<table>
<thead>
<tr>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>General eHealth adoption in primary care</td>
</tr>
<tr>
<td>Adoption of ePrescribing in primary care</td>
</tr>
<tr>
<td>Adoption of ePrescribing in secondary and tertiary care</td>
</tr>
<tr>
<td>National ePrescribing strategies and projects</td>
</tr>
<tr>
<td>Recent European ePrescribing benchmarking and indices</td>
</tr>
<tr>
<td>EU funded eHealth and ePrescribing projects</td>
</tr>
</tbody>
</table>
4.2. The Spread of ePrescribing in Europe since 2000

ePrescribing has been slowly spreading in primary care in Europe in recent decades. During the 1980s and 1990s, pilot projects were undertaken in some countries, and national ePrescribing projects commenced in Denmark, Sweden, the Netherlands and the UK in the early 2000s. The EPSOS definition includes ETP as an integral part of ePrescribing, and by using published ETP data, the overall growth of ePrescribing in Europe since 2000 is illustrated in Figure 4-1. This graph shows ePrescribing data from three EC studies in 2002, 2007 and 2013 in 15, 29 and 31 countries respectively, as the EU expanded over this period. This data was cross-checked with published literature in each country (cf. Appendix G), and was consistent with data from other sources. As shown in Figure 4-1, only 2% of European GPs were ePrescribing in 2002, and 6% in 2007, but this figure increased to approximately 32% by 2013.

Figure 4-1: Growth of ePrescribing in primary care in Europe: 2002-2013

According to the most recent data on eHealth in primary care in Europe, most GPs (approximately 97%) have access to the Internet and use a computer during consultations, and most (approximately 83%) use these systems for recording clinical records for patients such as prescriptions (Codagnone and Lupiañez-Villanueva 2013, Currie and Seddon 2014, Kiørkegaard 2013, Stroetmann and Artmann 2012, Van Welsum et al. 2013). However, a further analysis of the data reveals that most prescriptions are printed and signed rather than transmitted electronically, which suggests that ETP is the key ePrescribing challenge in most countries.
An analysis of the data by individual country is shown in Figure 4-2. This graph illustrates that in 2002, Denmark, Sweden and the Netherlands reported ePrescribing adoption rates above 10%, and by 2007 the rates in these three countries had increased significantly, but the picture in the remaining countries had not changed. However, the spread of ePrescribing since 2007 is evident, and ePrescribing adoption rates in the top 11 countries are now higher that 50%, although 14 of the remaining 20 countries still report ePrescribing adoption rates of less than 10%.

Figure 4-2: Adoption patterns of ePrescribing in primary care by country: 2002-2013

Data Sources: (Codagnone and Lupiañez-Villanueva 2013, Empirica 2008, European-Commission 2003)

4.3. Adoption Groups

Figure 4-2 shows that Denmark, Estonia, Croatia, Sweden, Iceland, the Netherlands, Norway and Finland are the ePrescribing leaders in the European primary care sector with adoption rates of 80% or higher. Turkey, Romania, Spain, France, the UK and Greece are also making progress, but ePrescribing is at the early stages in the remaining 17 countries. These findings for the adoption of ePrescribing were compared with the adoption categories popularised by Rogers: innovators; early adopters; early majority; late majority; and laggards (Rogers 2003). This comparison is explored in the remainder of this section.
4.3.1. Innovators
The evidence indicates that Sweden, Denmark and the Netherlands are the ePrescribing innovators in Europe (Björnberg 2014, Brennan 2010, Empirica 2011, Kiirkegaard 2013, Mäkinen et al. 2011, Ortega Egea et al. 2010). Sweden developed the first ePrescription in Europe from pilot projects in 1983, and the tipping point in Sweden is now thought to have occurred in 2002, twenty years after the first ePrescription, as illustrated in Figure 4-3 (Astrand 2007).

![Figure 4-3: Tipping point for ePrescriptions in primary care in Sweden](image)

Source: (Hellstrom et al. 2009)

Denmark has been making progress with ePrescribing since the early 1990s on a national basis, supported by the work of MedCom, who coordinated national standards and ePrescribing projects (Johansen and Demkjaer 2010, Johansen and Protti 2003, Protti et al. 2008a, Protti et al. 2006, Purves and Scholte 2002).

The Netherlands was also making progress on a regional basis at the same time and is now consolidating this progress on a national basis (Nictiz 2009, Protti and Smit 2006). Widespread ePrescribing in the Netherlands arose as a result of the pioneering work of the two Dutch professional GP associations in the late 1980s, when a reference model (WCIA model) for EHRs including prescriptions was developed and agreed, and as EHRs became widely adopted, ePrescribing also became very common. Dutch ICT companies developed regional networks (OZIS clusters) which are still widely used today, and these networks facilitate the adoption of ePrescribing with ETP among GPs and pharmacists (Protti and Smit 2006).
4.3.2. Early Adopters
The success of ePrescribing in Iceland is the result of a seven year project that commenced in the early 2000s and led to the national ePrescribing project that was launched in 2009 (Doupi et al. 2010, Empirica 2008). Estonia and Croatia are two countries that have made substantial progress in recent years, with national ePrescribing projects commencing in January 2010 and January 2011 respectively; and by 2012 over 80% of prescriptions were transferred electronically in each country (Eesti-Haigekassa 2012, Hercigonja–Szekeres and Stevanović 2012).

Two other national projects also went live in 2010 and 2011 in Finland and Norway, respectively and both countries report high volumes of primary care ePrescriptions transmitted through their national networks (Hämäläinen and Bergman 2015, Hyppönen et al. 2015). For example in Norway, in the first month, 300,000 ePrescriptions were recorded in the national system (Ictparliament.org 2011). In both of these countries, pilot projects had been in progress for several years, leading to legislative changes introduced to accommodate national ePrescribing initiatives (Empirica 2010). All the innovator and early adopter countries were members of EPSOS except Iceland, which is not an EU member.

4.3.3. Early Majority
Turkey, Romania, Spain, France, the UK and Greece are currently progressing towards national adoption of ePrescribing in primary care. Romania stands out as the only member of this group that was not involved in the EPSOS project. In both Romania and Turkey, large national pilot projects launched in 2012 became mandatory in January 2013, which may explain the high adoption rates reported, as limited data is available for these projects. In the Andalucía region of Spain, a robust ePrescribing system has been in use for the last decade, with almost 100% adoption (EHRimpact 2009), and there are plans to extend this project to the whole country. National pilot projects are underway and have been making progress for several years in France (Empirica 2010). In the UK, the former English national health ICT programme (NPfIT/Connecting for Health) has made progress since 2002 with the first two phases of a national project based on barcodes, but implementing ETP services planned in phase three is a key challenge and adoption remains low (Barber et al. 2014, Christensen et al. 2009, NHS 2009, Protti et al. 2008b). In more recent years, Northern Ireland and Wales have both implemented similar national projects based on printed barcode prescriptions, while a national ETP project (ePharmacy) is widely adopted in Scotland (Empirica 2010).
In an unusual development, an instruction for the mandatory use of ePrescribing in 2011 was contained in the memorandum of understanding issued by the Troika responsible for the fiscal re-organisation of Greece and Portugal, respectively. In Greece, the memorandum stated the intention to introduce “compulsory ePrescription by active substance and of less expensive generics when available ... and the full implementation of ePrescription” (IMF 2011a, p55, p78). Greece already had a national project underway, following pilot projects from 2006-2008 (Deloitte and Ipsos 2011).

In the case of Portugal, the memorandum stated in section 3.58 “Make electronic prescription for medicines and diagnostics covered by public reimbursement fully compulsory for physicians in both the public and private sector” (IMF 2011b, p43), and in 2011 this became a legal requirement in Portugal (ePractice.eu 2011). The evidence to date suggests that mandatory ePrescribing instructions have accelerated adoption in primary care in Greece, but not to the same degree in Portugal which ranks among the laggards (cf. 4.3.5).

4.3.4. Late Majority
Cyprus, Germany, Luxembourg, Italy, Austria, the Czech Republic, Latvia and Belgium all have lower than average rates of ePrescribing in primary care. All of these countries were members of the EPSOS project (except Cyprus and Latvia), and each has a national ePrescribing strategy (except Luxembourg). Most have national projects and pilots underway but delays in these projects have been the common experience due to legal, organisational and technical problems (Ammenwerth et al. 2014, Empirica 2010, Empirica 2011). Scalability has also been a challenge, for example in Italy where progress has been steady in the Lombardy region with a project that started in 2000 (Leonardi 2006), and plans are now advanced to scale this project up to national level. It was suggested that participation in the EPSOS project may help some countries in this group to find a solution to these challenges (Empirica 2010).

4.3.5. Laggards
At the bottom of the scale are a group of countries where there is little evidence of ePrescribing in the primary sector and it appears that ePrescribing has not yet reached their respective national eHealth agendas. These countries are Bulgaria, Hungary, Ireland, Lithuania, Malta, Poland, Portugal, Slovakia and Slovenia. There are no national plans for ePrescribing in Hungary, Ireland or Malta, while Bulgaria, Ireland and Lithuania were not members of the EPSOS project. Within this group Poland
seems to be making most progress with pilot projects, while ePrescribing is now a legal requirement in Portugal, and this may make a difference in future years.

4.4. Regional Variations
The findings suggest that while most European countries have started national ePrescribing projects in the primary care sector, variations appear in the different regions of Europe. The leading group of countries is in the Nordic region, and the national services throughout this region seem to have been influenced by the innovators in Sweden and Denmark. Estonia is unique in the Baltic region with a well-established national system, while its neighbours are at the start of their ePrescribing journey.

On the west of Europe, the Netherlands, the UK, France and Spain all show evidence of good progress, but Ireland and Portugal report little evidence of ePrescribing. Most countries in central and eastern Europe are also at the early stages, where Croatia, Romania and Turkey are the exceptions, with national projects in recent years. Most countries in southern Europe report evidence of slow progress at a national level, with many pilot projects under development, although some regional ePrescribing services are well-established, such as Lombardy and Sicily in Italy and Andalucia in Spain.

4.5. Population Variations
A noticeable finding is that all of the leading countries (innovators and early adopters) have relatively small populations, while countries with larger populations such as Germany, France, Italy, Spain, Poland, Turkey and the UK do not feature in the leading groups. A similar conclusion was reached by the EC regarding the adoption of EHR systems in Europe in its 2011 report (Empirica 2011) which defined countries with small populations as having less than 10 million people.

4.6. North-South Digital Divide
The findings by country (cf. Figure 4-2) illustrate an emerging digital divide in ePrescribing in primary care in Europe. The progress of the top 11 countries where national ePrescribing and ETP services are available is in sharp contrast to the remaining 20 countries, where such services are not yet available, developed or widely adopted. This finding confirms prior research on the digital divide in Europe, both in the ICT domain (ITU 2013) and also in the eHealth domain, where a divide was observed between the Nordic region (north) and the regions further south (Currie and Seddon 2014, Ortega Egea et al. 2010).
4.7. Correlation between EHRs and ePrescribing

The research data over the previous 15 years provides a rich insight into the use of eHealth and EHRs in primary care in Europe. According to the most recent data, almost all GPs use an EHR during consultations, and record clinical data such as prescriptions in EHRs. However, ETP services are not available in the majority of countries where prescriptions remain in paper format, either printed or written. ETP has surfaced as a key challenge in ePrescribing, and the connectivity and interoperability of EHRs varies between countries. However, GPs in Europe also exchange other types of clinical data (requests, results, referrals) with external parties such as hospitals and other medical professionals. The use of EHRs by GPs to exchange clinical data was compared to the rate of ePrescribing by country and population size using the EC on-line comparison data (European-Commission 2015a). The results are shown in Figure 4-4.

Figure 4-4: ePrescribing and EHR use with population indicators - 2013

Source: (European-Commission 2015a)
Figure 4-4 shows a strong correlation between the use of EHRs and the rate of ePrescribing for most countries. It illustrates many of the factors previously discussed, such as the variations in adoption groups, region and population. In the upper right hand quadrant are the leaders and innovators. This is the group of countries where GPs have high adoption rates for both ePrescribing and EHRs (Empirica 2009, Kiirkegaard 2013). They include the innovators of Sweden, Denmark and the Netherlands, and the early adopters of Estonia, Iceland, Finland and Norway. These are mostly countries with small populations in the Scandinavian region of northern Europe.

In the lower right hand quadrant are Romania, Turkey and Croatia. These countries report high rates for ePrescribing but low rates for exchanging other EHR data. This cluster of countries is unusual in showing a weak correlation between the use of EHRs and ePrescribing. All three countries have implemented mandatory national ePrescribing projects in recent years; and although the early data indicates high adoption of ePrescribing, there is limited published data available to date. It may be some time before further evidence and a more complete picture is available, and this group requires further study.

Towards the upper left hand quadrant are a group of countries where GPs report high use of EHRs to transmit data but a lower use of ePrescribing. This includes Spain and the UK, while France is also going in that direction. It is notable that three of the countries with the largest populations in Europe occupy the middle of the graph, and have established good EHR clinical data exchanges for other purposes, but seem to find ETP an adoption challenge.

In the lower left hand quadrant are the majority (18 countries) where the rates of adoption for ePrescribing and the exchange of electronic data in EHRs in primary care are both low. This group includes most of the late majority and laggards, and also includes Germany, Italy and Poland, three countries with comparatively large populations. Most of these countries are located in central and eastern Europe.

4.8. Summary
ePrescribing in primary care is increasing in Europe. The innovators - Sweden, Denmark and the Netherlands - have been joined in recent years by countries such as Iceland, Finland and Norway, where long-term national projects are now making an
impact. Early adopters including Estonia, Croatia, Turkey and Romania have also made progress in recent years by implementing mandatory national ePrescribing services.

In many other countries, the research suggests that GPs record prescriptions in computer systems during consultations, but are unable to transmit ePrescriptions to pharmacies because of organisational, legal, regulatory, technical or other structural reasons in their primary care environments (Castro 2009). This situation corresponds to Stage 1 ePrescribing as defined in Chapter 2 (cf. Table 2-3). This is a significant challenge in those countries where GPs use EHRs to create prescriptions, but then print and sign paper prescriptions because ETP services are not available. This suggests that a digital divide exists in primary care ePrescribing between the leaders and the followers, and may explain some of the reasons why the international adoption of ePrescribing remains low despite a great deal of effort and investment (Castro 2009, Eggertson 2009, Empirica 2008, EPSOS 2009, Robeznieks 2007).

This chapter has explored the background and the status of ePrescribing in primary care in Europe. An analysis of the research data reveals high adoption rates in 11 countries in Europe at this time, and a strong correlation between the use of EHRs and ePrescribing, except in the three outlier countries with recent mandatory projects. However, the spread of ePrescribing across Europe is uneven with notable variations between regions and population size, and the evidence suggests a digital divide has materialised between the leaders (north) and the followers (south).

What are the reasons behind these patterns? A deeper comparison of the case study data may reveal hidden patterns and insights into the ePrescribing domain, but in order to undertake such a task, an appropriate theoretical framework is required to address the broad range of factors from a national perspective. This is addressed in Chapter 5.
5. Theoretical Framework

“He who loves practice without theory is like the sailor who boards ship without a rudder and compass and never knows where he may cast.” (Leonardo da Vinci)

5.1. Introduction

This thesis is a study of national ePrescribing and eGovernment services using empirical evidence from 2000-2014, from a national viewpoint, taking into account the perspective of internal and external stakeholders. It is qualitative in nature, with a comparative analysis of case studies and a cross-domain comparison approach used, supported by interviews with domain experts in ePrescribing and eGovernment. A conceptual framework is required that can accommodate all of these perspectives, that is appropriate for the adoption of new technology and systems over time, and is also widely used in similar academic research.

5.2. Conceptual Frameworks

There are many established conceptual frameworks used in IS research, and I found several frameworks which may be suitable for this particular research. These include the critical success factors method (Boynton and Zmud 1984), technology acceptance model (Davis 1989), technology, organisation and environment model (Tornatzky and Fleischer 1990), actor network theory (Latour 2007), IS success models (DeLone 2003, Petter et al. 2013, Seddon 1997), diffusion of innovation theory (Rogers 2003) and context, content and process frameworks (Cornford et al. 1994, Pettigrew and Whipp 1991, Stockdale and Standing 2006, Walt and Gilson 1994).

When evaluating these frameworks it became apparent that some are intended for use at an individual level, and some at an organisation level. The analysis also revealed that there is an increasing recognition of the multi-dimensional nature of IS to include social, cultural, political and legal aspects as well as the technical dimension, as the investigation of IS purely as a technical problem may lead to invalid conclusions (Hammar 2014, Hirschheim and Smithson 1988). In this context it is interesting to note that DeLone & McLean have developed and included more elements to their framework over 20 years to accommodate the complexity of IS research (DeLone 2003, Petter et al. 2013).

The evaluation of IS often requires a mixed methods approach and a framework that can accommodate the broader context required for case study research (Lifford et al. 2009).
From a national perspective, some frameworks were broad and included many perspectives to capture the complex variety of factors required for the development and adoption of national systems and services, while others view the problem from the users’ perspectives and rely on methods such as user surveys.

A review of the frameworks found that the context, content and process frameworks provide a very good basis to include the wide range of factors at play in national systems and services in a cohesive way, for example as shown by Stockdale and Standing (2006) in their paper “An interpretive approach to evaluating information systems: A content, context, process framework”. This work was based on the concepts of the earlier work by Pettigrew and Whipp (1991) who proposed a framework for the analysis of strategic change in organisations.

5.3. Context, Content and Process Framework
The Pettigrew and Whipp framework was based on a qualitative review of strategic changes in eight UK firms over three decades, and focused on the change in processes within their contexts over time, described by Pettigrew (1990, p268): “The analytical cornerstone ... is the view that theoretically sound and practically useful research on change should explore the contexts, content, and process of change together with their interconnections through time. The focus is on changing, catching reality in flight; and in studying long-term process in their contexts, a return to embeddedness as a principal of method. Context refers to the outer and inner context of the organisation. Outer context includes the economic, social, political, and sectoral environment in which the firm is located. Inner context refers to features of the structural, cultural, and political environment through which ideas for change proceed”.

Pettigrew (1997) suggested that the analysis of the content and process of change within contexts, supported by the weight of qualitative evidence over a long period, was a useful research method. This has been the subject of discussion by some authors, as Langley (2007, p9) observed: “Forms of process research that incorporate narrative, interpretative and qualitative data are more immediately appealing for the richness of process detail they provide... when it is done well, it has an incomparable capacity to communicate process understandings in ways that resonate with experience while incorporating theoretical insight”. Pettigrew and Whipp emphasise the inter-relationship between context, content and process, and advocate the study of the dynamics of process over time to understand how and why strategic changes occur.
They suggest that strategic change does not happen in a linear way, but is much more likely to be "continuous, iterative and uncertain" (Pettigrew and Whipp 1992, p234).

This framework continues to be widely used in the analysis of strategic change in many sectors, including eGovernment and eHealth (Guven-Uslu and Conrad 2011, Hage et al. 2013, Ijkema et al. 2014, Kaniadakis 2012, Stetler et al. 2007). For these reasons, the Pettigrew and Whipp framework of strategic change was selected as the most appropriate conceptual framework for this research. This framework is also known as the context, content and process framework (or CCP framework). The central questions concerning the development, adoption and diffusion of ePrescribing and eGovernment services are addressed by using the CCP framework as a research lens.

The CCP framework suggests the study of changes in the contexts (internal and external) and content (the ePrescribing and eGovernment artefacts), and how these dimensions influence the adoption process. It is also crucial to examine in turn how the adoption process alters the contexts and content over time. Pettigrew and Whipp emphasise the central role of stakeholders, and the dynamic interactions between stakeholder groups at the margins of the changing contexts over time (Pettigrew and Whipp 1991). Accordingly, an exploration of stakeholder interactions for the ePrescribing and eGovernment domains is included. An adaptation of the CCP framework is illustrated in Figure 5-1.

![Figure 5-1: CCP Framework 1](image)

Figure 5-1 illustrates how the different elements of a national IS can change over time as a result of stakeholder interaction. The initial external context changes to a modified context, the initial internal context becomes mature and the initial content is modified as
adoption takes place. Stakeholder interaction occurs between the contexts as stakeholders engage and grapple with the content, and when adoption occurs, stakeholders move from the external (outer) context to the internal (inner) context. The inner context typically contains the organisers and providers of national systems and services, and the actual users.

The CCP framework has also been used in the health policy area to analyse and understand how and why policy changes occur. Walt and Gilson (1994) argued that much health policy research concentrates on the content of policy and neglects the context, process and especially the actors/stakeholders involved. They suggest a similar analytical framework to the CCP framework, with the same concepts which allows researchers to gain a better understanding of the process of policy reform, and plan for more effective implementation. They also argue that these dimensions are inter-related, and that the policy content is the end result of complex processes involving actors/stakeholders in particular contexts. In this framework, actors/stakeholders are also central to the development of the contexts, content and process. This complementary view of the CCP framework is illustrated in Figure 5-2.

Figure 5-2: CCP Framework 2

Is the CCP framework appropriate for this research? A central issue in the research is the investigation of how the leading countries achieved national adoption of ePrescribing. Pettigrew and Whipp argue that a close study of the process of change
(the adoption of ePrescribing) within specific contexts (in primary care in different countries) over a long period will reveal the dynamic nature of the change and the actual reasons behind the change. When applying the CCP framework in this research, it is necessary to identify the key factors in the contexts, content and processes for each domain, extract these factors from the case study data, and carry out a comparative analysis.

A similar framework was devised for a large study into the diffusion of innovations in the health sector (including EHRs) for the English NHS by Greenhalgh et al. (2004). The authors reviewed a wide range of research traditions, and devised a conceptual framework using similar concepts such as inner context, outer context, implementation, and adoption process from the works of several leading authors (Kanter 1988, Pettigrew and Whipp 1992, Rogers 2003). A review of other studies in this field that employ the CCP framework also propose that it provides a structured, yet flexible approach, required for research of this nature (Guven-Uslu and Conrad 2011, Hage et al. 2013, Ijkema et al. 2014, Kaniadakis 2012, Stetler et al. 2007).

5.4. Diffusion of Innovations Framework

The life work of Everett Rogers was trying to understand the adoption of innovations across many domains. His methods were typically case studies and his findings were grounded in the evidence he gathered and reported with scientific and academic rigour. Rogers was a pioneer in the academic research field of adoption of innovations, and his theories about a general process of diffusion continue to inform research across a wide application area. His framework (Rogers 2003) for the understanding of adoption of innovation over time was used in Chapter 2 to explain the tipping point (cf. Section 2.11) and in Chapter 4 (cf. Section 4.3) to identify different adoption groups. This well-established framework suggests variables that influence adoption, the rate of adoption and the five adoption groups that can be identified for most innovations (innovators, early adopters, early majority, late majority, laggards). This framework is also appropriate for this research and is useful to underpin and complement the CCP framework and help to understand and explain adoption patterns. It is established and widely used in health research to explain adoption in eHealth (Bate et al. 2004, Bratan et al. 2010, Cresswell and Sheikh 2014, Iles and Sutherland 2001).
5.5. **Summary**

This chapter described how both the CCP theoretical framework and the diffusion of innovation framework were selected as suitable lenses for this research. As discussed in Section 3.5, the research design is constructed to provide robustness in the data collection and validity in the data analysis, while the cross domain comparison provides a degree of validation and insight. The CCP framework underpins the research design by providing a research lens from a national perspective and providing a common framework for a comparison between the two domains. It also provides a structure for the discussion, and is central to the conclusions. The diffusion of innovations framework provides a solid basis to make sense of the emerging adoption patterns, and helps to explain the rate of adoption of ePrescribing in Europe.

Chapter 4 presented ePrescribing data from Europe, and Chapter 6 will employ these frameworks to explore the data and gain deeper insights into the adoption of ePrescribing in Europe.
6. Comparative Analysis of ePrescribing in Primary Care in Europe

"Not everything that counts can be counted and not everything that can be counted counts."  
(Albert Einstein)

6.1. Introduction

Chapter 4 presented data on the adoption of ePrescribing in 31 European countries and analysed the data into adoption categories popularised by Rogers (2003), which is shown in Table 6-1. Other adoption patterns were also explored in Chapter 4 such as regional variations, population variation and the use of EHRs for data communication in primary care, but clearly there are many other factors that explain the uneven adoption patterns in Europe. This issue is explored in this chapter.

**Table 6-1: Adoption of ePrescribing in Europe - 2014**

<table>
<thead>
<tr>
<th>Rank 2013</th>
<th>Country</th>
<th>% ETP (2013)</th>
<th>Adoption Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Denmark</td>
<td>100</td>
<td>Innovator</td>
</tr>
<tr>
<td>2</td>
<td>Estonia</td>
<td>100</td>
<td>Early Adopter</td>
</tr>
<tr>
<td>3</td>
<td>Croatia</td>
<td>98</td>
<td>Early Adopter</td>
</tr>
<tr>
<td>4</td>
<td>Sweden</td>
<td>97</td>
<td>Innovator</td>
</tr>
<tr>
<td>5</td>
<td>Iceland</td>
<td>96</td>
<td>Early Adopter</td>
</tr>
<tr>
<td>6</td>
<td>Netherlands</td>
<td>94</td>
<td>Innovator</td>
</tr>
<tr>
<td>7</td>
<td>Norway</td>
<td>86</td>
<td>Early Adopter</td>
</tr>
<tr>
<td>8</td>
<td>Finland</td>
<td>82</td>
<td>Early Adopter</td>
</tr>
<tr>
<td>9</td>
<td>Turkey</td>
<td>73</td>
<td>Early Majority</td>
</tr>
<tr>
<td>10</td>
<td>Romania</td>
<td>57</td>
<td>Early Majority</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>53</td>
<td>Early Majority</td>
</tr>
<tr>
<td>12</td>
<td>France</td>
<td>28</td>
<td>Early Majority</td>
</tr>
<tr>
<td>13</td>
<td>UK</td>
<td>21</td>
<td>Early Majority</td>
</tr>
<tr>
<td>14</td>
<td>Greece</td>
<td>18</td>
<td>Early Majority</td>
</tr>
<tr>
<td>15</td>
<td>Cyprus</td>
<td>16</td>
<td>Late Majority</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>15</td>
<td>Late Majority</td>
</tr>
<tr>
<td>17</td>
<td>Luxembourg</td>
<td>11</td>
<td>Late Majority</td>
</tr>
<tr>
<td>18</td>
<td>Italy</td>
<td>9</td>
<td>Late Majority</td>
</tr>
<tr>
<td>19</td>
<td>Austria</td>
<td>8</td>
<td>Late Majority</td>
</tr>
<tr>
<td>20</td>
<td>Czech Rep</td>
<td>8</td>
<td>Late Majority</td>
</tr>
<tr>
<td>21</td>
<td>Latvia</td>
<td>6</td>
<td>Late Majority</td>
</tr>
<tr>
<td>22</td>
<td>Belgium</td>
<td>5</td>
<td>Late Majority</td>
</tr>
<tr>
<td>23</td>
<td>Bulgaria</td>
<td>5</td>
<td>Laggard</td>
</tr>
<tr>
<td>24</td>
<td>Ireland</td>
<td>5</td>
<td>Laggard</td>
</tr>
<tr>
<td>25</td>
<td>Poland</td>
<td>4</td>
<td>Laggard</td>
</tr>
<tr>
<td>26</td>
<td>Slovakia</td>
<td>4</td>
<td>Laggard</td>
</tr>
<tr>
<td>27</td>
<td>Portugal</td>
<td>3</td>
<td>Laggard</td>
</tr>
<tr>
<td>28</td>
<td>Hungary</td>
<td>2</td>
<td>Laggard</td>
</tr>
<tr>
<td>29</td>
<td>Lithuania</td>
<td>1</td>
<td>Laggard</td>
</tr>
<tr>
<td>30</td>
<td>Slovenia</td>
<td>1</td>
<td>Laggard</td>
</tr>
<tr>
<td>31</td>
<td>Malta</td>
<td>0</td>
<td>Laggard</td>
</tr>
</tbody>
</table>

* Non-EU
6.1.1. A wide range of factors

Adoption of eHealth in primary care in Europe has been an area of interest to many stakeholders and researchers over recent decades. The EC has been an active stakeholder, and commissioned many reports in recent years on eHealth and related topics (cf. Appendix A(1)). It is clear from this work and other related literature that there are many factors at play in the development and adoption of national eHealth and ePrescribing services, but there seems to be no clear agreement about these factors or dimensions in the literature (Bate et al. 2004, Cresswell and Sheikh 2009, Deloitte 2013, Esterle L and Kouroubali A 2010, Fickenscher and Bakerman 2011, Greenhalgh and Stones 2010, Hage et al. 2013, Kruse et al. 2014, Meade et al. 2009, Pizzi et al. 2005, Protti and Peel 1998).

The literature suggests that there are various groups of factors within the organisation, regulation, technology and implementation of national EHR and ePrescribing services. For example, a report for the Australian government by KPMG (2008) suggested four factors central to the adoption of EHRs and ePrescribing as: unique patient and provider identifiers; electronic connectivity between health provider ICT systems; ICT security and data integrity; and technical standards for health data collection and transmission. The EPSOS project identified several key factors necessary for cross border ePrescribing, such as: unique identifiers for patients and healthcare organisations; patient consent; legal and technical interoperability; and transaction logging (EPSOS 2009). A recent EC report on European eHealth strategies (EU 2011) discussed key factors for the adoption of eHealth including: eHealth policy action; current strategies and roadmaps; administrative and organisational structures; deployment of eHealth applications; interoperability standards; unique identification of patients and healthcare professionals; electronic ID cards; legal and regulatory facilitators; financing and reimbursement issues; and evaluations.

Several systematic literature reviews have examined critical factors for the implementation and adoption of ePrescribing, EHRs, eHealth and telemedicine. A Canadian systematic review by Gagnon et al. (2014) into the adoption of ePrescribing from a user’s perspective (34 papers) found six critical groups of factors: design and technical concerns; interoperability; relevance of the data; attitude towards ePrescribing; productivity; and resources. They also found that certain adoption factors can be barriers in other contexts, and these can change from facilitators to barriers and vice versa during implementation. A similar finding was reached by Goundrey-Smith (2008)
who identified four key groups of adoption factors for ePrescribing as human; regulatory; financial; and political. In another Canadian systematic review of 86 articles from seven countries carried out by Ludwick and Doucette (2009) on the adoption of EHRs in primary care, groups of “risk factors” such as safety, privacy, and finances were identified; these can be mitigated by “insulating factors” such as leadership, standards and project management. The study also highlighted “socio-technical fit factors” such as ICT usability which can influence adoption. Another systematic review of 68 articles on critical adoption factors from a physician’s viewpoint was carried out in Mexico by Castillo et al. (2010), and found the following factors the most critical: user attitude towards information systems; workflow impact; interoperability; technical support; communication among users; and expert support. In the UK, a systematic review of 94 papers on the adoption of telemedicine by Salibaa et al. (2012) found that four key groups of factors supported or hindered adoption of cross-border telemedicine services: legal factors; cultural and language factors; contextual factors such as infrastructure; and sustainability factors such as financing and integration into national health services.

Where these studies found a variety of different factors, some studies suggested that similar critical success factors exist in all countries, and that strategic, organisational and human challenges are usually more difficult to master than the technical challenge. For example, an Austrian study of five national EHR projects by Deutscha et al. (2009) suggested several common areas for successful adoption of national projects as follows: acceptance and change management; demonstration of benefits and funding; project management; health-policy-related goals; implementation strategy; and basic legal requirements, particularly in the field of data protection. And Denis Protti, who is an authority on the adoption of EHRs in primary care, observed in a study of England, Scotland and Denmark (Protti et al. 2006) that common key adoption factors included the use of ICT in primary care; the national health service model; a secure and robust national network; data standards; and peer influence in the domain.

6.1.2. Selection of factors for analysis
The CCP conceptual framework (cf. Section 5.3) was used to make sense of these groups of factors from the literature. ePrescribing is a strategic change whether it occurs in a single institution or as a national project, and the CCP framework suggests that a longitudinal analysis of the contexts (external and internal), content (ePrescribing artefact) and process (adoption) of strategic change may highlight the key factors.
The CCP framework was compared to the key categories used for the analysis of the qualitative literature and interviews (cf. Appendix A(2)), and a very close match was apparent between both approaches (cf. Table 6-2). The organisation and environment categories matched to the inner and outer contexts. The legislation and regulation category was associated with the outer context and the content, as this factor overlaps both areas. The ICT and technical category was directly linked to the content, while the project and adoption category fell under the process. The stakeholder category overlapped all CCP elements, which provided a very useful way of re-analysing the literature to highlight the stakeholder interactions in each element of the CCP model. These links are illustrated in Table 6-2.

<table>
<thead>
<tr>
<th>Key Data Analysis Categories</th>
<th>Organisation &amp; Environment</th>
<th>Legislation &amp; Regulation</th>
<th>ICT &amp; Technology</th>
<th>Projects &amp; Adoption</th>
<th>Actors &amp; Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linked CCP Elements</td>
<td>Inner context &amp; outer context</td>
<td>Outer context &amp; content</td>
<td>Content</td>
<td>Process</td>
<td>Outer context, inner context, content &amp; process</td>
</tr>
</tbody>
</table>

A review of the research literature was undertaken using the CCP framework as the method of identifying and ranking the key factors, and the results are outlined as a schematic analysis in Figure 6-1. These factors were selected as they appeared most frequently in the literature, and were regularly found and discussed by other authors to have a bearing on the development and adoption of national ePrescribing, eHealth and eGovernment services. They are listed under the CCP headings in Figure 6-1, and closely correspond to the sub-categories in Appendix A(2). The highest-ranked factors are selected for further analysis in this chapter, and are shown in italics in Figure 6-1.

This analysis also provides the basis for all of the factors selected for analysis in the cross-domain comparison in Chapter 9, and also for a detailed comparative analysis of the leading countries in Chapter 10. This schematic analysis is illustrated in Figure 6-1.
A review of the factors suggests that the outer and inner context factors make up the background landscape for national eHealth and ePrescribing services, while the content factors are important for the user who has to engage and grapple with the technical artefact. Together, these factors may be seen as building blocks for national systems that need to be developed and established before adoption can take place.

The factors concerned with the process of are numerous, and are different to the building blocks in that they are directly concerned with the process of adoption and can be used to influence adoption (or not). Consequently they may be seen as critical success factors for the adoption of national systems and services. Actor and stakeholder consultation takes place in many different ways, and it is clear from the literature that stakeholder engagement takes place at all levels in national projects, both within and between the CCP groups. For this reason, it is included in all four elements and also at
the centre of Figure 6-1. The key factors selected for review (in italics) are explored in
the remainder of this chapter, and the qualitative data that supports this analysis is found
by country in Appendix G.

6.2. Comparative Analysis – External Context
6.2.1. National Health Models
A key contextual factor in every country is the underlying national health model.
Different national health models have been developed over the previous century or so,
and while the classification of such models is complex and difficult, and the model in
each country is unique, Reid (2009) identified four common models. These are similar
to those used by the EC, can be usefully applied in this research, and are presented in
this subsection.

The pioneering model was the Social Insurance Service (SIS) model, also known as the
Bismarck model after the German Chancellor who introduced laws in 1883, 1884 and
1889 to provide for mandatory health insurance. Under the SIS model, both employer
and employee must contribute to a health insurance fund (sickness fund), which then
provides basic health services to the employee and their family. Many hundreds of
sickness funds sprang up in Germany, and this concept spread to the surrounding
countries such as Austria, France, Belgium, the Netherlands, and also to other countries
such as Japan in recent decades (Lameire et al. 1999, Toth 2013).

The second model to appear was the NHS model, also known as the Beveridge model
after Sir William Beveridge who designed the National Health Service in Britain in the
1940s, although New Zealand had already established an NHS in 1938. Under this
model, the state provides most health services through general taxation, and this model
has become established in most of Scandinavia, Southern Europe and Cuba (Lameire et
al. 1999, Stuckler et al. 2010).

The third model is the National Health Insurance System (NHIS) model which came to
light in Canada in the 1960s. It is known as the Douglas model after Tommy Douglas, a
politician who designed a universal health coverage (UHC) system for the
Saskatchewan region, which later spread to all of Canada. Under the NHIS model all
citizens pay into one health insurance plan managed by the state, which in turn provides
UHC by purchasing health services from the private and public voluntary sectors.
Taiwan, South Korea and Australia have adopted similar versions of this model (Reid
2009, Toth 2013).
The fourth and most common model is known as the Out of Pocket (OOP) model and is found in almost 70% of all countries worldwide – mainly in Africa, Asia, and South America. Under the OOP model, the state does not provide UHC because in many cases these are low-income countries without well-developed functioning tax systems or health services, and are simply too poor or disorganised to provide mass health services for their citizens (Reid 2009, Stuckler et al. 2010). In these cases, most people pay for health services “out of pocket, with no insurance or government plan to help” (Reid 2009, p19).

Codagnone and Lupiañez-Villanueva (2013) defined similar health system models in their research, analysis and findings. They identified three different models operating in Europe at this time - the NHS, SIS and the Transition Countries (TC). The TC group comprises former Eastern bloc countries that have gained independence in recent decades and joined the EU, where their health services are now in transition, as it is not yet clear if they belong to the NHS, SIS or NHIS groups. In some cases, these emerging models combine different elements of the NHS, SIS, NHIS and OOP models. These groups are presented in Table 6-3, and a geographical representation is shown in Figure 6-2.

<table>
<thead>
<tr>
<th>National Health System (NHS)</th>
<th>Social Insurance System (SIS)</th>
<th>Transition countries (TC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyprus</td>
<td>Austria</td>
<td>Bulgaria</td>
</tr>
<tr>
<td>Denmark</td>
<td>Belgium</td>
<td>Croatia</td>
</tr>
<tr>
<td>Finland</td>
<td>France</td>
<td>Czech Republic</td>
</tr>
<tr>
<td>Greece</td>
<td>Germany</td>
<td>Estonia</td>
</tr>
<tr>
<td>Iceland</td>
<td>Ireland</td>
<td>Hungary</td>
</tr>
<tr>
<td>Italy</td>
<td>Luxembourg</td>
<td>Latvia</td>
</tr>
<tr>
<td>Malta</td>
<td>Netherlands</td>
<td>Lithuania</td>
</tr>
<tr>
<td>Norway</td>
<td>Turkey</td>
<td>Poland</td>
</tr>
<tr>
<td>Portugal</td>
<td></td>
<td>Romania</td>
</tr>
<tr>
<td>Spain</td>
<td></td>
<td>Slovakia</td>
</tr>
<tr>
<td>Sweden</td>
<td></td>
<td>Slovenia</td>
</tr>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: (Codagnone and Lupiañez-Villanueva 2013)

The map in Figure 6-2 highlights some interesting clusters in Europe. The SIS cluster is based in central Europe around Germany and France, with Turkey and Ireland as extremities on the east and west. The NHS model dominates across northern and southern Europe, while the TC countries form one block from Estonia to Bulgaria.
The study by Codagnone and Lupiañez-Villanueva (2013) for the EC took 18 months, and 9,196 GPs (2%) across 31 European countries were surveyed in detail about the adoption of eHealth in primary care using four measures: EHRs; Personal Health Records (PHRs); Health Information Exchange (HIE); and Telehealth; with a score of one point for each measure, or a maximum of four. I analysed the results and calculated averages for the NHS, SIS and TC groups, as shown in Figure 6-3.
As Figure 6-3 illustrates, eight of the top 10 countries employ the NHS model, and the average score for NHS is higher than for the SIS or TC groups. This research found that the overall adoption of eHealth is higher in NHS countries across all four measures. The research also found that the diffusion of eHealth in Europe is occurring in all countries, with a gradual change from the lowest adopters to the highest, as can be seen in Figure 6-3.

I compared the results from the analysis of European ePrescribing (cf. Table 6-1) with the national health model groups, and the results are shown in Figure 6-4. The difference between Figures 6-3 and 6-4 is striking. Figure 6-3 shows a gradual variation in the overall adoption of eHealth, but Figure 6-4 shows much greater variation in the adoption of ePrescribing across the 31 countries. This suggests that eHealth is gradually spreading across most European countries in a similar way, but for certain specific applications such as primary care ePrescribing, there is a much greater variation between countries. The data also suggests that an ePrescribing divide exists between the leaders and the followers.
It is also evident that the NHS countries are also foremost among the ePrescribing leaders as illustrated in Figure 6-4. The NHS model shows the highest average adoption rates in five of the top ten countries. The SIS and TC averages are similar, with most of these countries in the middle and lower ranks, with some outliers in the data. The analysis suggests a strong correlation between NHS countries and high adoption rates for ePrescribing.

This is consistent with the findings for the broader adoption of eHealth in Europe, where NHS countries scored highest on the overall index (Codagnone and Lupiañez-Villanueva 2013). Most NHS countries have a single authority with a small number of institutions responsible for the management of the national health service and the associated eHealth services, as Codagnone and Lupiañez-Villanueva (2013, p87) observed: “…on average NHS countries have higher adoption levels on all dimensions, suggesting that institutional settings, funding of healthcare, the entailed structure of incentives and command chain are more favourable to eHealth adoption than, for instance, the Social Insurance model. If we take as correct the feedback from GPs stating that eHealth is becoming a mandatory obligation imposed for administrative purposes, then this is clearly more direct and effective in the NHS model where in relative terms hierarchy prevails over the market as compared to the Social Insurance model”.

72
The EC research found that a single national health authority with a clear hierarchical structure is the central reason that explains why NHS countries have high eHealth adoption rates when compared to SIS and TC countries. This suggests that the national health model in operation in a country is a key contextual factor for the adoption of eHealth and ePrescribing.

6.2.2. Legal and Regulatory Framework

The regulation of sensitive personal health information is a universal HI issue. The nature of ePrescribing demands the secure electronic transmission of sensitive medical information with data privacy safeguards at all points of the ETP journey. The legal status of ePrescriptions, eReceipts, and digital signatures requires clarification in the national laws of each country (European-Commission 2014b). Another specific issue is the legislation that governs the prescribing of controlled substances, which specifies in some countries that the prescription must be handwritten (Shores et al. 2010). The same issue has proven to be a barrier and a challenge to ePrescribing in many countries such as Australia, Ireland, Japan, and the UK (Friedman et al. 2009, Halamka 2011, HIQA 2012, Xiao et al. 2011).

A recent trend evident is the development of specific national legislation for ePrescribing. For example, in Finland, legislation on the use of ePrescriptions was passed in 2007, and in 2010 the Finnish Client Data Act mandated all public healthcare organisations to store all health records in electronic form by 2011 (Ruotsalainen et al. 2011). Further amendments to the Finnish ePrescribing legislation were passed in 2010 which re-scheduled the national project, and in 2014 new laws were passed to make ePrescribing mandatory for all sectors in Finland from January 2017, when paper prescriptions will be illegal (Hämäläinen and Bergman 2015).

The literature for each of the 31 countries was examined for specific legislation to support eHealth and ePrescribing, and the results are shown in Table 6-4.
Table 6-4: Legislation of eHealth and ePrescribing

<table>
<thead>
<tr>
<th>Rank</th>
<th>2013</th>
<th>Country</th>
<th>Specific eHealth Law</th>
<th>Legislation - Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Denmark</td>
<td>Yes</td>
<td></td>
<td>Flexible legal framework &amp; specific eHealth laws</td>
</tr>
<tr>
<td>2</td>
<td>Estonia</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>3</td>
<td>Croatia</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>4</td>
<td>Sweden</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>5</td>
<td>Iceland</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>6</td>
<td>Netherlands</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>7</td>
<td>Norway</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>8</td>
<td>Finland</td>
<td>Yes</td>
<td></td>
<td>Several specific eHealth laws since 2000</td>
</tr>
<tr>
<td>9</td>
<td>Turkey*</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>10</td>
<td>Romania</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth clauses in laws</td>
</tr>
<tr>
<td>12</td>
<td>France</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>13</td>
<td>UK</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>14</td>
<td>Greece</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>15</td>
<td>Cyprus</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>17</td>
<td>Luxembourg</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>18</td>
<td>Italy</td>
<td>No</td>
<td></td>
<td>Limited legal framework for eHealth</td>
</tr>
<tr>
<td>19</td>
<td>Austria</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>20</td>
<td>Czech Rep</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>21</td>
<td>Latvia</td>
<td>No</td>
<td></td>
<td>Limited specific legal framework for eHealth</td>
</tr>
<tr>
<td>22</td>
<td>Belgium</td>
<td>Yes</td>
<td></td>
<td>Specific eHealth laws</td>
</tr>
<tr>
<td>23</td>
<td>Bulgaria</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>24</td>
<td>Ireland</td>
<td>No</td>
<td></td>
<td>Health Information Bill in progress since 2008</td>
</tr>
<tr>
<td>25</td>
<td>Poland</td>
<td>No</td>
<td></td>
<td>Health Information Act in progress since 2008</td>
</tr>
<tr>
<td>26</td>
<td>Slovakia</td>
<td>No</td>
<td></td>
<td>New eHealth Act in progress</td>
</tr>
<tr>
<td>27</td>
<td>Portugal</td>
<td>No</td>
<td></td>
<td>Limited specific legal framework for eHealth</td>
</tr>
<tr>
<td>28</td>
<td>Hungary</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>29</td>
<td>Lithuania</td>
<td>No</td>
<td></td>
<td>No specific legal framework for eHealth</td>
</tr>
<tr>
<td>30</td>
<td>Slovenia</td>
<td>No</td>
<td></td>
<td>Limited specific legal framework for eHealth</td>
</tr>
<tr>
<td>31</td>
<td>Malta</td>
<td>No</td>
<td></td>
<td>Limited specific legal framework for eHealth</td>
</tr>
</tbody>
</table>

* Non-EU

Table 6-4 shows 14 of the 31 countries (45%) have specific legislation for eHealth. It is notable that 10 of these 14 countries are in the upper half of the table, while nine of the bottom 10 countries have no specific eHealth legislation including the entire laggards group. Croatia, Turkey and Romania are again unusual in that there is little or no specific eHealth legislation in these countries, yet high adoption rates of ePrescribing in primary care are reported in these countries (Drăgănescu et al. 2013, Ertürkmen 2014, European-Commission 2014b, Hercigonja–Szekeres and Stevanović 2012).

A package of eHealth legislation exists in the leading countries to provide legal privacy safeguards for data gathering, use, storage, sharing, access and disposal of health information. A common feature in these countries is the development of legislation to provide safeguards for health data transmission between institutions for clinical and administrative purposes, and also for personal on-line access. Denmark, the
Netherlands, Sweden and Estonia have been active in this area (European-Commission 2014b). Most EU countries have established legislation for general data protection, freedom of information and electronic communications arising out of EU directives (European-Commission 2014b). The countries in the lower half of the table rely on this legislation as the de-facto regulation of eHealth, but the lack of specific eHealth legislation is a barrier in most of these countries. Both Ireland and Poland are examples of this, where comprehensive health information bills have been in progress since 2008 but have been subject to lengthy delays (EHRimplement 2008, European-Commission 2014b).

It is clear that countries which developed specific legislation for eHealth are mostly in the upper half of the table, while those that have not are in the lower half. Consequently there are two groups of countries in Europe – the leaders who have legislated for eHealth and ePrescribing and the followers who have not yet developed specific legislation. This suggests that an eHealth legislative divide exists between the ePrescribing leaders and followers in Europe.

6.3. Comparative Analysis – Internal Context

6.3.1. National Organisation and National ePrescribing Strategy

A single national competence centre or “unifying body or health system integrator” (Protti et al. 2009a, p21) for eHealth is a key factor in the internal context of national eHealth and ePrescribing projects. This unifying organisation is typically responsible for a variety of related services: the co-ordination of national projects; development of technical standards; certification of software; national messaging and broker services; consultation; collaboration and consensus-building with stakeholders; management of incentives; and so forth.

A national strategy for ePrescribing is another key factor in the internal context. While most countries have published national eHealth strategies, some are specific regarding the place of ePrescribing in the national eHealth strategy, for example Estonia (Parv et al. 2014); but some strategies are vague, for example Ireland (HSE 2013). The literature for the 31 countries was examined to establish the status of national competence centres for eHealth and also national ePrescribing strategies. The results are shown in Table 6-5.
Table 6-5: National ePrescribing strategies and national eHealth competence centres

<table>
<thead>
<tr>
<th>Rank 2013</th>
<th>Country</th>
<th>National ePrescribing Strategy</th>
<th>National eHealth Competence Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Denmark</td>
<td>Yes</td>
<td>Digital Health, MedCom</td>
</tr>
<tr>
<td>2</td>
<td>Estonia</td>
<td>Yes</td>
<td>Estonian eHealth Foundation</td>
</tr>
<tr>
<td>3</td>
<td>Croatia</td>
<td>Yes</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>4</td>
<td>Sweden</td>
<td>Yes</td>
<td>Center för eHälsa i Samverkan, Carelink, Apotekens AB</td>
</tr>
<tr>
<td>5</td>
<td>Iceland *</td>
<td>Yes</td>
<td>Ministry of Health/Directorate for eHealth</td>
</tr>
<tr>
<td>6</td>
<td>Netherlands</td>
<td>Yes</td>
<td>Nictiz</td>
</tr>
<tr>
<td>7</td>
<td>Norway *</td>
<td>Yes</td>
<td>Ministry of Health &amp; Norwegian Directorate of Health</td>
</tr>
<tr>
<td>8</td>
<td>Finland</td>
<td>Yes</td>
<td>Ministry of Health, Kela, Valvira, THL</td>
</tr>
<tr>
<td>9</td>
<td>Turkey*</td>
<td>Yes</td>
<td>Turkish Ministry of Health</td>
</tr>
<tr>
<td>10</td>
<td>Romania</td>
<td>Yes</td>
<td>No single eHealth centre since NCOEHiS abolished</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>Yes</td>
<td>Ministry of health, and nine regional centres</td>
</tr>
<tr>
<td>12</td>
<td>France</td>
<td>Yes</td>
<td>ASIP-Santé</td>
</tr>
<tr>
<td>13</td>
<td>UK</td>
<td>Yes</td>
<td>English, Scottish Welsh &amp; Northern Ireland NHS</td>
</tr>
<tr>
<td>14</td>
<td>Greece</td>
<td>Yes</td>
<td>No single eHealth competence centre</td>
</tr>
<tr>
<td>15</td>
<td>Cyprus</td>
<td>Yes</td>
<td>Ministry for Health</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>Yes</td>
<td>Gesellschaft für Telematik and Selbstverwaltung</td>
</tr>
<tr>
<td>17</td>
<td>Luxembourg</td>
<td>No</td>
<td>Plan in progress to establish a national competence centre</td>
</tr>
<tr>
<td>18</td>
<td>Italy</td>
<td>Yes</td>
<td>Tavolo di lavoro Permanente per la Sanità Elettronica</td>
</tr>
<tr>
<td>19</td>
<td>Austria</td>
<td>Yes</td>
<td>ELGA GmbH</td>
</tr>
<tr>
<td>20</td>
<td>Czech Rep</td>
<td>Yes</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>21</td>
<td>Latvia</td>
<td>Yes</td>
<td>Vesellbas Ekonomikas Centrs</td>
</tr>
<tr>
<td>22</td>
<td>Belgium</td>
<td>Yes</td>
<td>La plate-forme eHealth</td>
</tr>
<tr>
<td>23</td>
<td>Bulgaria</td>
<td>Yes</td>
<td>Ministry of Health/Directorate for eHealth</td>
</tr>
<tr>
<td>24</td>
<td>Ireland</td>
<td>No</td>
<td>No single eHealth competence centre</td>
</tr>
<tr>
<td>25</td>
<td>Poland</td>
<td>Yes</td>
<td>Centrum Systemów Informacyjnych Ochrony Zdrowia</td>
</tr>
<tr>
<td>26</td>
<td>Slovakia</td>
<td>Yes</td>
<td>National Health Information Centre</td>
</tr>
<tr>
<td>27</td>
<td>Portugal</td>
<td>Yes</td>
<td>Administraçao Central do Sistema de Saúde ACSS</td>
</tr>
<tr>
<td>28</td>
<td>Hungary</td>
<td>No</td>
<td>No single eHealth competence centre</td>
</tr>
<tr>
<td>29</td>
<td>Lithuania</td>
<td>Yes</td>
<td>Ministry of Health</td>
</tr>
<tr>
<td>30</td>
<td>Slovenia</td>
<td>Yes</td>
<td>Plan in progress to establish a national competence centre</td>
</tr>
<tr>
<td>31</td>
<td>Malta</td>
<td>No</td>
<td>Under the national Maltese IT Agency (MITA)</td>
</tr>
</tbody>
</table>

* Non-EU

Table 6-5 reveals that 24 out of 31 countries have established national competence centres for eHealth. Some advanced countries have more than one national centre, reflecting more advanced and complex organization structures. For example, MedCom in Denmark and Apoteket AB in Sweden are organisations that undertake a national role for ePrescribing in primary care (Brennan 2010, Castro 2009); but other national organisations in these countries also play a role in the national eHealth service, for example Digital Health in Denmark and Carelink in Sweden. These organisations typically share the management responsibility for the following: strategy development; standard-setting; the implementation of national eHealth projects; technical infrastructure; national re-imbursement services; national registers; national eHealth services such as ePrescribing; and so forth (Castro 2009).
A striking feature of the data is that the most recent EU members from Central and Eastern Europe have quickly established national centres in countries such as Bulgaria, Croatia, Czech Republic, Estonia, Latvia, Lithuania, Poland, and Slovakia. In all countries, the most common type of competence centre is established under the national ministry of health, although independent and voluntary models also exist, especially in the leading countries.

A strategy for ePrescribing is included in the national eHealth agenda for 27 countries, an increase from 16 in 2007 (Empirica 2011). This data suggests an increasing trend towards nationally organised solutions for ePrescribing across primary care in Europe. Hungary, Ireland, Luxembourg and Malta are the group of countries that have neither a national ePrescribing strategy nor a dedicated national eHealth competence centre.

When the EPSOS project commenced in 2008, there were 12 participating countries, but by 2014 this had increased to 24, of whom 22 have national ePrescribing strategies. Cyprus, Hungary, Iceland, Ireland, Latvia, Lithuania and Romania did not participate in EPSOS. Many countries have encountered challenges in national ePrescribing projects, and it has been suggested that some of these challenges can be better understood and overcome by participating in international projects such as EPSOS (Empirica 2010).

6.4. Comparative Analysis - Content

6.4.1. Technical standards
There are several different levels of technical standards required for interoperability, and the use of common standards for data representation and communications is a key technical building block in eHealth. The innovators of ePrescribing in Europe (Denmark, Sweden and the Netherlands) adopted similar technical standards for ePrescribing messages and communication (based on EDIFACT standards) between fifteen and twenty years ago. These standards have been in constant use since that time, with a gradual shift to XML in Sweden and Denmark (Ohlund 2006, Protti et al. 2009b). Technical standards have been developed to support the interoperability in the health sector over many years, and two of the most well-developed standards in international use are HL7 and SNOMED CT (Benson 2010). HL7 supports the electronic transfer of data between clinical application in healthcare, and the most recent version published in 2005 (V3) is specified and designed to support semantic interoperability, although previous versions are still in widespread use (Benson 2010). SNOMED CT is an international multilingual clinical terminology standard. Some countries have adopted
these two standards as the key national interoperability standards. For example, the Dutch national eHealth strategy has chosen HL7-V3 as the national messaging standard, and SNOMED CT as the national clinical terminology standard (Nictiz 2009). As the adoption of these two standards is increasing over time in the international HI domain, the literature from the 31 countries was examined for the use of these standards. The results are shown in Table 6-6.

<table>
<thead>
<tr>
<th>Rank 2013</th>
<th>Country</th>
<th>Country specified HL7 as a national standard (any version)</th>
<th>Country uses SNOMED CT as a national standard or has a national licence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Denmark</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>2</td>
<td>Estonia</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3</td>
<td>Croatia</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Sweden</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>5</td>
<td>Iceland *</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>6</td>
<td>Netherlands</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>Norway *</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>8</td>
<td>Finland</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>9</td>
<td>Turkey*</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>Romania</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>12</td>
<td>France</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>13</td>
<td>UK</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>14</td>
<td>Greece</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>15</td>
<td>Cyprus</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>17</td>
<td>Luxembourg</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>18</td>
<td>Italy</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>19</td>
<td>Austria</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>20</td>
<td>Czech Rep</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>21</td>
<td>Latvia</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>22</td>
<td>Belgium</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>23</td>
<td>Bulgaria</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>24</td>
<td>Ireland</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>25</td>
<td>Poland</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>26</td>
<td>Slovakia</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>27</td>
<td>Portugal</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>28</td>
<td>Hungary</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>29</td>
<td>Lithuania</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>30</td>
<td>Slovenia</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>31</td>
<td>Malta</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

* Non-EU

When the data was analysed, 74% use HL7 but only 19% use SNOMED CT as shown in Table 6-6. Most countries use HL7-V2 with some countries in transition to version 3, but this is a long process involving many actors; and SNOMED CT has only been adopted in six of the leading countries, and in none of the late majority or laggard countries. This suggests that the transition to international standards such as HL7-V3 and SNOMED CT remains a challenge to most countries.
6.4.2. **Unique Identification System for Patients and Providers**

When developing national information services, it is apparent from the literature that a system to uniquely identify all the citizens of a country is a fundamental building block. In healthcare, it is also necessary to uniquely identify healthcare professionals and providers such as doctors, nurses, pharmacists, hospitals, clinics, insurance organisations and so forth. The literature and data for 31 countries was examined for unique identifiers, and the results are shown in Table 6-7.

<table>
<thead>
<tr>
<th>Rank 2013</th>
<th>Country</th>
<th>Unique Patient Identifier</th>
<th>Unique Identifiers for Health Professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Denmark</td>
<td>State national ID</td>
<td>National register: State Board of Health</td>
</tr>
<tr>
<td>2</td>
<td>Estonia</td>
<td>State national ID</td>
<td>National register: State Board of Health</td>
</tr>
<tr>
<td>3</td>
<td>Croatia</td>
<td>State national ID</td>
<td>National register of healthcare providers</td>
</tr>
<tr>
<td>4</td>
<td>Sweden</td>
<td>State national ID</td>
<td>National register: State Health Board</td>
</tr>
<tr>
<td>5</td>
<td>Iceland *</td>
<td>State national ID</td>
<td>Pilot Project since 2006</td>
</tr>
<tr>
<td>6</td>
<td>Netherlands</td>
<td>Citizen service ID</td>
<td>National register: Ministry of Health</td>
</tr>
<tr>
<td>7</td>
<td>Norway *</td>
<td>State national ID</td>
<td>National register: State Board of Health</td>
</tr>
<tr>
<td>8</td>
<td>Finland</td>
<td>State national ID</td>
<td>National register: Ministry of Health</td>
</tr>
<tr>
<td>9</td>
<td>Turkey*</td>
<td>Citizenship number</td>
<td>National Doctor Data Bank, only for Doctors</td>
</tr>
<tr>
<td>10</td>
<td>Romania</td>
<td>State national ID</td>
<td>National register is only for doctors</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>National ID code</td>
<td>No national register, separate professional registers, plan in progress for national register</td>
</tr>
<tr>
<td>12</td>
<td>France</td>
<td>State national ID, Project to upgrade</td>
<td>National register: Ministry of Health</td>
</tr>
<tr>
<td>13</td>
<td>UK</td>
<td>NHS number in England &amp; Wales, different registers in Scotland and NI</td>
<td>Register is managed by regional authorities</td>
</tr>
<tr>
<td>14</td>
<td>Greece</td>
<td>National insurance number</td>
<td>No national register, separate professional registers</td>
</tr>
<tr>
<td>15</td>
<td>Cyprus</td>
<td>State national ID</td>
<td>National register: Ministry of Health</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>Generated from the state social insurance number</td>
<td>Register not yet complete for some professionals</td>
</tr>
<tr>
<td>17</td>
<td>Luxembourg</td>
<td>No national register</td>
<td>No national register, separate professional registers</td>
</tr>
<tr>
<td>18</td>
<td>Italy</td>
<td>State national ID</td>
<td>No national register, separate professional registers, plan in progress to establish national register</td>
</tr>
<tr>
<td>19</td>
<td>Austria</td>
<td>State national ID</td>
<td>Register for doctors &amp; dentists, new project started</td>
</tr>
<tr>
<td>20</td>
<td>Czech Rep</td>
<td>Birth cert number</td>
<td>National register: Health Insurance Organisations</td>
</tr>
<tr>
<td>21</td>
<td>Latvia</td>
<td>State national ID</td>
<td>Official register of healthcare professionals – MoH</td>
</tr>
<tr>
<td>22</td>
<td>Belgium</td>
<td>State national ID</td>
<td>National register: Ministry of Health</td>
</tr>
<tr>
<td>23</td>
<td>Bulgaria</td>
<td>State national ID</td>
<td>National Register only for doctors</td>
</tr>
<tr>
<td>24</td>
<td>Ireland</td>
<td>No national register</td>
<td>No national register, separate professional registers</td>
</tr>
<tr>
<td>25</td>
<td>Poland</td>
<td>State national ID</td>
<td>No national register, separate professional registers</td>
</tr>
<tr>
<td>26</td>
<td>Slovakia</td>
<td>State national ID</td>
<td>National register: Health Care Surveillance Authority</td>
</tr>
<tr>
<td>27</td>
<td>Portugal</td>
<td>State national ID</td>
<td>No national register, separate professional registers</td>
</tr>
<tr>
<td>28</td>
<td>Hungary</td>
<td>State national ID</td>
<td>National register is only for doctors (stamp)</td>
</tr>
<tr>
<td>29</td>
<td>Lithuania</td>
<td>State national ID &amp; citizen number</td>
<td>National register: State Board of Health</td>
</tr>
<tr>
<td>30</td>
<td>Slovenia</td>
<td>Health insurance ID</td>
<td>National register of healthcare providers</td>
</tr>
<tr>
<td>31</td>
<td>Malta</td>
<td>State national ID</td>
<td>No national register, separate professional registers</td>
</tr>
</tbody>
</table>

* * Non-EU
The data in Table 6-7 reveals that national systems for uniquely identifying patients are used in 29 of the 31 countries, the exceptions being Ireland and Luxembourg. In many European countries the citizen national identification number has been used for many decades as the unique identifier for many purposes such as passports, driving licences, taxation, banking, pensions, and so forth. The use of this number for eHealth purposes is well-established in Europe with 21 countries (70%) using this unique identifier in healthcare. Few countries have separate identification systems for healthcare such as that found in the UK (the NHS number), and some countries use the health insurance number or social insurance number as the unique identifier.

Ireland and Luxembourg are the two countries where there is no established national system to uniquely identify patients. In Luxembourg, a national master patient index has been under discussion since 2006, while in Ireland, HIQA published reports in 2009 and 2010 on this issue. HIQA recommended a completely new system for Ireland, and subsequently the Health Identification Bill was passed into law in 2014. The legislation indicated that a new authority may be established to issue unique health identification numbers in the future.

A similar analysis of the data revealed that national systems for uniquely identifying healthcare professionals are used in 60% of the 31 countries, also shown in Table 6-7. In the 10 countries that have no national register, seven of these countries use separate professional registers as the identification system for professionals. While this has been standard practice in countries for many years, it carries the risk that the records are not unique, and it is possible that, for example, a doctor or a pharmacist may be mistaken for a dentist, a nurse, or another allied health professional.

This data suggests that national unique identification systems for patients and health professionals is a key factor in the development and operation of eHealth and ePrescribing, while in the countries that have not established such systems, this is a barrier to the adoption of eHealth.

6.5. Comparative Analysis – Process

6.5.1. National implementation strategy

A comparative analysis of factors for the contexts and content in the national eHealth domains is straightforward. However a comparative analysis of the process factors for the adoption of ePrescribing is limited to the 20 countries that have national ePrescribing projects in progress and have published data about these projects. At a
high level, some of the process factors that can be compared are: the national implementation strategy; the regional or national focus of the project; and the question of voluntary or mandatory use by prescribers.

The implementation strategy is derived from the project data, and the classifications described by Coiera (2009) are used (top-down, bottom-up, middle-out). Top-down strategies are defined as centrally managed and controlled by national health authorities or government (e.g. the former English NPIIT/CfH national programme), while bottom-up strategies evolve in a local way, but are un-coordinated at national level (e.g. USA primary care). The middle-out strategy is a combination of these approaches (e.g. the New Zealand national eHealth strategy), where central authorities manage the national coordination of certain factors such as standards, but do not mandate the use of any particular solution (Bowden and Coiera 2013). This is negotiated by close co-operation between stakeholders including users, the ICT industry and national authorities. Close collaboration between all stakeholders to develop a solution is the key factor in a middle-out strategy (Morrison et al. 2011). The literature was analysed for these factors, and the results are shown in Table 6-8.

<table>
<thead>
<tr>
<th>Rank 2013</th>
<th>Country</th>
<th>Implementation Strategy</th>
<th>Regional or National</th>
<th>Voluntary or Mandatory for Prescribers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Denmark</td>
<td>Middle-out</td>
<td>National</td>
<td>Voluntary until 2011</td>
</tr>
<tr>
<td>2</td>
<td>Estonia</td>
<td>Middle-out</td>
<td>National</td>
<td>Mandatory after 2011</td>
</tr>
<tr>
<td>3</td>
<td>Croatia</td>
<td>Top-down</td>
<td>National</td>
<td>Mandatory</td>
</tr>
<tr>
<td>4</td>
<td>Sweden</td>
<td>Middle-out</td>
<td>Regional</td>
<td>Voluntary</td>
</tr>
<tr>
<td>5</td>
<td>Iceland *</td>
<td>Middle-out</td>
<td>National</td>
<td>Voluntary</td>
</tr>
<tr>
<td>6</td>
<td>Netherlands</td>
<td>Bottom-up</td>
<td>Regional</td>
<td>Voluntary</td>
</tr>
<tr>
<td>7</td>
<td>Norway *</td>
<td>Top-down</td>
<td>National</td>
<td>Voluntary</td>
</tr>
<tr>
<td>8</td>
<td>Finland</td>
<td>Middle-out</td>
<td>Regional</td>
<td>Voluntary, Mandatory in 2017</td>
</tr>
<tr>
<td>9</td>
<td>Turkey *</td>
<td>Top-down</td>
<td>National</td>
<td>Mandatory</td>
</tr>
<tr>
<td>10</td>
<td>Romania</td>
<td>Top-down</td>
<td>National</td>
<td>Mandatory</td>
</tr>
<tr>
<td>11</td>
<td>Spain</td>
<td>Middle-out</td>
<td>National</td>
<td>Mandatory</td>
</tr>
<tr>
<td>12</td>
<td>France</td>
<td>Middle-out</td>
<td>Regional</td>
<td>Voluntary</td>
</tr>
<tr>
<td>13</td>
<td>UK</td>
<td>Top-down</td>
<td>National</td>
<td>Voluntary</td>
</tr>
<tr>
<td>14</td>
<td>Greece</td>
<td>Top-down</td>
<td>National</td>
<td>Mandatory</td>
</tr>
<tr>
<td>15</td>
<td>Cyprus</td>
<td>Top-down</td>
<td>National</td>
<td>Voluntary</td>
</tr>
<tr>
<td>16</td>
<td>Germany</td>
<td>Middle-out</td>
<td>Regional</td>
<td>Voluntary</td>
</tr>
<tr>
<td>17</td>
<td>Luxembourg</td>
<td>Middle-out</td>
<td>National</td>
<td>Voluntary</td>
</tr>
<tr>
<td>18</td>
<td>Italy</td>
<td>Bottom-up</td>
<td>Regional</td>
<td>Voluntary</td>
</tr>
<tr>
<td>19</td>
<td>Austria</td>
<td>Top-down</td>
<td>National</td>
<td>Voluntary</td>
</tr>
<tr>
<td>20</td>
<td>Czech Rep</td>
<td>Top-down</td>
<td>National</td>
<td>Voluntary</td>
</tr>
</tbody>
</table>

* Non-EU

The implementation and adoption of ePrescribing is a complex process, and Table 6-8 provides some contextual information about the process. Nine countries have used the
top-down approach, and nine have also used the middle-out approach, with two in the bottom-up category. Six countries are implementing national projects on a regional basis, but this seems to be influenced by the organisational structures in healthcare in those countries. Five countries have chosen a mandatory implementation approach, while in 15 countries the prescribers may join on a voluntary basis.

Taking these factors together with the rankings, the combination of middle-out, national and voluntary is the most common in the top 11 countries. Within this group, Croatia, Turkey and Romania have chosen a mandatory, top-down, national approach. This approach can lead to high adoption rates, but it is clearly a different strategy to the countries where adoption is voluntary and a strategy is not imposed from the top-down.

6.6. Summary
This chapter explored the adoption of ePrescribing in 31 European countries in terms of context, content and process. A number of context, content and process factors were identified from the literature, and the highest ranking factors were selected for a high-level comparative analysis.

Trends that came to light from the analysis suggest that some factors are present among most of the leading countries such as national health models; supporting eHealth legislation; national competence centres; a national ePrescribing strategy; common technical standards; national identification systems for patients and health professionals; and a national implementation approach. A legal divide in the ePrescribing domain in Europe was also observed between the leading countries and the followers.

When these factors are considered with the evidence from Chapter 4, a clearer picture of the development and adoption of ePrescribing across Europe begins to appear, as further trends and patterns come into view. These patterns are explored in greater detail in the leading countries in Chapters 10 and 11, when the analysis moves from the general to the specific.

Part Three explores the Irish ePrescribing domain. A case study from another domain (eGovernment) is also examined in detail, and the domains are then compared. This section begins with a review of ePrescribing in Ireland in Chapter 7.
PART THREE: The Irish Context

*In which we review the eHealth domain in a single country, examine a similar solution from another domain, and then compare the domains.*
7. ePrescribing – the Irish Context

“If Ireland is to become a new Ireland she must first become European.” (James Joyce)

7.1. Introduction
National eHealth services are spreading in Europe with many countries developing their capacity for eHealth and launching national EHR and eHealth projects (cf. Section 2.9). From the analysis of ePrescribing adoption in primary care in Europe (cf. Chapter 4) Ireland was ranked 24 out of 31, and featured in the laggards group (cf. Figure 4-2). The objective of this case study is to analyse the Irish ePrescribing and eHealth domains to understand the reasons for this.

In 2010, I interviewed national experts and professionals responsible for the development, implementation and management of national eHealth services in Ireland. These interviewees are listed in Table 7-1, with abbreviated references used in this thesis.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Country/Interviewee</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE-IV 1</td>
<td>Ireland Interviewee 1</td>
<td>ICT Manager-Primary Care</td>
<td>HSE</td>
</tr>
<tr>
<td>IE-IV 2</td>
<td>Ireland Interviewee 2</td>
<td>Community Pharmacist</td>
<td>Community Pharmacy</td>
</tr>
<tr>
<td>IE-IV 3</td>
<td>Ireland Interviewee 3</td>
<td>Project Manager</td>
<td>National GPIT Group</td>
</tr>
<tr>
<td>IE-IV 4</td>
<td>Ireland Interviewee 4</td>
<td>Standards/Technology Officer</td>
<td>HIQA</td>
</tr>
</tbody>
</table>

7.2. Background to the Irish Health Service

The Irish public health service includes 52 acute hospitals, approximately 3,000 GPs, 2,500 medical consultants, and 1,700 pharmacies (Brennan 2010, HSE 2014). Most GPs, dentists and pharmacists are sole-traders, and provide public services through public health contracts (Burke 2009). Since 2005, the public healthcare system is managed by a single authority, the Health Service Executive (HSE), which operates in the acute and community sectors. The HSE has an operating budget over €12 billion and employs the equivalent of 97,000 full-time staff, making it Ireland’s largest employer (HSE 2014).

Codagnone and Lupiañez-Villanueva (2013) classified the Irish healthcare system as an SIS model in their research (cf. Table 6-3) but a closer examination suggests it is a mix of several models. All people in employment (including the self-employed) in Ireland pay social insurance, which provides certain minimum public health services in primary care and hospitals, for example critical hospital care, the maternity scheme, and breast
screening. These schemes are similar to the original Bismarck SIS model. Low-income groups and the elderly are also entitled to free healthcare under the medical card scheme, which covers approximately 37% of the population of approximately 4.6 million (HSE 2014). This scheme is funded through taxation, and is closer to the original Beveridge NHS model. However, capacity in the public system is limited, and approximately 44% of the population hold private health insurance on a voluntary basis, which again is close to the SIS model. The remaining 19% of the population, who hold neither medical cards nor private health insurance, pay for health services as they arise, which is closest to the OOP model (Burke 2009).

While a significant private sector exists in healthcare provision, an unusual feature of the Irish health sector is that most private practice in secondary and tertiary care is carried out in public hospitals. The unusual combination of national health models and the overlapping public-private nature in the structure of the Irish health system provides unique challenges when developing national eHealth and ePrescribing services.

7.3. ICT and eHealth Developments in the Irish Health Service

Developments in ICT since the 1970s in the Irish health service were carried out in regional and institutional settings, along the structural lines of the health service, which comprised 11 regional health boards along with voluntary institutions, such as voluntary hospitals. Following several critical reports on the organisation of the health service in the early 2000s (the Brennan, Hanley and Prospectus reports), the regional structures of the health service were replaced in 2005 by one single authority, the HSE (McDaid et al. 2009).

The first national eHealth strategies were published in 2004, when the Department of Health and Children (DoH&C) published “Health Information: A National Strategy” (DoH&C 2004b); and in the same year, the Health Boards Executive (HEBE) published a report “Embedding the e in Health”, which was a companion to the national health information strategy, and set out a strategic eHealth framework for the Irish healthcare system (HEBE 2004).

Both of these reports briefly mentioned ePrescribing for the first time. The national strategy referred to ePrescribing only in the context of the potential of the EHR, and noted that a supporting infrastructure was required for the transfer of data between hospitals, general practice and pharmacists (DoH&C 2004b), as “the technical
infrastructure in most pharmacies is used for ordering medicine and on-line banking, not for linking to GPs or hospitals” (IE-IV 2).

The HEBE report provided more detail on the challenges on the ground. For example it discussed the issue of medical errors resulting from handwritten prescriptions, and suggested several areas for attention such as CDSS. It also found that “while ICT supports exist in both community and general pharmacy, there is little electronic transfer of data between general practice and community pharmacy” (HEBE 2004, p34).

The strategic plans set out in both the DoH&C and the HEBE reports were overtaken by subsequent events and little progress was made on these strategies. In 2005 when the HSE was established, one of the first key decisions was to suspend the largest national ICT project in the health sector, the “Personnel, Payroll and Related Systems” (PPARS) project. A subsequent report by the Irish Comptroller and Auditor General (C&AG) found significant failures of governance and project management with the PPARS project (C&AG 2005), and the consequences of this decision were that: “this has increased concerns around the viability of health related ICT projects amongst senior policy makers. One effect of this is that all health ICT projects are now subjected to very rigorous scrutiny” (EHRimplement 2008, p31).

In 2007, HIQA was established as part of the national reform of the health sector, and has been active in the area of information standards in recent years. HIQA published several reports about information standards covering areas such as unique health identifiers, information governance, and general practice messaging standards (HIQA 2009, HIQA 2010a, HIQA 2010b, HIQA 2010c). For example, in 2009 and 2010 HIQA published two reports into national health identifiers for patients and providers, and as a direct result of this work, legislation for a new national identification system was passed in 2014. HIQA has been active in the ePrescribing area and published three ePrescribing reports in recent years (HIQA 2012, HIQA 2015a, HIQA 2015b). The 2012 report reviewed ePrescribing and ETP in ten countries and also discussed the EPSOS project, while the 2015 reports define a dataset and a data model to support ePrescribing. All three reports noted that the ICT infrastructure in Ireland’s health and social care sector is highly fragmented, with major gaps which prevent the safe transfer of information.
In 2008, the HSE published a corporate plan (2008-2011) with six strategic objectives (HSE 2008). Under the operational excellence objective, the plan stated “the development of ICT in particular will have a major role as an enabler of change and in supporting decision making at frontline delivery of healthcare... in conjunction with DoH&C and HIQA we will develop a Health Information Framework to include governance standards and to inform how data is compiled, protected and used, while ensuring security and confidentiality. The efficient and effective management and interpretation of timely, accurate and relevant data is essential. Working with DoH&C and HIQA, the development and implementation of a Health Information Portal and national ICT Strategy to keep pace with technological innovations is one of our Key Result Areas (KRA) over the next few years” (HSE 2008, p20).

In the HSE corporate plan, KRA number 20 (ICT) outlined a high level plan to implement a series of major strategic initiatives in areas such as Cancer, Primary Care Teams, Electronic Blood Tracking, Laboratory Information Management Systems, Mental Health and Hospital Patient Record Systems, but not ePrescribing. The corporate plan also proposed to implement a Health Information Bill, and a consultation process took place in 2008-2009, but by 2015 the bill had not yet been debated or even published by the Government, as one interviewee noted: “the Health Information Bill has been in the background for too long, it needs to be pushed to the front” (IE-IV 1).

Both the HSE and HIQA are bodies under the aegis of the DoH&C, which also published a new strategy in 2008, in which three strategic ICT objectives were identified (DoH&C 2008b): a Health Information Bill, a data and statistics strategy, and a plan to ensure coherence between the various strands of the information reform process. The previous DoH&C statement of strategy in 2005 referred to the HSE and HIQA carrying out their “respective functions” (DoH&C 2005), but the 2008 statement of strategy clarifies for the first time the co-operation and coherence needed between the three key health information governance stakeholders: DoH&C, HSE and HIQA.

A new eHealth strategy was published in December 2013 jointly by the DoH&C and the HSE, which is evidence of this co-operation. In this new strategy, ePrescribing is described in vague terms as one of seven potential priority projects (HSE 2013). In contrast, one national eHealth project managed by the HSE that has made substantial progress in recent years is the National Integrated Medical Imaging System (NIMIS)
project. This project commenced in 2007 with an objective to install a single national radiology RIS-PACS system in all 52 public hospitals, and by 2014 the system was live in 30 hospitals (IMT 2014). NIMIS is a single top-down solution for all hospitals managed by the HSE, with connections to a national imaging archive.

In summary there has been a period of intense strategic planning, reform and change in the management of the public health service in Ireland since the year 2000 but little progress has been made in developing national eHealth and ePrescribing services. Two new institutions (HSE and HIQA) were established as part of the Irish health service reforms, but their respective roles in the eHealth area have only started to become clear. In recent years, a new national infrastructure for eHealth is beginning to appear, with three organisations, the DoH&C, the HSE and HIQA responsible for different aspects of the development of national eHealth services. It is now clear that HIQA will objectively set information and technical standards, while the HSE will implement these standards, which suggests that these bodies will need to work closely together. The 2013 eHealth strategy proposed another new entity to oversee Ireland’s eHealth journey, and the HSE established a new organisation called “eHealth Ireland” in June 2015 (HSE 2015). This institution may provide the coordination required for the development and adoption of national eHealth systems and services in future years.

7.4. ePrescribing in Ireland

In Ireland there is ample evidence of the risks involved in prescribing (DoH&C 2008a, Kirke et al. 2007, Oireachtas 2007, Osborne et al. 1999). In 2009, the State Claims Agency (SCA) reported 83,847 patient safety incidents, of which almost 10% related to the medication process (Starsweb 2009). The pharmaceutical regulator, the Irish Medicines Board (IMB), also reported that it assessed 3,276 individual adverse reactions in relation to human medicines in 2009 (IMB 2010). Furthermore, the largest medical indemnity organisation in Ireland, the Medical Protection Society (MPS), reported in 2010 that almost 25% of medical claims against GPs relate to ADRs, many relating to prescription errors (Meade 2009, MPS 2010). MPS (2010) also noted that the level of medication errors could be up to 60% higher due to under-reporting.

Although figures for deaths from medication errors in Ireland are not readily available, proportional estimates based on international studies suggest figures of between 250 and 400 per annum. These estimates are significantly higher than the number of deaths from road traffic accidents in Ireland, which were 196 in 2014 (RSA 2014).
Some evidence is available on the adoption of EHRs and ePrescribing in primary care in Ireland. A study carried out from 2000 to 2003 suggested that about 75% of Irish GPs surveyed (n=1408) used a computer system in their practice by 2003, with a trend showing an increasing use of computers, as shown in Figure 7-1 (Meade et al. 2009).

![Figure 7-1: EHR use by Irish GPs (2000 and 2003)](image)

The study found that in the GP cohort who used computers by 2003, 56% recorded acute prescriptions and 74% recorded repeat prescriptions in an EHR. The authors of the study were aware of the potential for improvement in the safe practice of medicine by adopting ePrescribing, noting: “The study would support the notion that a basic national electronic healthcare record could be established containing demographic information and medication lists as a starting point for further development. As medications errors are recognised as a significant cause of morbidity and mortality this would seem an excellent place to start. Furthermore the interface between primary and secondary care has always proved a communications black spot” (Meade et al. 2009, p556).

ePrescribing was briefly mentioned in the 2004 national ICT strategy (DoH&C 2004b). At workshops for the primary care sector later in 2004, the key concern in the prescribing area was discussed as follows: “Prescriptions are often hand written and can contain inaccuracies in terms of requests or correct codes and therefore need to be
checked before being dispensed. A wider issue concerns the lack of monitoring of prescribing at a community level and the risk therefore of multiple prescriptions for the same individual by different GPs” (DoH&C 2004a, p3).

Although concerns about patient safety and polypharmacy were evident in 2004, there is little evidence of progress in the development of ePrescribing in Ireland in the following years. The 2007 EC benchmarking survey found: “Electronic exchange of prescriptions, commonly referred to as ePrescribing, is practiced by not even 1% of GP practices in Ireland, and ePrescribing can be regarded as a reality in only three Member States: Denmark, the Netherlands and Sweden. Apart from these countries adoption levels are never higher than 5%” (Empirica 2007a, p1).

The Irish Pharmacy Union (IPU) makes reference to ePrescribing in their annual reports, and in the context of a national strategy noted the following in 2009: “When discussing a national strategy for ETP, it is important to take into consideration certain professional and legal aspects that apply to the provision of cross border health services... Firstly, the pharmacist must be able to ensure that the prescriber in question is allowed to prescribe; secondly, the pharmacist must be able to contact the prescriber if any clarification is needed in relation to the prescription” (IPU 2009, p50). The 2014 and 2015 IPU annual reports refer to work with HIQA on the development of standards for ePrescribing, with the HSE on the implementation of their ICT strategy, and involvement in a primary care ePrescribing pilot project in Cork (IPU 2014, IPU 2015). As one interviewee observed “we need building blocks for ePrescribing, but they must be applicable to the Irish market” (IE-IV 4).

In recent years, EHR use in community pharmacies has become widespread (IPU 2009), and overall EHR use among GPs has caught up with the EU average of 97%, up from 64% in 2007 (Codagnone and Lupiañez-Villanueva 2013). Prescription records for individual patients with full medication details are now recorded in EHRs by almost every GP in Ireland, and “most scripts are now printed and signed, and are much easier to read than the handwritten ones” (IE-IV 2). However, a study of GPs in the west of Ireland by Hor et al. (2010, p2) found that only 27% of the GPs surveyed were familiar with decision support in ePrescribing, and: “in the Irish primary care setting, despite increasing application of electronic medical records (EMR), the functions of ePrescribing have only been partially adopted and utilized. Currently, the majority of general practitioners (GPs) utilize the paper mechanisms”.
There is some evidence of progress in the certifications of EHRs for ePrescriptions. The Irish College of GPs ICT group (GPIT) has been active in promoting the use of ICT by GPs in Ireland and since 2007 has been involved in the certification of EHR software products used by GPs (GPIT 2007). The certification standards include the recording of medication information and decision support for prescriptions. The majority of EHRs have now been certified, and work is ongoing with the remaining suppliers. However, there is no agreed ePrescription format in the standards yet, although the recent HIQA standards should provide some guidance (HIQA 2015a, HIQA 2015b). One reason why the ePrescribing area in EHRs is relatively underdeveloped is that “in ePrescribing the pharmacist gets all the benefit but the GP gets none, so we have not come very far” (IE-IV 4). Economic factors also provide part of the explanation as one interviewee observed “Who is going to pay for a national ePrescribing system? And will there be any incentives for GPs to use it?” (IE-IV 3).

The evidence points to slow progress in ePrescribing over the previous 15 years in primary care in Ireland. HIQA has developed 12 national GP messaging standards in 2010, carried out an international review of ETP in 2012 and published national standards for an ePrescribing dataset and data model in 2015. ePrescribing is now included in the HSE 2013 eHealth strategy as a potential priority project. A de-facto national organisation for health message exchange has been established in the last decade called Healthlink, although it can only provide certain services in some regions due to the historical regional organisation of ICT communication networks and different technical standards used, as one interviewee commented: “Healthlink has become the national broker by default, but communications between agencies is poor” (IE-IV 4).

The organisational, technical and legal requirements for a national ePrescribing service including ETP remain to be developed in a coherent way, and it appears that “nobody takes the lead in Ireland” (IE-IV 3). A national eHealth organisation responsible for ePrescribing and the exchange of ePrescriptions, equivalent to the leading countries identified in Chapter 4, does not exist, but the new institution (eHealth Ireland) may fulfil this role in future years.

7.5. Summary
Practically all GPs and pharmacists in Ireland now use a certified EHR to create and store prescriptions. These ERHs contain features to record and print prescriptions and medication information, and provide CDSS for prescribing, but this feature is not
widely adopted. Most prescriptions are now printed, but a small number are still handwritten. HIQA has published a variety of standards, but there are no national standard messaging formats for ePrescribing, and there is no established national ETP service. ePrescribing has not been addressed in a strategic way by the DoH&C, the HSE, HIQA, the GPIT group, the IPU or the IMB. However, national structures for eHealth are beginning to appear, and a new institution (eHealth Ireland) was established in 2015.

In conclusion, progress in primary care ePrescribing is slowly gaining momentum and ePrescribing is beginning to appear on the national eHealth agenda. This is the beginning of a long journey and it has taken a very long time to reach the starting point. These conclusions confirm in detail the findings from Chapter 4 where Ireland was ranked 24 out of 31 countries in the adoption of ePrescribing (cf. Section 4.2).

This chapter examined the ePrescribing environment in Ireland. Chapter 8 presents a case study from the eGovernment domain. The case study explores a national electronic IS in order to compare the domains and explore different factors in national systems. This comparison is then presented in Chapter 9.
8. eGovernment Case Study- the Irish Revenue On-Line Service

“It is the duty of government to make it difficult for people to do wrong, easy to do right.” (William Gladstone)

8.1. ROS Case Study - Research Overview

In recent decades governments in many countries have started to develop national eGovernment and eHealth services, as the opportunity to develop on-line services became apparent with the widespread adoption of Internet technologies during the 1990s. eGovernment and eHealth services are slowly increasing across most of Europe, but some regions are more advanced than others (Hyppönen et al. 2015) with evidence of a digital divide between north and south, similar to the findings in Chapter 4 (European-Commission 2015b). The objective of this case study is to analyse a successful national eGovernment system in Ireland in order to examine the critical success factors underlying the development and adoption of eGovernment services in Ireland, and then to compare this domain with the ePrescribing domain.

The Revenue on-line Service (The ROS) operated by Revenue was selected for the case study because it is an established national system for on-line transaction processing of tax returns and payments; has reached the highest levels of on-line sophistication for eGovernment applications; and has been one of the most notable successes in eGovernment in Ireland (Bannister et al. 2010, C&AG 2007, Scott and Robbins 2008). The case study examines the ROS project in order to gain insights into the process of development and adoption and to identify the critical factors for a successful eGovernment system. This case study also highlights aspects of the creation of a nationwide eTax and eGovernment environment. The research objectives are listed in Table 8-1.

<table>
<thead>
<tr>
<th>Table 8-1: Research objectives for ROS case study</th>
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<tbody>
<tr>
<td>• Explore and examine the background to the ROS project</td>
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<tr>
<td>• Investigate the implementation process of ROS</td>
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<tr>
<td>• Identify the developments each year as the project progressed</td>
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<tr>
<td>• Identify adoption trends and tipping points</td>
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<tr>
<td>• Identify the key stakeholders in ROS</td>
</tr>
<tr>
<td>• Establish the costs and benefits of ROS</td>
</tr>
<tr>
<td>• Review evaluations of ROS</td>
</tr>
<tr>
<td>• Identify themes and draw conclusions from the research</td>
</tr>
</tbody>
</table>

Following approval from Revenue in 2012, I arranged interviews with key members of staff from Revenue involved in the ROS project. These included a former ROS
Strategy Manager, two members of the Planning Division responsible for ROS and national systems, and two members of the current ROS Development and Operations team. These interviewees are listed in Table 8-2, with abbreviated references used in this thesis.

<table>
<thead>
<tr>
<th>Reference</th>
<th>ROS/Interviewee</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROS-IV 1</td>
<td>ROS Interviewee 1</td>
<td>Strategy Manager</td>
<td>Revenue - Planning Division</td>
</tr>
<tr>
<td>ROS-IV 2</td>
<td>ROS Interviewee 2</td>
<td>Principal Officer</td>
<td>Revenue - Planning Division</td>
</tr>
<tr>
<td>ROS-IV 3</td>
<td>ROS Interviewee 3</td>
<td>Project Manager</td>
<td>Revenue - Planning Division</td>
</tr>
<tr>
<td>ROS-IV 4</td>
<td>ROS Interviewee 4</td>
<td>Project Manager</td>
<td>Revenue – ROS Operations</td>
</tr>
<tr>
<td>ROS-IV 5</td>
<td>ROS Interviewee 5</td>
<td>Development Manager</td>
<td>Revenue – ROS Operations</td>
</tr>
</tbody>
</table>

8.2. **ROS Case Study – Background**

This section provides a brief summary of the Irish Revenue Commissioners and an introduction to the ROS project. The background and the strategic preparations for ROS are described in the following section, including the organisational (internal), contextual (external), legal and technical areas leading up to the launch of ROS in 2000.

8.2.1. **Background to Revenue**

The Office of the Irish Revenue Commissioners (Revenue) was established by a Government Order in 1923 as an independent statutory body. The Mission Statement of Revenue is “To serve the community by fairly and efficiently collecting taxes and duties and implementing customs controls” (Revenue-Commissioners 2013b, p3). There are approximately 100 Revenue offices countrywide with a staff complement of approximately 6,000 (Revenue-Commissioners 1997-2012). Revenue computer projects commenced in 1961, when a decision was made to centralise tax collection under the “one taxpayer, one charge” system (Reamonn 1981, p151). In 1974, the Revenue Computer Centre in St John’s Road, Dublin was opened, with network links to all Revenue offices throughout the country. The Revenue’s Data Processing Division developed many specific tax management programs and applications and “by 1976 VDU’s were on many officials' desks” (Revenue-Commissioners 2012b).

In the 1980s, Revenue took a more proactive role in stakeholder relations and established its own press office, and in 1989 the Tax Administration Liaison Committee (TALC) was established, which included many stakeholders such as tax experts from both Revenue and the private sector (Revenue-Commissioners 2012c). The objectives of TALC were to simplify and consolidate existing tax practices and to provide a
standing forum for an exchange of views. These early examples of stakeholder consultation paved the way for a more customer focused organisation.

During the 1990s many Revenue initiatives were driven by computer developments such as the consolidated taxes project (CONTAX), which integrated all of a customer’s tax data into one record, as “we had stovepipe systems, one for each tax, and we could not easily get an overview of the taxpayer” (ROS-IV 2). Although Revenue had made significant progress on the computerisation of internal systems by the 1990s, most tax returns at that point were still submitted on paper by taxpayers and tax agents, which were then entered into the CONTAX system by Revenue staff. As with all national paper-to-disc systems, this method took considerable resources and was prone to errors and delays. Revenue first launched a website (www.revenue.ie) in 1996, and quickly grasped the opportunity that the Internet provided for the on-line submission of tax returns and payments. This was the central idea behind ROS.

8.2.2. ROS Strategic Preparations 1998-2000
In 1997, the Information Society Commission (an independent advisory body to Government) published a statement of strategy for all Irish Government Departments which strongly recommended the development of self-service eGovernment services over the Internet as a national priority (ISC 1997). In response, the Revenue strategy of 1997-1999 stated that it was the intention of Revenue to “encourage electronic filing of returns and declarations and other electronic information exchange” (Revenue-Commissioners 1998, p4).

In 1998, Revenue embarked on the ROS project and assembled “a full-time team drawn from all relevant areas of the organisation” (Revenue-Commissioners 2000b, p4), with a detailed business knowledge of the Irish tax domain and the operations of Revenue as “business requirements always came first, ROS was not an IT project” (ROS-IV 3). As a result, ROS was a project with a business focus from the beginning, rather than a techno-centric project.

In late 1998, following stakeholder consultation, the business team “documented the vision of exactly what ROS was going to do” (ROS-IV 1). This was an extensive document clearly setting out the plans for on-line tax filing, payments and communications between taxpayers and Revenue. This was followed in early 1999 by formal corporate commitment to funding by Revenue, and an international public tender for software development and system security services. This procurement process was
completed in early 2000, when contracts were signed with Anderson Consulting (later re-branded as Accenture) for software development and Baltimore Technologies for online system security services.

In 1999, Revenue separated the ROS project from the mainstream Revenue offices, and a new centre was opened in Blackrock, County Dublin, approximately 10km from the national Revenue offices in Dublin Castle. Work commenced there in late 1999 with Accenture and Baltimore on the development of ROS in a shared public-private systems development with “Revenue as the senior partner. We did good work with Accenture, there was no us and them” (ROS-IV 3). In preparation for the live launch of ROS, the Blackrock office was organised into five new departments: “live operations, helpdesk, current systems, next developments and marketing” (ROS-IV 3). After a short period of system development and testing, ROS went live on 29 September 2000.

8.2.3. Technical and Fiscal Environment 1998-2002
The Irish technical and fiscal environment was undergoing significant change in the period when ROS was launched. Three fundamental technical and organisational changes occurred in the period 1998–2002 which had a major impact on the normal operations of Revenue. The first was the year 2000 (or Y2K) problem, which affected computer programs which used a two-digit year, and had a profound effect on the computer industry worldwide in the late 1990s. The second change was the Irish pound (IR£) which was replaced by the new Euro (€) currency from 1 January 1999 when the exchange rate was fixed, until 1 January 2002, when the Euro began to circulate and the Irish pound was withdrawn.

During this three year period, all businesses in the state had the option of converting to the Euro under the no prohibition-no compulsion rule, and could elect to have their tax returns processed in either currency. The third change was the tax year. Since the foundation of the state, the official tax year ran from 6 April to 5 April, but in the year 2001, the government changed the tax year to correspond with the calendar year. As a result, there was a short tax year from 6 April 2001 to 31 December 2001, and from 2002, the tax year was the calendar year.

Revenue was aware of these factors, and the potential risk they posed to the ROS project. In December 1998, Revenue first announced their plans for ROS in the
Revenue publication *Tax Briefing*[^1], as follows: “Notwithstanding Year 2000, Euro developments, and other potential demands on its resources, Revenue is committed to providing the resources necessary to ensure that ROS becomes a central part of its filing, payment and information services over the next number of years” (Revenue-Commissioners 1998, p4).

### 8.2.4. Legislation Framework

All actions and functions of Revenue are based on legislation, as “we do nothing without legislation” (ROS-IV 1). The legislative framework in 1998 which was relevant to the ROS project is shown in Table 8-3.

<table>
<thead>
<tr>
<th>Legal framework (1998)</th>
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</thead>
<tbody>
<tr>
<td>Finance Acts 1923 to 1998 (provided legal basis to assess and collect taxes)</td>
</tr>
<tr>
<td>Official Secrets Act 1963</td>
</tr>
<tr>
<td>Data Protection Acts 1988 and 2003</td>
</tr>
<tr>
<td>Freedom of Information Act 1997</td>
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</tbody>
</table>

Revenue was aware of the new legal requirements arising from the ROS project as follows: “There are two specific legal issues of concern in relation to electronic filing. The first is what is the legal status of an electronically filed return. Legislation will be drafted to follow a European Union model that it is intended will guarantee the standing of an electronically generated document in a court of law and will ensure the recognition of a digital signature. The Department of Public Enterprise will also be addressing this issue in the broader context of electronic commerce. The second issue is how can practitioners ensure that their clients cannot repudiate returns which they have filed on the clients’ behalf. This issue is obviously a concern for Revenue also. The problem has been addressed by different countries in different ways. In the US, for example, the taxpayer must follow the electronic submission with a hand signed declaration. In the UK the practitioner or filer must first generate a hard copy of the return for signature by the client before the electronic return is submitted. Either practitioner or client can retain this copy for production as evidence, if required. Since Revenue is adamant that submission of paper documents defeats the objective of

[^1]: *Tax Briefing* is a technical publication issued by Revenue on a quarterly basis to all registered Tax Agents and Accountants since 1990. It provides detailed technical discussions on tax matters, information about annual budget changes, and upcoming developments by Revenue. It first introduced ROS in issue 34 (December 1998), almost two years before ROS went live, and provided factual and technical details of the project in subsequent issues leading up to September 2000, when ROS went live and in the following 15 years. It was supplemented in 2004 by a weekly eMail briefing called *eBrief*. 

97
electronic filing, the solution may lie between the UK requirement and suitable amendments to our own legislation.” (Revenue-Commissioners 1998, p7).

To resolve these complex issues “the legislation people came to the software meetings” (ROS-IV 1). The legislation in Table 8-4 was created specifically to accommodate the ROS project, and some of this legislation paved the way for the wider use of eCommerce and eGovernment in Ireland. As a result, the ROS project was on a firm legal footing in the year 2000 when it was launched, and the principle that the “legislation is ahead of the technology” (ROS-IV 3) was a feature of ROS.

Table 8-4: Legislation required for ROS

<table>
<thead>
<tr>
<th>Legislation required for ROS</th>
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<tbody>
<tr>
<td>• Taxes Consolidation Act 1997 (allowed for the electronic filing of tax returns)</td>
</tr>
<tr>
<td>• Finance Acts 1999 and 2000 (this legislation regulated all ROS activities)</td>
</tr>
<tr>
<td>• E-Commerce Act 2000 (legislated for digital signatures and gave equal status to both paper</td>
</tr>
<tr>
<td>and electronic documents and records)</td>
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</tbody>
</table>

8.2.5. ROS Technical Architecture

Revenue wished to exploit the Internet as the technical platform, and ROS was designed as an interactive website. Consequently, Revenue needed to develop a technical solution that could support multiple platforms, was flexible, secure, easy to use, and could integrate with Revenue’s existing systems. Revenue consulted with many stakeholders in the design of ROS, such as professional tax and accountancy bodies, representative bodies of specific business and industry sectors, banks, accountancy firms, private businesses, third party software companies, and so forth. ROS was designed to meet the requirements of this diverse user group.

The chosen technology was a range of off-the-shelf products from established international technology companies: The EasyTax system (Accenture); WebLogic application server (BEA); UniCERT security technology (Baltimore); OpenIngres Database (Computer Associates); Enterprise Java Beans (Sun Microsystems); and Hyper Text Markup Language (HTML). Accenture were awarded the contract to build the ROS system (central and remote) from these components which were chosen for their openness and scalability. ROS supports multiple browsers (e.g. Microsoft Internet Explorer, Netscape, Safari) and operates on many platforms (e.g. Windows, Apple Macintosh, UNIX).

The data entered and submitted by users from the ROS website was not directly integrated into the Revenue internal systems such as the Integrated Tax Processing
System (ITPS) which was the successor to CONTAX. Instead Revenue engineered a checkpoint between the ROS data and the internal Revenue systems in order to validate tax return records from ROS users via the Internet, and also maintain absolute security of internal systems by allowing no direct external access to ITPS. This checkpoint initially took the form of an overnight batch process update of ROS data into the ITPS, which meant ROS was unavailable for two hours each night in the first two years.

In this way, the ROS architecture separated the functionality of tax submission and tax payment from the validation and integration of this data into the internal Revenue systems. Revenue put systems in place to ensure that the records in the ITPS were exact copies of the data entered by taxpayers through ROS, “as the authentic record existed in the ITPS” (McDonough et al. 2007, p40). The separation of front-end Internet-based customer systems (e.g. ROS) from back-end eGovernment systems (e.g. ITPS) has been discussed in the literature in the context of international tax administration and best practice. For example, Hasseldine (2010, p7) observes: “Countries with a record of successful implementation include Singapore, Australia and the Nordic approach ... Ireland recognizes the importance of electronic service provision with eFiling and other services provided to customers, but it is also crucial to have technology available internally e.g. for risk management, data capture, management information, etc”.

8.2.6. ROS Security System
The security of the system and the data was ranked as Revenue’s top priority in the development of ROS, and a secure method that won the confidence of users was required. As there were over three million potential users of ROS, a failsafe security system was a mandatory requirement. During the planning and evaluation phase of ROS, fundamental security requirements were identified, and are listed in Table 8-5.

<table>
<thead>
<tr>
<th>Table 8-5: ROS security requirements</th>
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</thead>
<tbody>
<tr>
<td>• Clear authentication measures for users logging into ROS</td>
</tr>
<tr>
<td>• Guarantees regarding the integrity and confidentiality of data entered and submitted by end-users</td>
</tr>
<tr>
<td>• Non-repudiation of tax returns - information cannot be disowned by the taxpayer</td>
</tr>
<tr>
<td>• Maintaining confidentiality and privacy of data in the on-line environment</td>
</tr>
<tr>
<td>• Ease of use on a standard web browser</td>
</tr>
</tbody>
</table>

The technical security solution chosen for ROS was the use of public key infrastructure (PKI) technology, secure socket layer (SSL) technology, data encryption technology and digital certificates. This security infrastructure was directly supported by legislation
for encrypted data transmission and digital signatures. Revenue was concerned about the security of data transmitted over the Internet, and made considerable efforts to develop and test a system with an “extremely high level of security which was virtually unbreakable” (ROS-IV 1). The task of rigorously testing security in ROS was “a bloody hard job” (ROS-IV 1), and included the hire of specialist firms who attempted to hack into ROS and other Revenue systems; and involved searching for printed documents and other media which could contain security information around Revenue offices, and in waste disposal centres used by Revenue and their development partners.

Revenue also spent time explaining the security system to their stakeholders. The ROS security system, including the role of digital signatures and PKI, were described in detail in the June 2000 issue of Tax Briefing (Revenue-Commissioners 2000c). The importance Revenue attached to the PKI security system can be appreciated in the full extract from the Tax Briefing (cf. Appendix D).

All ROS users are required to formally apply for a digital certificate, which contains the digital signature for that user. This is a three-step process, which includes Revenue issuing two letters by post with a code and a password to the address of the applicant, who is also required to hold a Personal Public Service Number (PPSN) or a Tax agent Identification Number (TAIN). This application process has the effect of limiting digital certificates to genuine taxpayers and agents.

The ROS application was tightly integrated within the PKI environment, which was designed to control access to the system and to ensure the authenticity, integrity, confidentiality and non-repudiation of all transactions between Revenue and its ROS customers, as “the level of encryption was set at a military level” (ROS-IV 2). With this security architecture, “ROS runs on a secure national network where the security is within the application, not on the device” (ROS-IV 4). According to Foscarini (2008) Revenue was a pioneer in the design of security systems for eGovernment services.

8.3. 2000 – 2002: The Launch of ROS
ROS was a large scale undertaking by Revenue, with approximately three million potential customers - almost one million business customers and two million ordinary taxpayers (employees). Revenue made a strategic decision at the beginning of the ROS project to concentrate on the business sector in the initial phases, and defer the employee sector for several years. Revenue also decided to initially concentrate on the
most common and frequent business taxes, and develop facilities for the less frequent business taxes later, as “the plan was for two extra services per year” (ROS-IV 3).

ROS went live on September 29, 2000 as one interviewee observed “going live proved the concept and the security” (ROS-IV 3). The first phase included the two most common taxes, deductions from employees known as “Pay As You Earn/Pay Related Social Insurance” (PAYE/PRSI) and Value Added Tax (VATx). Phase two of ROS was released in April 2001, and provided new functionality to file and pay year-end PAYE/PRSI liabilities and facilities for credit and laser cards. Phase three of ROS was launched in October 2001, and provided facilities to electronically file Income Tax (ITx) returns for self-employed individuals, and Corporation Tax (CTx) returns for companies. Also, these groups had, for the first time, on-line access to historical ITx, CTx and Capital Gains Tax (GGTx) details.

Revenue also released an off-line version of ROS, which contained a number of electronic forms which could be completed off-line and uploaded on-line. A new feature of the ITx and CTx returns for agents and taxpayers was the facility to calculate the exact tax liability prior to filing. This feature was of significant benefit to all taxpayers, because the exact tax liability was now visible prior to filing the tax returns for the first time, and provided tax planning features to agents in particular as follows: “The ROS Form 11 contains a calculation facility that accurately computes the tax liability of the filer at any stage in the completion of the Form. This calculation facility allows the filer the opportunity to calculate their tax liability prior to receiving their notice of assessment” (Revenue-Commissioners 2001, p4).

The Euro came into circulation on January 1, 2002 and ROS phase four was released to provide Euro facilities. Other facilities included the Environmental Levy, Vehicle Registration Tax (VRTx), Deposit Interest Retention Tax (DIRT), Professional Services Withholding Tax (PSWT), Dividend Withholding Tax (DWT), Investment Undertaking Tax (IUT), Life Assurance Exit Tax (LAET), and Special Savings Incentive Account (SSIA).

Extensive stakeholder consultation was a key feature in the development of these taxes, as “there was no point in building something we think people need; we have to ask them” (ROS-IV 3). For example the new VRTx system was developed following lengthy consultation with stakeholders from the motor industry including the Society of
the Irish Motor Industry (SIMI) and vehicle distributors, and was immediately successful with almost 70% adoption in the first year of operation.

The year 2002 was also the year that the “pay and file” system was introduced by Revenue. Up to that point, 31 October was the deadline for filing and payment of ITx, CTx and GGTx, but under the pay and file arrangements the deadline was extended by three weeks if the tax was filed and paid using ROS. This provided many taxpayers with a financial incentive to register for ROS in 2002 and also in later years, as the benefit of the extended deadline for electronic filing has remained in place.

8.3.1. 2000-2002: Adoption of ROS
Revenue did not know in advance how the system would be received by the taxpaying community, and noted in the publication Tax Briefing: “It is difficult to anticipate what the initial uptake will be, but the development of ROS has been warmly welcomed by all sections of Revenue’s customer base and an active marketing strategy is being pursued to maximise the uptake” (Revenue-Commissioners 2000d, p1).

Adoption of ROS by tax agents, accountants and businesses exceeded the expectations of Revenue, and the target for the first year of IR£50 (€63.5) million paid on-line was reached in eight weeks (Revenue-Commissioners 2000a). New topics arose which were discussed openly with stakeholders such as incentives for adoption and the use of attachments to file detailed financial accounts as follows: “Incentives: The conclusion reached is that no cash or tax based incentives will be given. We are confident that ROS will to a large extent sell itself. Attachments: We also decided we will not proceed with the option to allow the filing of accounts as an attachment. The size of the accounts attachment files would be too big to make this option technically viable. It would have the potential to cause major bottleneck problems for tax practitioners and Internet service providers, particularly during busy periods. There is also, of course, a greater risk of virus attack from attachment files” (Revenue-Commissioners 2000e, p37). These decisions were taken following lengthy consultation with stakeholders who were fully informed of these developments on an ongoing basis in the Tax Briefing publication and by other channels.

By June 2001, almost 3,000 taxpayers had registered on ROS, almost 15,000 tax returns had been submitted, and more than €900 million had been paid on-line. In the first full year of ROS in operation (2001) almost €2 billion in taxes were paid directly through
ROS and in 2002 this rose to €3.6 billion, almost 10% of gross tax paid in Ireland (Revenue-Commissioners 2002).

The Revenue annual report for 2000 described the launch of ROS as follows: “This success can be attributed to the co-operation of our customers, who embraced this new technology, and to our staff, who were instrumental in the design of the service and its promotion amongst our customers... We are confident of achieving our twin goals of having 50% of all business tax returns filed electronically by the year 2005 and of having our customers conduct business electronically with us, at a time and location that suits them best” (Revenue-Commissioners 2000a).

8.3.2. User Supports and Social Marketing Campaign
The launch of ROS in the early years 2000-2002 was supported by an organised system of user supports and an extensive social marketing campaign by Revenue. The user supports were extensive, integrated and comprised: a national team of 120 ROS liaison officers who were appointed in every tax district, and were “the key to national adoption” (ROS-IV 3); a national training service with a mobile classroom for users to use and test the ROS system; a national ROS information and technical helpline; and eMail support. These services were provided to all users free of charge.

The marketing campaign was “an investment that paid for itself many times over” (ROS-IV 1). The objectives of the marketing campaign were to make taxpayers and other stakeholders aware of the ROS on-line facility, and convince taxpayers of the benefits of using ROS. A social marketing campaign with a customer-centric view was a new venture for Revenue, and an example of private-sector style of management which featured throughout the ROS project (Scott and Robbins 2008). Prior to the launch of ROS, Revenue provided open public details about the marketing campaign to stakeholders as follows: “Marketing: Once ROS goes live it will be important to ensure that as many of our potential customers are aware of and know how to use it. We have developed a layered strategy to achieve this. The first layer involves using our existing resources to contact customers - via Tax Briefing, providing presentations and demonstrations for seminars, conferences etc., writing directly to customers including mail-shots with other correspondence to our customers - VAT3s and P30s – and providing articles for trade and representative body magazines. The second layer is more focused: internet advertising on popular news and business web-sites coinciding with ROS going live; and the use of a mobile classroom which we will have at
exhibitions, seminars and conferences in the months following the launch of ROS. This classroom has eight networked PCs on which it will be possible to give customers training in the use of ROS. We hope to make the classroom available countrywide on a pre-arranged basis through representative and business organisations. The final layer is the traditional newspaper and business magazine advertising. This will commence towards the end of September and run through the period when ROS goes live” (Revenue-Commissioners 2000d). The three layered marketing strategy was accompanied by a range of advertising material. An example is shown in Figure 8-1.

Figure 8-1: Advertisement for ROS in 2001

Source: Tax Briefing issue 45 Oct 2001

8.3.3. 2000-2002: Summary
ROS was launched in September 2000 after two years of preparation work, and initially focused on the business sector. ROS was designed using open architecture and common
technical standards, which facilitated systems development and expansion, with new software releases coming on-line in planned phases every six months. The launch was supported by a well-designed legal framework, a professional marketing campaign and a range of user supports including ROS liaison officers, mobile training facilities and a national helpline. The ROS implementation strategy was described as “think big, start small, scale fast” (ROS-IV 1).

For taxpayers and tax agents ROS was an interactive website which was easy to use and was available nationwide, with a formal method of registration, and a secure method of transmitting electronic data. The uptake of ROS exceeded the expectations of Revenue; by 2002 almost 10% of income tax returns were filed and almost 10% of gross taxes were paid via ROS.

8.4. 2003 – 2005: The Tipping Point
8.4.1. The ROS Transaction Journey
Revenue was keen to build on the early success of ROS. Revenue’s objective was to make all business taxes available on-line in ROS, with a target of 50% of all taxes filed in ROS by 2005. By 2003 the ground rules for ROS had become clearly established and users were becoming familiar with the ROS transaction journey.

All ROS transactions are created by taxpayers and their agents. Tax return forms and tax payments are the two key transactions, but there are other transactions such as requests for tax clearance certificates and statements. These transactions are processed on-line in ROS when the user submits the transaction by entering a password for their unique digital signature and a transaction receipt (eReceipt) is immediately issued. Revenue views the signing action as “a ‘ceremony’ which is central to the ROS system claim of non-repudiation, as it inextricably links the submitted form to the person or agent involved” (McDonough et al. 2007, p42).

These transactions and receipts are integrated into the Revenue’s integrated tax processing database, where a permanent electronic record of the transaction is maintained for statutory purposes. These transactions may then be subject to further analysis in the national case management database, or the business intelligence database, or subject to data mining operations by Revenue (Revenue-Commissioners 2011b). This transaction journey is illustrated in Figure 8-2.
8.4.2. 2003 – 2005: Intensive Developments in ROS

During this period there was an intensive programme of systems development as ROS gained broad acceptance, and the demand for additional facilities was increasing. The development of systems for new taxes continued at the same pace, even when additional requirements and technical support issues were increasing as tens of thousands of new users came to grips with ROS.

The national ROS helpline and the open communication channels for stakeholders were crucial during this period, as the live system was maintained, developed and upgraded while new releases were launched. A review of the intense scale of these developments from 2003 to 2005 provides details of 20 significant new developments in ROS (cf. Table 8-6).
Table 8-6: ROS developments and releases 2003-2005

- All on-line and off-line ROS tax return forms updated for the 2002/2003/2004 budgets
- eFiling and ePayment of Relevant Contracts Tax (RCTx) for the construction industry in ROS
- New Computerised Transit System (NCTS) facility for electronically submitting transit messages to ROS and linking to the new EU-wide NCTS
- eFiling of Capital Acquisitions Tax (CATx) returns in ROS
- A facility for employers to access tax credit certificate information for their employees in ROS
- VATx on eServices, and the eFiling of VIES and Intrastat returns in ROS
- Web-connected services for Income Tax and Corporation Tax. These services allowed customers to interact with ROS via their compatible third party tax preparation software
- Re-design of payments and introduction of a payment confirmation screen for customers in ROS
- The extension of ROS to provide on-line access to tax information for the previous seven years
- eFiling of Income Tax Returns by tax agents for clients not yet registered for Income Tax or for clients not yet registered with an agent in ROS
- An upgraded version of the ROS off-line application with versions of all historical tax forms
- An off-line payment facility to complete ROS payment screens off-line and upload in batches
- The export traders refund facility in ROS for Common Agricultural Policy/Direct Trader Input
- An on-line Vehicle Registration Tax (VRTx) calculation facility in ROS
- An on-line Forgotten/Lost Password facility in ROS
- An on-line facility to allow Bookmakers to file Betting Duty returns and payments in ROS
- Dual signature functionality to e-file and pay Gift and Inheritance tax in ROS following a request from the Law Society
- GGTx assessments processed automatically and sent to the ROS inbox
- A facility to e-file EU Savings Directive returns in ROS
- Extended web services for uploading Forms from ROS compatible tax software

Many of these developments involved third-party software written to interoperate with ROS, such as financial and tax preparation software. This was facilitated by the efforts of Revenue to create a forum for the ICT industry to interact with Revenue, and included the provision of technical specifications, file formats, on-line testing facilities and regular collaboration. This initiative came about because “one of the biggest mistakes we made in the early days was to underestimate the suppliers of tax and financial software, so we went out of our way to include them and put up test systems, developers toolkits, file formats and technical specs on-line for their staff, and worked very closely with them” (ROS-IV 1).

8.4.3. 2003-2005: Adoption of ROS

The total volume of all ROS transactions increased in 2003 by 181%, tax returns increased by 281%, and customer enquiries increased by 191%, and according to Revenue: “last year we reached a ‘tipping point’ in relation to the electronic filing of income tax returns through our Revenue On-Line Service (ROS): over 40 percent of all income tax self assessment returns came in through ROS. This is hugely encouraging. ROS is also a major success in other areas such as vehicle registration tax, with 70% of all eligible motor vehicles now registered on-line, and in total over €6 billion was paid through the system last year” (Revenue-Commissioners 2003, p5).
A significant increase in income tax returns was recorded, but the volume of increased users and transactions caused technical difficulties. This is an indication of the level of ROS adoption at that time, which was described as follows: “Performance issues during Pay and File 2003: ... the ultimate take up was far greater than anticipated. The volume and mix of transactions received was therefore in excess of the performance and load tests carried out in advance of the peak period, and system difficulties resulted. Despite the remedial steps that were taken to eliminate these issues in the final weeks, the huge demand in the final days, particularly by new users, caused the service to slow down and gave rise to complaints... with a disproportionate number of complaints from the West of Ireland relating to connectivity issues” (Revenue-Commissioners 2004b, p17).

These technical problems in 2003 led to “a whole overview of ROS, and a huge increase in infrastructure; and less pretty but more functional screens” (ROS-IV 3). These technical difficulties were an indication of the demand for ROS services which processed “between 8,000 and 10,000 returns or payments a day as well as handling up to 10,000 information requests per day” (Revenue-Commissioners 2004a, p4).

The proportion of all tax returns filed in ROS increased to 15% by 2004. The average number of total tax returns filed per month was approximately 20,000 in January 2003, but by June 2005, it had reached approximately 140,000, a seven fold increase. Income tax returns increased from 9% in 2002 to 65% by 2005, also a seven fold increase. This is the tipping point that Revenue observed during this period. This pattern is shown in Figure 8-3.

In 2003, following a root and branch review of all operations, a reorganisation of Revenue took place, which resulted in new regions, new divisions and new responsibilities, as “right from the start this was top management’s vision and ROS was the catalyst for the re-structure of Revenue” (ROS-IV 1). ROS provided the flexibility to re-organise services in a customer-centric way, as Revenue had “historically developed around specific taxes and duties and we decided that we needed to align it with systems and strategies that focused on our customers” (Revenue-Commissioners 2003, p8).
8.4.4. 2002-2005 Summary

The years 2003-2005 were a watershed when ROS gained the trust of the Irish tax community, and the tipping point was reached for the whole project. ROS gained momentum across a broad range of taxes, and the tax community began to accept ROS as the way to file and pay taxes in the future. The technical problems encountered in 2003 were addressed in an open and transparent way, and clearly did not affect the continued adoption of ROS in 2004 or 2005.

The benefits of on-line filing of tax returns and processing tax payments and repayments become apparent during this period. The three week extended payment deadline was a compelling reason to use ROS over traditional payment methods. All tax returns, declarations, applications and repayments processed in ROS took five working days, compared to manual repayments which took up to 20 working days. Consequently, ROS was very useful to business taxpayers in tax repayment situations.

During this period the core features of ROS were firmly established, including: the instant acknowledgement of transactions; storage of partially completed returns; full calculation facilities; in-built validation in tax forms; an access control facility; batch filing facilities; and a 24 hour service (Computerworld 2004).
8.5. 2006 – 2008: Trial, Error and Redesign

8.5.1. ROS Expands to the Employee Sector

By 2006, 22 business taxes and duties could be filed on-line in ROS, and approximately 70% of all business taxes were filed in ROS (Blakemore 2006). As a result of this progress in the business sector, Revenue changed the focus of the ROS project to the employee sector. Revenue developed and launched the “PAYE on-line” service for employees in June 2006, and the launch was accompanied by a marketing campaign, when Revenue issued 2.2 million individual letters to PAYE taxpayers with a code (PIN) required for the new service (Revenue-Commissioners 2006).

However, adoption of this service was slow, and when a survey in 2007 highlighted the registration system was unwieldy and difficult to use, “we had to change it as it just did not work for users” (ROS-IV 3). The application was terminated, re-engineered, re-branded as “PAYE Anytime” and re-launched in September 2008. It was available on various platforms including smart phones for the first time, as Revenue’s strategy was to develop user-friendly systems for all taxpayers, especially two million PAYE taxpayers (Revenue-Commissioners 2008).

8.5.2. 2006-2008: Adoption of ROS

While the focus of ROS was on developments in the employee sector, the steady increase in adoption across all business taxes was consolidated during this period. By 2008, the rate of electronic submission for Customs declarations reached 99%, while VRTx, ITx and CTx had reached adoption rates of 94%, 76% and 75% respectively.

In 2007, the total gross tax receipts for Ireland were €66 billion, but in 2008 the gross receipts fell for the first time in two decades to €60 billion. This was the beginning of the economic recession, as gross receipts in 2009 fell to €51 billion and again in 2010 to €48 billion. While the total volume of tax returns and payments fell in this period, most taxes filed in ROS continued to increase. The only tax filed through ROS which reported a fall in 2008 was VRTx (by 22%), as the number of new vehicles sold in 2008 in Ireland decreased when compared to 2007, due to the economic recession.

8.5.3. 2006-2008: Summary

During this period Revenue changed the focus of the ROS project from business taxpayers to the PAYE sector, which had more than double the number of registered taxpayers. The key development in this period was the initial failure and subsequent
review, re-engineering and re-launch of the PAYE Anytime system. eFiling increased steadily across all tax returns, which reached almost 3.5 million in 2008 (2.1 million in 2005). Gross tax payments processed in ROS were €21.7 billion in 2008, approximately 36% of all gross tax payments. The gradual increase in the use of ROS for tax filing and payments across a wide range of taxes became established, and this pattern led Revenue to consider the next key development in the ROS journey, mandatory electronic filing. The ground rules were established in 2008, and in 2009 the mandatory filing phase commenced.

8.6. 2009 – 2012: Mandatory eFiling and Maturity

8.6.1. Mandatory eFiling Project
Revenue legislated for mandatory filing in 2003, but used a “carrot, not stick approach to adoption; you must bring stakeholders along” (ROS-IV 1). Mandatory eFiling was first discussed with stakeholders in 2007 when a consultation exercise took place with tax practitioners, industry representative bodies, software providers and taxpayers (Revenue-Commissioners 2007a). This led to the introduction of mandatory eFiling in 2009 for large companies and Government departments (approx. 7,000 tax entities) in phases one and two. Phase three was extended in 2011 to companies, partnerships and trusts for certain taxes (approx. 200,000 tax entities). By 2012, phase four was extended to all VATx and RCTx registered businesses (approx. 160,000 tax entities). Phase five in 2013 extended mandatory eFiling to include financial statements (with iXBRL) for all companies filing CTx returns dealt with by the Large Cases Division, which included the 300 largest corporate groups in Ireland (Revenue-Commissioners 1995-2012).

8.6.2. New ROS Developments
In 2009, two new taxes, the Income Levy and the Air Travel tax were integrated into ROS. A new eStamping system was also launched, following consultation with stakeholders including the Property Registration Authority and the Law Society. The eStamping system allows the on-line stamping of instruments such as conveyances and leases in ROS. This was followed in 2012 by an agreement that provided data on stamp duty returns to the Property Services Regulatory Authority. This populates and maintains an on-line register of residential house prices, reflecting the current values of residential properties in Ireland. A new electronic RCTx system was launched in 2012, and the use of this system was mandatory as Revenue decided to launch all new taxes in ROS by default from 2012 (Revenue-Commissioners 2012a).
The ROS website underwent a major upgrade in 2012, its first in six years. This included an improved user interface, easier navigation and improved functionality, comprising a new inbox and information services area, automatic archiving of records over three months old, and on-line demonstration videos for both taxpayers and agents. Revenue also embraced new technology to broaden ROS access during this period, including mobile telephone applications (PAYE Anytime and a health expenses application) with iPhone, Windows Mobile and other smart phone versions (Revenue-Commissioners 1995-2012).

Revenue continued to develop internal ICT expertise during this period, and while Accenture were still a partner there were “now more Revenue developers than Accenture developers” (ROS-IV 4). Revenue employed a formal project management method - Projects in Controlled Environment (PRINCE) and the ROS technical developments were managed by a “project management structure where all specs are documented for somebody else to step in” (ROS-IV 1).

Tax authorities from other countries (e.g. England, France, Finland, Iran and some states of the USA) expressed interest in ROS from the early 2000s; this led Accenture and Revenue to enter into a joint ownership of ROS for commercial purposes during this period, and “there is now international interest in the risk analysis tool we have developed, and also the RCT system” (ROS-IV 3). Accenture have commercialised the product, and Revenue may recoup some of the investment if ROS is implemented in other countries.

8.6.3. 2009-2012: Adoption of ROS
In the period 2009-2012, the efforts of Revenue in the PAYE sector and the introduction of mandatory filing in the business sector made a significant difference to adoption. In the PAYE sector, the launch of the PAYE Anytime on-line application in 2008 was supported by focused surveys and marketing campaigns, and the number of registered users continued to increase, approaching approximately 40% of all employees (800,000) by 2012. In the business sector, new on-line services (e.g. eStamping and RCTx) and mandatory filing were introduced in the period 2009-2012. The 2011 Revenue Annual Report noted: “A stated objective in our Statement of Strategy 2011-2014 is to establish electronic channels as the norm for doing business with us. We have worked hard to make our electronic services attractive and easy to use and this, combined with the extension of mandatory eFiling to about 200,000 entities has resulted in substantial
increases in the number of customers using these services” (Revenue-Commissioners 2011a, p8).

An indication of the impact of mandatory eFiling can be seen in 2011/2012 where three taxes RCTx, VATx and PAYE recorded large increases as illustrated in Figure 8-4. The new mandatory RCTx system was fully adopted in 2012, while VATx and PAYE (P30 and P35 in Figure 8-4) increased significantly due to mandatory eFiling.

![Figure 8-4: eFiling by tax type 2012 v 2011](image)

Source: (Revenue-Commissioners 2012a)

8.6.4. 2009-2012: Summary
During this period Revenue consolidated the ROS success with a mandatory eFiling project, introduced new taxes on-line, improved their technology and upgraded the entire ROS application. There was a noticeable rise in the use of ROS by all taxpayers during this period, and by 2012, the total number of taxes filed was approaching five million, the gross tax paid in ROS was €36 billion (72% of the total), and the number of PAYE employees registered as users almost reached 800,000 by 2012. It was significant that the uptake of ROS continued to rise steadily, as Ireland was in recession throughout this period, when gross tax revenues fell sharply from a high of €66 billion in 2007 to approximately €50 billion in 2012. This suggests that during the years 2009-2012, ROS matured as a robust system for filing and paying tax in Ireland, and was established as a permanent eGovernment service during this period.

8.7. Outcomes of the ROS Project
In order to objectively understand the adoption of ROS, statistics were gathered on five key measures since 2000, as follows: (1) visits to the ROS website, (2) transactions
processed in ROS, (3) income tax returns filed through ROS, (4) PAYE Anytime adoption and (5) taxes paid through ROS. This analysis is presented in the following sections, along with a synopsis of the benefits, costs and stakeholders in ROS.

8.7.1.1. Visits to Revenue Website
From 2002, in order to login to the ROS application it was necessary to access the Revenue website (www.revenue.ie), and an analysis of visits to the Revenue website provides an indication of the adoption of ROS over time. The trend in Figure 8-5 shows that in 2002 there were just over two million visits, but in 2012 this was approaching 20 million. The decrease in 2008-2009 was the direct result of the economic crisis at that time, as there was a significant decrease in the volume of tax returns that were filed and paid in those years.

![Figure 8-5: Visits to Revenue website 2002-2012](image)

Source: (Revenue-Commissioners, 1995-2012)

8.7.1.2. Transactions Processed in ROS
The crucial evidence about the adoption of a national tax system is the trend in the volume of transactions processed over time. The volume of ROS transactions processed from 2000-2012 is shown in Figure 8-6. This graph shows a steady increase in taxes filed from approximately half a million in 2002 to almost 5 million in 2012. The volume of payment transactions in Figure 8-6 also increased from almost 80,000 in 2002 to over 1.3 million in 2012. These volumes represent an average annual increase in transactions processed of 100% and 170% respectively since 2002.
8.7.1.3. Tax returns filed in ROS
When the 24 different types of tax returns are analysed, a common pattern emerges. For example, the trend in income tax returns from the self-employed is shown in Figure 8-7. This graph shows 9% of returns were filed in ROS in 2002, but by 2012 this was approaching 90%. The tipping point occurred in the 2002-2004 period when an initial sharp increase was followed by a steadily increasing adoption pattern. Other taxes have different tipping points in different years, but the overall trend is similar to Figure 8-7.
8.7.2. PAYE Anytime adoption
In the employee sector, the re-launch of the PAYE Anytime on-line application in 2008 was supported by focused surveys and marketing campaigns. The number of registered users increased in the following years, and by 2012 was approaching 40% of all employees (800,000). The number of transactions per year has been close to the number of registered users since 2009, suggesting that most registered users now use the system once a year on average to amend tax credit information and submit health expense claims. This trend is illustrated in Figure 8-8.

![Figure 8-8: Uptake of PAYE Anytime 2007-2012](image)

8.7.2.1. Taxes Paid in ROS
An analysis of gross tax receipts processed through ROS since 2000 presents some illuminating data. In 2000, when ROS was launched, Revenue collected a total of €35 billion of which €800 million was processed in ROS (2%). By 2012, Revenue collected €50 billion, of which €36 billion was processed in ROS (72%).

In 2009, the proportion of gross tax receipts processed through ROS rose above 50% for the first time, and by 2012, almost three quarters of all taxes and duties collected in Ireland were processed in ROS, as shown in Figure 8-9. An interesting feature of this data is the pattern during the years 2007-2010. During that period, due to the economic recession gross tax receipts fell by €18 billion (28%), but gross receipts processed in ROS rose by €6 billion (28%).
This indicates that while gross tax receipts were falling, there was a corresponding rise in the proportion of receipts processed in ROS during the same period. This trend suggests that the majority of taxpayers were already using or changing to ROS, and the mandatory filing project which commenced in 2009 may also be a factor. Figure 8-9 also highlights the point in 2009-2010 (where the trend lines intersect) when ROS became the primary method of paying tax in Ireland.

**Figure 8-9: Pattern of gross tax receipts 1999-2012**

![Gross Irish Tax Receipts from all Taxes 1999-2012 (€Billions)](image)

Source: (Revenue-Commissioners, 1995-2012)

#### 8.8. Benefits of ROS

A wide range of benefits for many stakeholders were found in the literature and also discussed in the interviews. The benefits to Revenue and business are considerable (both financial and non-financial), and Revenue has made formal attempts to quantify these benefits. The financial benefits of ROS were calculated at approximately €6 million in 2004 and approximately €14 million in 2006 (Revenue-Commissioners 2007c), and another study confirmed significant savings were achieved by way of reductions in postage costs and customer service enquiries (Scott and Robbins 2008). In the 2012 Revenue Annual Report, savings of €24 million to businesses were estimated following the adoption of the new Relevant Contract Tax system (RCTx) which required significant changes to ROS (Revenue-Commissioners 2012a).
The benefits to taxpayers and tax agents published on the Revenue website are listed in Table 8-7.

<table>
<thead>
<tr>
<th>Table 8-7: Benefits of ROS to taxpayers</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improved customer service and faster turnaround time</td>
</tr>
<tr>
<td>• Improved accuracy and audit trails</td>
</tr>
<tr>
<td>• Reduced processing costs</td>
</tr>
<tr>
<td>• Avoidance of duplication of effort and reduce compliance costs</td>
</tr>
<tr>
<td>• Reduction in paper handling, photocopying and compliance costs</td>
</tr>
<tr>
<td>• More effective and efficient use of time</td>
</tr>
<tr>
<td>• More accurate processing of returns</td>
</tr>
<tr>
<td>• Access to a unique personal Revenue account from a personal computer</td>
</tr>
<tr>
<td>• 24 hour, 365 day access to Revenue</td>
</tr>
<tr>
<td>• Tax calculation facilities on-line and off-line to assist customers</td>
</tr>
<tr>
<td>• Instant acknowledgement of returns</td>
</tr>
<tr>
<td>• Faster processing of returns and payments</td>
</tr>
<tr>
<td>• Faster repayments than paper returns (average 5 days against 20 days)</td>
</tr>
</tbody>
</table>

Source: (Revenue-Commissioners 2013a)

Other stakeholders have also commented on the benefits of ROS, including organisations involved in tax administration such as the Irish Institute of Taxation, professional Accountancy bodies, the Law Society and the Irish Payroll Association. The Irish Government is a stakeholder in ROS, and the use of ROS to quickly and effectively pursue new Government policies has been observed (Navarra and Cornford 2005, Navarra and Cornford 2012, O'Donnell et al. 2003, O'Donnell et al. 2003, Scott and Robbins 2008). Examples of such policies include the Local Property Tax (LPTx) and the plastic bag levy when “facilitating the retailer to make its returns on the levy via the ROS … the result was immediate, one billion plastic bags vanished from Irish streets” (Navarra and Cornford 2005, p6).

8.9. Cost of ROS

ICT comprises a significant portion of the annual operating budget for Revenue, and its investment is maintained on an ongoing basis. In the context of other Revenue ICT projects, ROS was a lesser undertaking with approximately 30 staff re-deployed to the project. The capital cost of the ROS project included software development costs, infrastructure, and marketing, which were estimated at €43 million (C&AG 2007).

Revenue has consistently invested in ICT, with approximately 250 staff directly employed in the ICT section from a workforce of approximately 6,000. A review of the ten year period from 2003 to 2012 shows that the average total annual budget was €407 million. This includes the average annual ICT cost of €48 million (12%) shown in Figure 8-10. The annual running cost of ROS comprises system maintenance and
development, and was almost €5 million during this period, which is close to 10% of overall ICT costs, or 1% of the total Revenue budget.

8.10. ROS Stakeholder Analysis

Stakeholder management surfaced as a key theme, and a stakeholder analysis was carried out for the ROS project (cf. Appendix F). Almost 80 stakeholder roles were identified using the stakeholder analysis approach defined by Alexander (2005), and these are described in detail in Table F-1. An analysis was carried out against sixteen separate criteria for knowledge and involvement in ROS (cf. Table F-2), and the results are shown in Table F-3, and ranked in Table F-4.

This analysis demonstrated that there are at least 28 separate stakeholder groupings involved in ROS (cf. Table 8-8). The top four stakeholders based on knowledge and involvement are all within the Revenue organisation, which suggests that the primary stakeholder is Revenue. The second key groups of stakeholders that feature at the top of the list are taxpayers, tax agents and representative bodies such as TALC, the Customs Consultative Committee (CCC) and the Law Society. These groups were involved in the ROS consultation process from the beginning and throughout the project, which suggests the secondary key stakeholder is the taxpayer.
The third group of stakeholders is the core ROS project team, including system analysts, designers, architects, technical writers, Accenture, and also the marketing team. Other interested stakeholder groups include accountancy firms, software firms, the ICT community, the Irish Government, and also tax authorities in other countries. This third group have commercial, professional and other interests in ROS.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Stakeholder Role</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Revenue Commissioners</td>
</tr>
<tr>
<td>2</td>
<td>Revenue Staff</td>
</tr>
<tr>
<td>3</td>
<td>ROS Liaison Officers</td>
</tr>
<tr>
<td>4</td>
<td>ROS Strategy Manager</td>
</tr>
<tr>
<td>5</td>
<td>Tax Advisory Liaison Committee (TALC)</td>
</tr>
<tr>
<td>6</td>
<td>Revenue ICT Manager</td>
</tr>
<tr>
<td>7</td>
<td>Customs Consultative Committee (CCC)</td>
</tr>
<tr>
<td>8</td>
<td>Financial &amp; Tax Software Firms</td>
</tr>
<tr>
<td>9</td>
<td>Business Analysts</td>
</tr>
<tr>
<td>10</td>
<td>Law Society</td>
</tr>
<tr>
<td>11</td>
<td>Requirements Analysts</td>
</tr>
<tr>
<td>12</td>
<td>System Analysts</td>
</tr>
<tr>
<td>13</td>
<td>Tax Agents</td>
</tr>
<tr>
<td>14</td>
<td>Systems Designer</td>
</tr>
<tr>
<td>15</td>
<td>Systems Architect</td>
</tr>
<tr>
<td>16</td>
<td>Taxpayers (PAYE, self-employed, corporate)</td>
</tr>
<tr>
<td>17</td>
<td>Technical Writer</td>
</tr>
<tr>
<td>18</td>
<td>Accenture &amp; Baltimore &amp; Lancomms Staff</td>
</tr>
<tr>
<td>19</td>
<td>Marketing and Publicity Staff</td>
</tr>
<tr>
<td>20</td>
<td>Revenue Board</td>
</tr>
<tr>
<td>21</td>
<td>Revenue Chairman</td>
</tr>
<tr>
<td>22</td>
<td>ROS Helpdesk Staff</td>
</tr>
<tr>
<td>23</td>
<td>Firms of Accountants &amp; Tax Consultants</td>
</tr>
<tr>
<td>24</td>
<td>Revenue Computer Branch</td>
</tr>
<tr>
<td>25</td>
<td>ROS Maintenance Staff</td>
</tr>
<tr>
<td>26</td>
<td>ROS Operational Staff</td>
</tr>
<tr>
<td>27</td>
<td>Software/Hardware/PKI/Comms Developers</td>
</tr>
<tr>
<td>28</td>
<td>Tax Authorities in Other Countries</td>
</tr>
</tbody>
</table>

The analysis illustrates that while there are a wide range of stakeholders involved in ROS, the two key stakeholders are Revenue and taxpayers. The evidence from the research indicates a good working relationship between these two groups on the ROS project, with two-way collaboration at each step of the process. It is clear from the interviews that this degree of interaction between Revenue and taxpayers, both in formal consultations and through ROS liaison officers, had a significant impact on the adoption and diffusion of ROS, as “we never do anything without talking to our customers first” (ROS-IV 1). There are many concrete examples of stakeholder engagement throughout the ROS project, involving a wide range of stakeholders. These include the activities of TALC and CCC, and also regular consultations with industry representatives over the requirements for ROS, such as the Society of the Irish
Motor Industry (for Vehicle Registration Tax in 2002); the Construction Industry Federation (for Relevant Contracts tax in 2010); and the professional Accountancy bodies (for iXBRL in 2013). Other stakeholder engagement activities included the appointment of ROS liaison officers nationwide, the training roadshow and the establishment of a ROS helpline. The regular information channels for stakeholders Tax Briefing and eBrief were supplemented by marketing campaigns for ROS. The evidence from the ROS case study suggests that the stakeholder management strategy used by Revenue created a “receptive context” (Stetler et al. 2009, p2) which contributed to the adoption of ROS.

Finally, Pettigrew and Whipp (1991) suggest that a study of the interaction of stakeholders within the CCP dimensions over time provides clues to the factors behind strategic changes, and this is explored in detail in Chapter 9. A brief overview of stakeholder groups within the CCP dimensions can be provided by using the onion model concept popularised by Alexander (2005), and this is illustrated in Figure 8-11.

Figure 8-11: Stakeholders within CCP dimensions in onion model
8.11. Summary of the ROS Project

In the late 1990s, Revenue embarked on ROS. This was a strategic national project to transform tax returns and payments from a manual system to a national on-line system. This significant undertaking involved over 3 million taxpayers and agents nationwide. ROS was launched in 2000 and Revenue focused on the business community in the first five years, with priority given to the most common taxes in the early years such as PAYE/PRSI, VATx, ITx, CTx, and GGTx.

Revenue used an incremental development and phased implementation approach, concentrating on the most common business taxes in the early years, and gradually moving to the employee sector from 2006. By 2012, the ROS website had almost 20 million visits, processed almost 5 million tax return transactions, 1.3 million payments and €36 billion in tax receipts, accounting for 72% of all taxes and duties paid in Ireland. The capital cost of ROS was approximately €43 million, and the annual operating costs are approximately €5 million.

It is clear from an analysis of the data identified that ROS was widely adopted by the tax community, with the tipping point reached in the years 2003-2004 for the most common business taxes. Further adoption of ROS continues to increase, and the evidence from the mandatory eFiling project which started in 2009 suggests the trend towards full adoption of ROS for all taxes and payments will be achieved in the coming years. ROS “has become a mainstream national system, and is now the front door or post box for most tax returns” (ROS-IV 4).

In summary, Revenue’s strategy “think big, start small, scale fast” (ROS-IV 1) was effective and ROS was successfully adopted and diffused in Ireland. It is clear from the interviews and the literature that many stakeholders shared a wide range of benefits; and ROS has been acknowledged as a model of successful eGovernment (C&AG 2007).

How did Revenue achieve the successful development and adoption of ROS? This is an issue of central importance to the research question, and is addressed in Chapter 9 by examining the project in greater detail using the CCP framework, and comparing these findings to the Irish ePrescribing domain.
9. Cross-Domain Comparative Analysis – Ireland

“Analysis is the art of creation through destruction.” (P.S. Baber)

9.1. Introduction
From the evidence of the case study in Chapter 8, ROS was clearly a project which succeeded, but how did this occur? What prompted users throughout Ireland to adopt ROS? Was the development and adoption process linear and planned, or dynamic and uncertain? What were the critical success factors? How does the Revenue domain compare to the ePrescribing domain in Ireland? These questions are explored by applying the CCP conceptual framework in a cross-domain comparative analysis of the Revenue and eHealth domains.

The framework concentrates on the three dimensions that influence any major organisational change over time: the context, content and process of the change, while the interaction of stakeholders across all three dimensions plays a key role in explaining the adoption and outcome of the change. The context (internal and external) is explored initially (cf. Section 9.2), followed by the content (cf. Section 9.3). The process question is then addressed (cf. Section 9.4), and as stakeholders are central to the adoption process, a stakeholder comparison is included (cf. Section 9.5). The CCP framework has been used in case study research in many sectors for different types of strategic change (Hage et al. 2013, Ovretveit et al. 2012, Pettigrew 1985, Pettigrew et al. 1992, Pettigrew and Whipp 1991, Stockdale and Standing 2006), and a similar approach is used in this chapter.

9.2. Comparative Analysis – Context

9.2.1. External Context
An initial comparison of the two domains reveals that they are very different. The Irish national health model (cf. Section 7.1) is complex, with a fragmented provision of services in primary care by a number of agencies, including self-employed GPs and pharmacists, public health clinics and voluntary agencies. By contrast, the Revenue Commissioners operate a single central model, with one organisation and one service delivery model throughout the country. All Revenue’s operations are legislated and regulated, but in the eHealth domain very little legislation or regulation exists outside the data protection area. The Health Identifiers Act 2014 is a starting point for the development of specific Irish eHealth legislation, but this is a small part of a much
wider range of issues addressed in the proposed Health Information Bill in 2007, but this bill remains at the planning stages.

In the external context, public ICT infrastructures such as broadband and mobile communications are well developed in Ireland (ITU 2013), which Revenue employs to support ROS and other national services. However, in the eHealth domain this public infrastructure is not used for national ETP and ePrescribing purposes, but it is used in some regions for the transmission of eHealth data such as pathology results and oncology referrals (Healthlink 2011).

Changes in the external context such as new political structures, changes in government, new management structures in health, recession, and so forth have a profound effect on the eHealth area. As an example, very little progress was made in delivering the national eHealth strategy of 2004, in part due to the major reforms in the Irish health services following the establishment of the HSE in 2005. In contrast, Revenue manages external uncertainty in a strategic way by advanced planning, and has turned major external changes into facilitators to promote and develop ROS. A summary of these factors is shown in Table 9-1.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Irish Revenue Domain (ROS)</th>
<th>Irish eHealth Domain (ePrescribing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National model</td>
<td>Single service independent of government</td>
<td>Mix of NHS, SIS, NHIS &amp; OOP; mixed public-private model; complex &amp; fragmented</td>
</tr>
<tr>
<td>Organisation of national service</td>
<td>Single model of service in regional offices throughout the country</td>
<td>Primary care services are delivered by a number of agencies; fragmented with poor integration of information</td>
</tr>
<tr>
<td>National legal and regulatory environment</td>
<td>Revenue service entirely legislated and regulated</td>
<td>General data protection and health identification legislation, but little specific eHealth legislation or regulation</td>
</tr>
<tr>
<td>National ICT environment</td>
<td>Revenue exploit the Internet as common platform for ROS</td>
<td>Poor use of national ICT infrastructure, little eHealth data transmitted, ETP not available</td>
</tr>
<tr>
<td>External political &amp; economic changes</td>
<td>Revenue build changes into plans; use as opportunity to promote and adopt ROS</td>
<td>Recent reforms and external changes to the national health service have been barriers to national eHealth strategy; roles in national eHealth slowly emerging</td>
</tr>
</tbody>
</table>

This comparison illustrates that the eHealth domain is affected to a high degree by factors in the external context, and these have been barriers to ePrescribing in Ireland. Similar external factors have been exploited by Revenue in the ROS project, and a review of the Revenue strategy in the ROS case study is presented in the remainder of this section.
In the late 1990s, external factors in the Revenue domain included pressure from some stakeholders for an electronic tax system, widespread use of the Internet and the 1997 eGovernment strategy (ISC 1997). During this period the Y2K problem, the launch of the new Euro currency and the change to the official tax year in 2001 also had an impact on the normal Revenue operations. In this environment, Revenue designed and launched the ROS project in consultation with key stakeholders. Revenue was aware of the external factors, and the potential risk they posed to the new national on-line taxation service. However, Revenue viewed these factors as an opportunity to proceed with change, and viewed ROS as a long term project which could cope with such change, uncertainty and risk over time.

The economy of Ireland grew significantly from 2000-2007, and from 2008-2013, it experienced a severe economic recession. This external context provided Revenue with different challenges in the ROS project, especially after 2008 when national tax revenue fell by 28%. However, it was clear from the interviews that Revenue had considered (and legislated for) a mandatory eFiling programme from 2003, and following consultation with stakeholders, implemented this programme in 2009, during the economic crisis. This had the effect of increasing the adoption of ROS across all taxes and payments during a period of severe economic challenge (cf. Figure 8-9), when adoption may have fallen if different policies were employed.

Following the economic recession and the International Monetary Fund (IMF) assistance programme to Ireland (2010-2013) several changes were made to the tax system including the introduction of the LPTx in 2013. While this tax was intended for local authority use, it fell to Revenue to create a system for LPTx. This project was completed in nine months using the approach and architecture developed for the ROS project. LPTx was an unpopular tax, but the strategy of Revenue was to make the LPTx system “easy to use but difficult to avoid” (ROS-IV 4). The LPTx system went live in June 2013 and within six months 94% compliance had been achieved (76% on-line).

This degree of adoption from the public for a mandatory tax was without precedent, and illustrated the maturity in Revenue’s policy approach to developing and promoting a national system. A synopsis of the LPTx project is provided in Appendix E.
The evidence from the research and the interviews suggests that Revenue’s inner context was very responsive to changes in the outer context. The inner context strategically changed elements of the ROS project, in consultation with stakeholders, to bring ROS into concord with events in the external context. Examples of this are the launch of a dual-currency ROS system during the Euro changeover; the early focus on business taxes; the later focus on PAYE; and the rollout of the LPTx in 2013. The approach to mandatory filing is a good example, as Revenue considered mandatory eFiling from the beginning, and passed legislation in 2003, but used a “carrot, not stick approach; you must bring stakeholders along” (ROS-IV 1) as ROS developments unfolded.

In contrast, the inner context of the Irish eHealth domain appears to be more easily influenced by changes in the outer context. The reasons for this are explored in the next subsection in a review of the inner context.

9.2.2. Internal Context
A comparison of both domains reveals very different inner contexts, similar to the analysis of the outer context. Revenue is a single national organisation with a long-established well-organised inner context, including sections responsible for national ICT projects, legislation and marketing. The ROS project was engineered within those structures. Revenue manages “the largest public data warehouse in Ireland” (ROS-IV 4), invests heavily in ICT (12% of annual budget), uses internal budgetary control systems, and employs formal project management methods to manage national projects. Funding for projects is justified on the basis of savings or efficiencies which are formally evaluated, and the ICT strategies and project outcomes are published annually in the public domain. It was clear that Revenue employed many private sector management principles and techniques (Scott and Robbins 2008), which helped to create a strong inner context.

In contrast, the inner context of the Irish eHealth domain is fragmented. A number of organisations are involved in public eHealth projects including the HSE and the DoH&C; HIQA develop national HI standards; Healthlink provides data transmission services; the GPIT group certifies EHR software; the IPU and the IMB are interested stakeholders from the pharmacy sector; and other groups such as the Economic and Social Research Institute (ESRI) and the Health Research Board (HRB) maintain national registries of health data. However, there is no single “unifying body or health
system integrator” (Protti et al. 2009a, p21) responsible for national eHealth projects in Ireland. This situation has created a weak and fragmented inner context in the eHealth domain, and many essential building blocks for eHealth and ePrescribing are addressed in an uncoordinated way, or not addressed at all, as “nobody takes the lead in Ireland” (IE-IV 3). Consequently, the organisation, funding, accountability and transparency of national eHealth projects have suffered. The HSE has made progress with some national eHealth projects in public hospitals such as NIMIS and the Hospital In-Patient Enquiry System (HIPE), but these are the exceptions rather than the rule. The 2004 eHealth strategy has made little progress, and the level of public investment in national eHealth projects has been very small – less than 1% of the annual HSE budget over the previous decade (compared to 12% by Revenue). This is perhaps a direct result of a weak and fragmented inner context. These factors are compared in Table 9-2.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Irish Revenue Domain (ROS)</th>
<th>Irish eHealth Domain (ePrescribing)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>National institute</strong></td>
<td>Single organisation with strong inner context; ROS project was established as a new separate Revenue section</td>
<td>No national eHealth institute. Many fragmented groups -HSE; HIQA; DoH&amp;C; GPT; IMB; IPU; Healthlink;</td>
</tr>
<tr>
<td><strong>National ICT strategy and leadership</strong></td>
<td>Revenue publish regular ICT strategies &amp; invest heavily in ICT (12% of budget); Revenue provided leadership from the top, e.g. Strategy Manager role</td>
<td>2004 eHealth strategy made little progress (ICT is less than 1% of budget); 2013 eHealth strategy plans to build capacity with new national institute, projects and increase ICT investment</td>
</tr>
<tr>
<td><strong>Funding model</strong></td>
<td>ROS is funded from the annual Revenue budget plan justified by savings</td>
<td>HSE &amp; DoH&amp;C fund eHealth from public resources; unclear justification of eHealth</td>
</tr>
<tr>
<td><strong>Accountability &amp; Governance</strong></td>
<td>ROS project was managed under established Revenue budgetary systems</td>
<td>Accountability for eHealth projects fragmented among various groups</td>
</tr>
<tr>
<td><strong>Transparency in national projects</strong></td>
<td>Most information on ROS project in public domain</td>
<td>Little transparency in national eHealth projects</td>
</tr>
</tbody>
</table>

This comparison shows a strong inner context in the Revenue domain when compared to the eHealth domain. A brief review of the ROS inner context from the case study is presented in the remainder of this section.

Revenue created an internal environment for the ROS project which facilitated the management and control of the entire project. The strategic preparations (cf. Section 8.2) prior to the launch of ROS created the context for the long-term development and implementation of a national system. Revenue had a long history of national computer projects, and systems of governance, project management, budgeting and public accountability were in place and were embedded in the ROS project: “every division
has an annual budget which must be justified, and is used to manage projects; overspending on projects was out of the question, any additional cost had to be justified in terms of savings or efficiencies” (ROS-IV 1).

Strategic actions such as the initial separation of the ROS project team from the mainstream Revenue activities; the creation of new roles for the ROS project; a shared approach to software development; and the gradual implementation of on-line services, indicate a tightly controlled yet dynamic internal environment. This dynamic was clear from the interviews, covering areas such as stakeholder consultation, software development, marketing and legislation for ROS.

It was clear that Revenue “does nothing without legislation” (ROS-IV 2). Revenue have a long-established service that drafts legislation each year based on the annual budget and the subsequent Finance Acts (Revenue-Commissioners 2007b). The legislative framework for the ROS project was created in 1998-2000 when Revenue drafted legislation designed to cater for ROS activities and electronic communication with taxpayers (cf. Section 5.2.4). This legislation also paved the way for the wider use of eGovernment and eCommerce in Ireland. In subsequent years this legislation covered other aspects of ROS, such as mandatory filing, RCTx and LPTx. As a result of this framework, ROS was on a firm legal footing from the beginning. Revenue drafted legislation for ROS (inner context) to create the legal environment for ROS (outer context), and in this way exercised a degree of control over the external legal environment for ROS.

Revenue is a single organisation responsible for the national tax collection system, independent of the political system. Revenue managed the development of ROS in the internal context without undue influence or pressure from the external context, and this was a factor in the ROS project: “Revenue is independent of the political system and that really helped ROS” (ROS-IV 1). The freedom from political pressures in the ROS project is in contrast to other eGovernment and eHealth projects in Ireland which suffered as a result of such pressure (C&AG 2007).

This analysis suggests that the inner context of the Revenue domain had a positive impact on the development and adoption of ROS. On the other hand, the inner context of the eHealth domain is fragmented, and the development of national ePrescribing systems and services has not yet commenced, and faces many challenges.
While the contexts of the two domains are very different, the content (technical, legal and support artefacts) of national electronic systems may be similar. This question is examined in the next section in a review of the content.

9.3. Comparative Analysis – Content

National eGovernment and eHealth services share similar components. These include the ICT artefact (hardware, software, communications), and the supporting content that surrounds and governs the service such as national authentication and data protection systems; unique identification systems; secure national networks for data transmission; specific legislation; and local regulations.

When comparing the ICT content in the Revenue and eHealth domains, it is clear that technically, ROS is a simpler system than an ePrescribing system. ROS is provided to users as an interactive website and an off-line application, and many Irish financial and tax software packages now include a ROS compliant export format. In contrast, ePrescribing requires complex interoperability between prescribers and pharmacists through national networks and databases, using a common drug database and ETP services. Consequently the technical components required for ePrescribing, although similar, are more complex.

When comparing the supporting content between the domains, many differences in the basic building blocks appear. Revenue established ROS with authentication based on a national unique identification system. ROS was developed using open technical standards to operate on a secure national network over the Internet using PKI technology, with embedded legislation and a national technical support service provided to all users.

In comparison, the eHealth domain reveals significant gaps at the national level. Legislation has been passed in 2014 for a national unique identification system for eHealth purposes in Ireland, but the implementation of this service to the whole population and within the eHealth domain will take some time. Specific eHealth legislation to govern the privacy, confidentiality, transmission, storage and use of digital health data does not exist yet. Although Healthlink is making regional progress, a secure national network for ETP is not developed, and there are no equivalent national support systems in place for users. In the software development area, HIQA is involved in developing national eHealth technical standards, which are now used by most
software suppliers in developing their products, along with the certification standards set by the GPIT group (GPIT 2007). In summary, it is clear that some key technical components for a national ETP service are not developed yet, and this finding is in accord with the fragmented eHealth domain. The comparison of these factors is shown in Table 9-3.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Irish Revenue Domain (ROS)</th>
<th>Irish eHealth Domain (ePrescribing)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User software</strong></td>
<td>Interactive website; ROS offline application; financial and tax software interoperate with ROS</td>
<td>GP EHRs &amp; Pharmacy EHR Systems; technically complex; limited interoperability; no ETP</td>
</tr>
<tr>
<td><strong>Unique identifiers</strong></td>
<td>PPSN, TAIN</td>
<td>Legislation passed in 2014, but not implemented yet</td>
</tr>
<tr>
<td><strong>Common technical standards</strong></td>
<td>Open technical standards used to develop ROS</td>
<td>HIQA publishes and develops standards; HL7 in use in some settings</td>
</tr>
<tr>
<td><strong>Secure national network</strong></td>
<td>Based on Internet technology using PKI &amp; formal registration systems</td>
<td>Fragmented regional networks; Healthlink operate in some regions; no secure national network developed to support ETP</td>
</tr>
<tr>
<td><strong>Legal content</strong></td>
<td>Legislation prepared by Revenue on an ongoing basis; specific ROS legislation;</td>
<td>No specific eHealth legislation; health information bill in draft form since 2008</td>
</tr>
<tr>
<td><strong>User supports</strong></td>
<td>National ROS helpline, ROS training, ROS liaison officers</td>
<td>No equivalent national support system developed for primary care</td>
</tr>
</tbody>
</table>

Revenue’s approach to the software development and security aspects of ROS provides some illuminating contrasts to similar developments in the eHealth domain. ROS was developed as a public-private partnership between Revenue and Accenture with Revenue as “the senior partner” (ROS-IV 3). The ROS software was developed and released in phases, with each phase building on the previous (live) phases. Revenue was in control of the developments and releases, and all software was written to detailed specifications. This development strategy “reduced the risk and cost when compared to acquiring a complete solution up-front” (ROS-IV 1).

Revenue wished to capitalise on the widespread availability of the Internet, and ROS was designed as an interactive website. In so doing, Revenue developed a technological solution that could support multiple platforms; was flexible; secure; easy to use; and could be integrated with Revenue’s existing internal systems. Revenue consulted with multiple stakeholders in the design of ROS, and security and usability emerged as the top two requirements, as “security was our top priority” (ROS-IV 3). ROS was designed and tested to meet these specific requirements.
The chosen technology was a range of off-the-shelf products from established international technology companies. Accenture and Revenue together built the national ROS system from these components which were chosen for their openness and scalability. ROS supported multiple browsers and ran on multiple platforms, and ROS data was technically separate from Revenue internal systems for security reasons.

ROS serves the entire population including a large number of taxpayers and a relatively small number of professional practitioners scattered throughout the country, such as accountants, tax advisors and revenue officials. The data recorded is sensitive (personal, corporate, financial and taxation) and consequently data protection regulation and data privacy laws are key elements of ROS. The security of ROS was the “the most critical issue in the development of ROS” (ROS-IV 1); with over three million potential users of ROS, a failsafe security system was a mandatory requirement.

The eventual technical security solution chosen for ROS was a combination of PKI, SSL and encryption technologies; digital certificates; and supporting legislation for encrypted data transmission and digital signatures. ROS operates within the PKI environment, which is designed to control access and ensure the integrity, confidentiality and non-repudiation of all ROS transactions. The formal application system for ROS users to apply for a digital certificate which included Revenue issuing two letters by post is another security measure. This has had the effect of limiting digital certificates to genuine taxpayers and tax agents. All of these measures combined to provide ROS with an effective, robust security system, and there have been no known breaches of the ROS security system: “ROS has never been hacked, they just can’t get in” (ROS-IV 5).

By contrast, very limited software development has been carried out in the Irish eHealth domain, where national projects have been subject to public tender, with the successful (external) supplier providing the entire solution. A case in point is the NIMIS project which was a public tender, awarded to McKessons Inc. who provided the entire software suite, including the software to manage the national image archive. This is the default approach for national HSE eHealth projects, (e.g. Breastcheck mammography system, laboratory information management system, blood tracking system) with little or no public-private software development equivalent to the ROS project.
This comparison has uncovered substantial differences in the content of national systems between the two domains, consistent with the differences found in the outer and inner contexts. An analysis of the process of adoption follows, where further differences are explored.

9.4. Comparative Analysis – Process

The process of implementation and adoption of national systems and services is naturally complex, and it can take years or decades for a system to become embedded and fully adopted by users. The ROS case study provides good data about the adoption process since 2000, but comparative data in the eHealth domain is limited to a few national eHealth projects where data has been published.

When a comparison is made using common factors, differences are evident in the process between the two domains. Revenue employ a middle-out approach to national systems, which is characterised by central government working in close collaboration with all stakeholders (including the private sector) to achieve close communication and useful ICT solutions (Bowden and Coiera 2013). This was evident in the ROS project, where stakeholder engagement was embedded from the beginning. This included extensive engagement with the ICT industry, and social marketing campaigns targeting stakeholders and the general public. In contrast, recent national projects in the eHealth domain have been characterised by top-down approaches (e.g. NIMIS and PPARS), stakeholder engagement has been poor, engagement with the ICT sector has been by way of public tenders for package solutions, and social marketing has not been a feature of any national project.

When the process is considered from the viewpoint of the users, further differences are evident. Revenue employed a voluntary opt-in policy for ROS, and chose not to follow a mandatory policy until adoption reached critical mass after ten years, and then following extensive stakeholder consultation. ROS operates in a clearly defined data privacy environment where digital certificates for all users are computer-specific, and a range of national supports are provided free of charge to users including: ROS liaison officers; training services; eMail support; and helplines. Revenue did not use financial incentives to promote ROS, but instead provided cashflow benefits to business users who filed through ROS.

132
In the eHealth domain, cashflow incentives similar to ROS exist for prescribers and pharmacists in primary care to submit claims electronically to the Primary Care Reimbursement Service (PCRS), but no obvious incentives exist to adopt ePrescribing or develop ETP. The evidence to date for national eHealth systems such as PPARS and NIMIS is that a mandatory approach was employed, but this varies with individual projects. In a similar way, the technical support required for national projects is provided by external suppliers, as no national support service for primary care ICT has been developed in the eHealth sector yet.

Data privacy, confidentiality and consent are key issues for patients in managing their data electronically, but the technical-legal environment in Ireland does not actively support electronic sharing of patient data, and the existing framework assumes paper records are used by default. Consent from patients to use electronic records is limited to the data recorded in individual institutions including GP offices, pharmacies and hospitals, with opt-out as the default for most institutions. The existing data protection legislation covers this situation at the institution level, but does not provide for the transmission or sharing of electronic health data. Consequently, there is no comprehensive legal framework for the provision of national ETP services. A summary of these comparative factors is shown in Table 9-4.

<table>
<thead>
<tr>
<th>Factor</th>
<th>Irish Revenue Domain (ROS)</th>
<th>Irish eHealth Domain (ePrescribing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project approach &amp; Implementation strategy</td>
<td>Middle-out approach; incremental implementation strategy;</td>
<td>Top-down (e.g. PPARS, NIMIS) and bottom-up (e.g. GPIT); different implementation strategies</td>
</tr>
<tr>
<td>Stakeholder engagement &amp; management</td>
<td>Permanent engagement on ROS project (e.g. TALC)</td>
<td>Fragmented inner context, poor organisation, poor stakeholder management, HIQA making progress</td>
</tr>
<tr>
<td>Engagement with ICT &amp; software industry</td>
<td>Public-private software development of ROS; ongoing engagement with ICT industry</td>
<td>HSE engagement is through public tenders (e.g. NIMIS); limited engagement with ICT industry</td>
</tr>
<tr>
<td>Marketing, promotion &amp; Publicity</td>
<td>Social marketing campaigns for ROS, detailed information provided to all ROS stakeholders</td>
<td>Social marketing not used for national eHealth purposes by DoH&amp;C or HSE</td>
</tr>
<tr>
<td>Incentives</td>
<td>No financial incentives to use ROS; extended payment deadline; quicker tax refunds; on-line tax calculation facilities</td>
<td>Faster processing of claims by GPs and community pharmacists from national reimbursement schemes; no obvious incentives for ePrescribing or ETP</td>
</tr>
<tr>
<td>Mandatory or Voluntary use</td>
<td>Not mandatory for first 10 years of ROS; mandatory use by 2016</td>
<td>Depends on project (e.g. NIMIS and PPARS mandatory)</td>
</tr>
<tr>
<td>User supports</td>
<td>National ROS helpline, ROS training, ROS liaison officers</td>
<td>Provided by external suppliers for national systems</td>
</tr>
<tr>
<td>Consent management</td>
<td>Opt-in for ROS, mandatory use for all taxpayers from 2016</td>
<td>No national policy/opt-out is default for patients</td>
</tr>
<tr>
<td>Data privacy &amp; confidentiality</td>
<td>Integrated technical-legal framework for ROS</td>
<td>No legal framework for ETP; framework for paper prescriptions</td>
</tr>
</tbody>
</table>
Again, there are substantial differences between the domains. A review of the Revenue implementation strategy may illuminate the process of ROS adoption. The strategy for the ROS project was “think big, start small, scale fast” (ROS-IV 1). Revenue implemented ROS in three distinct phases: the business tax sector (2000-2005); the PAYE sector (2006-2010); and a consolidation of ROS and mandatory electronic filing (2011-2016). In each of the three phases the development and implementation of ROS was incremental, and software was released every six months or so including additional taxes and new product features. As a result, ROS was phased in slowly over time, and not all at once.

While stakeholder consultation was an ongoing feature of the ROS project, Revenue also undertook specific activities to support the process of implementation, adoption and diffusion of ROS. These included the provision of substantial volumes of public information to stakeholders about ROS as it progressed, including Revenue objectives, technical issues and system changes as they occurred. For example between 2004 and 2012, 642 eBriefs were published covering a vast range of technical tax matters. ROS topics accounted for 177 (28%) of the eBriefs, which is an indication of the central role ROS has come to occupy in the mainstream tax system.

This degree of openness about ROS was consolidated by a professional social marketing campaign, which was created to promote ROS as a normal commercial software product. The normalisation of ROS also included Revenue establishing a national ROS helpline and appointing approximately 120 ROS liaison officers in all tax districts who were “the key to national adoption” (ROS-IV 3). Finally, a mobile ROS training unit (the ROS roadshow) visited all tax districts in the early years to provide hands-on training for users. ROS was promoted as a typical software product, but the registration, training and use of ROS was (and remains) free to all users.

Revenue took a systematic approach to supporting the implementation process, but problems occurred. In the early years for example, the on-line traffic for ROS services exceeded the technical capacity at peak times such as 2003 and 2005 (Lawlor and Murray 2005); and the new PAYE on-line service in 2006 was found to be unwieldy and was re-designed and re-branded as PAYE Anytime in 2008. Revenue was open about these problems in their communications with ROS stakeholders, which was consistent with a policy of transparency.
This cross-domain comparison illustrates differences in the inner context and the approach to stakeholder management. As stakeholder collaboration, communication, and engagement has surfaced as a key factor, a brief comparison of stakeholder groups in both domains is presented in Section 9.5.

9.5. **Comparison of Stakeholder Groups**

There are many ways to analyse stakeholder groups in healthcare (Roberts et al. 2002), and the mapping technique employed by Barber et al. (2010) highlights the high number of stakeholder groups and the complexity of relationships in ePrescribing (cf. Section 2.7). The mapping technique involves the selection of stakeholder groups and relationships, and also the inevitable omission of some groups and relationships (Barber et al. 2010). Using this method and acknowledging this limitation, it is possible to construct illustrative maps of the stakeholder groups in the Irish (paper-based) prescribing domain (cf. Figure 9-2), and also for ROS (cf. Figure 9-1), as the ROS stakeholder groups were identified in Section 8.10.

The inner context comprises the authorities that provide the national prescribing or ROS services and the actual users of the service – while the outer context comprises all other stakeholder groups. It is clear that the inner context can influence and be influenced by the outer context, and the mapping technique provides a useful way to compare these contexts. These maps are shown in Figure 9-1 and Figure 9-2.

![Figure 9-1: Stakeholder map - ROS](image-url)
In Figure 9-1, the professional relationships between the taxpayers, accountants and Revenue is supported by a single database to which all parties have access. This creates a very tightly integrated inner context between all parties. In Figure 9-2, the relationships are more complex: the patient is the transmitter of information; there are commercial relationships; and there are reimbursement systems for prescribers and pharmacists to manage. However, there is no single database available to all parties as in Figure 9-1, and there is no central authority for ePrescribing, as one interviewee noted “nobody takes the lead in Ireland” (IE-IV 3).

In both diagrams, there are a limited number of parties involved in the central transaction: the taxpayer; tax agent and Revenue for ROS; and the prescriber, patient and pharmacists for prescribing; which respectively comprise the inner context. In both cases, there are several surrounding stakeholder groups. These comprise different groupings such as: national authorities and government; regulatory bodies; professional organisations; trade unions; other medical providers; representative bodies; ICT suppliers; industry bodies; the general public; and so forth. These comprise the outer context. This comparison demonstrates that a large number of diverse (yet similar) stakeholder groups are involved in both domains. Although these groups may be peripheral to the central transaction, the evidence from Chapters 7 and 8 suggest that in order to implement a national system or service it is necessary to manage and engage with many complex groups of stakeholders.
9.6. Cross-Domain Comparison – Emerging Themes

The questions posed at the beginning of this chapter focused on how Revenue achieved national adoption of ROS, and how the Irish eHealth domain fared by comparison. In the analysis and comparison of the domains, the ROS adoption process has become clearer and several themes come to light.

The first theme is the strength and coherence of the inner context of ROS, in contrast to the fragmented inner context in the eHealth domain. The leadership in Revenue was clearly effective, and the ROS inner context was shaped by early strategic decisions, such as the separation of the project from the mainstream Revenue operation and the shared approach to systems development with the private sector. The ROS project was free from external political pressure (unlike the eHealth domain) which seems to have provided Revenue with the environment to manage the ROS project through the dynamic and changing external context. This included the launch of ROS in an unstable fiscal environment, and the increased adoption of ROS during the economic crisis of 2008-2014.

A related theme that surfaced is the way that Revenue’s inner context played a key role in shaping the outer context to create a positive context for users to adopt ROS. This finding is in contrast to the eHealth domain, where events in the outer context influence the inner context to a greater degree, which can become barriers to the development of national eHealth systems and services. Revenue influenced the external context with investment in open technology across platforms; a national support infrastructure for users; social marketing; and legislation drafted to guarantee data privacy and confidentiality. In all these activities, Revenue contributed to a favourable environment for the adoption of ROS.

The evidence suggests that the process of adoption and diffusion of ROS was facilitated by the quality of the ROS artefact. The security and usability of ROS was the top priority in the development of the system, and the shared public-private development was a factor in Revenue’s control and ownership of ROS. Research in the IS field suggests IS quality, information quality and support service quality have a strong correlation with actual use and user satisfaction (DeLone 2003). The ROS website was examined in a study by Connolly and Bannister (2010) who found that taxpayers and tax agents registered a high level of satisfaction with ROS. The efficiency and ease of
completion of tax returns and payments were found to be the key factors for users in adopting ROS. Little comparative data exists for national projects in the Irish eHealth domain as there are few similar projects in operation. However, it must be acknowledged that the ePrescribing and ETP environment is technically more complex than the ROS environment.

The final, and arguably the most critical theme, is the degree of stakeholder engagement in the ROS project. This is a recurring theme throughout the case study. Revenue used pioneering techniques such as the frequent publication of information about ROS, social marketing campaigns, a mobile training unit and a national roadshow, the appointment of ROS liaison officers, and a helpdesk. The process of adoption and diffusion of ROS was incremental and iterative, but the techniques and strategies used by Revenue supported stakeholders to make the transition to ROS steadily over time. All the research evidence – interviews, literature and reports – suggest that stakeholder consultation and the availability of public information were key factors in the success of the ROS project.

By comparison, stakeholder management in the eHealth domain has traditionally been poor in the fragmented inner context. In recent years HIQA have made some progress and have undertaken formal stakeholder engagement on a range of eHealth topics, including ePrescribing. However, as Figures 9-1 and 9-2 illustrate, there are many stakeholder groups involved in national systems, and the evidence suggests a strong inner context is required to co-ordinate and engage with all of these groups.

9.7. Summary
The cross-domain comparison using the CCP framework reveals significant differences between the domains. In the Revenue domain, ROS developed over 15 years into a comprehensive suite of feature-rich, on-line applications, where taxpayers operate within a well-established legal, regulatory and security framework. In the eHealth domain, a national ePrescribing service has not been developed, and many challenges are apparent. Four interrelated themes came to light from the comparison:

- A strong, dynamic inner context which provides leadership, management and coordination of national projects is the key factor in the domain.
- A strong inner context can influence the outer context to create a positive environment and a receptive context for the development and adoption of national systems and services.

- The quality of the content in terms of technology, usability, security, legal certainty and national supports is a key adoption factor for users.

- Stakeholder management plays a critical role in the process of development and adoption of national systems and services.

The findings in this comparison are consistent with the central concepts of stakeholder theory suggested by Donaldson and Preston (1995, p67) that “corporations practicing stakeholder management will, other things being equal, be relatively successful in conventional performance terms”. Based on the evidence of the ROS case study it can be argued that Revenue, primarily through stakeholder management, carefully aligned the content, context and process over time, which resulted in the nationwide adoption of ROS. In a recent study on eHealth adoption, the authors argue that “… too often, eHealth adoption fails due to underestimating implementation factors and their interactions. We argue that rural eHealth implementation only leads to sustainable adoption (i.e. it sticks) when the implementation carefully considers and aligns the eHealth content (the clicks), the pre-existing structures in the context (the bricks), and the interventions in the implementation process (the tricks) (Hage et al. 2013, p14).

How do the lessons from the cross domain comparison in general and the ROS project in particular compare with the experiences in the wider European ePrescribing domain? This question is explored in Chapter 10, where a comparative analysis of the leading ePrescribing countries is presented, and the findings from ROS are included for further comparison.
PART FOUR: Comparative Analysis and Reflections

In which we undertake further comparisons of the subject matter, reflect on the findings, reach logical conclusions and complete the work.
10. Comparative Analysis – ePrescribing Leaders in Europe

“Even if one is interested only in one's own society, which is one's prerogative, one can understand that society much better by comparing it with others.” (Peter L. Berger)

10.1. Introduction

10.1.1. Resume

Chapter 4 found that ePrescribing is gaining traction in Europe. A correlation with EHR use was found, and five adoption groups were identified. Regional and population variations were found, and a north-south ePrescribing divide was observed. In Chapter 6, a high level comparison of the 31 countries discovered patterns in the areas of: national health models; legislation; national competence centres; national ePrescribing strategies; unique identifiers; technical standards; and implementation strategies. In this chapter the focus moves from the general to the specific, as the ePrescribing success stories in the leading countries are compared.

The countries with the highest adoption rates for ePrescribing are the three innovators and the five early adopters (cf. Section 4.3). These eight countries are selected for comparative analysis, and Table 10-1 shows data from Chapter 4 (Section 4.3 - adoption groups) and Chapter 6 (Figure 6-3 - national health model, eHealth rank and starting date) for these countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Adoption Group</th>
<th>National Health Model</th>
<th>eHealth Rank</th>
<th>National ePrescribing Project Started</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>Innovator</td>
<td>NHS</td>
<td>1</td>
<td>1999</td>
</tr>
<tr>
<td>Sweden</td>
<td>Innovator</td>
<td>NHS</td>
<td>8</td>
<td>1999</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Innovator</td>
<td>SIS</td>
<td>5</td>
<td>2002</td>
</tr>
<tr>
<td>Estonia</td>
<td>Early Adopter</td>
<td>TC</td>
<td>4</td>
<td>2010</td>
</tr>
<tr>
<td>Croatia</td>
<td>Early Adopter</td>
<td>TC</td>
<td>22</td>
<td>2011</td>
</tr>
<tr>
<td>Iceland *</td>
<td>Early Adopter</td>
<td>NHS</td>
<td>10</td>
<td>2009</td>
</tr>
<tr>
<td>Norway *</td>
<td>Early Adopter</td>
<td>NHS</td>
<td>3</td>
<td>2011</td>
</tr>
<tr>
<td>Finland</td>
<td>Early Adopter</td>
<td>NHS</td>
<td>6</td>
<td>2010</td>
</tr>
</tbody>
</table>

* non EU

The three innovators from Table 10-1 (Denmark, Sweden and the Netherlands) are a distinct group as their national ePrescribing services were developed over 20 to 30 years, with various pilot projects undertaken in all countries before national projects were launched around the year 2000 (Hämäläinen and Doupi 2008). The early adopter group
(Estonia, Croatia, Iceland, Norway and Finland) provide different insights as the national ePrescribing projects in these countries all started in recent years, as shown in Table 10-1.

What are the common threads that bind the leading countries together? A comparative analysis may reveal some of the answers and insights. Chapter 8 found that ROS was a pioneer in Irish eGovernment services, therefore ROS is included in the comparative analysis to provide a view from a different domain where relevant. The objective of the comparative analysis is to explore patterns in the data of the leading ePrescribing countries, having regard to their respective adoption groups. A second objective is to explore these parallels with ROS.

The CCP framework is used as a guide, and begins with a comparison of the external context in all countries, which highlights additional factors in the external context that are facilitators for ePrescribing. A strong inner context was found to be a key factor in the adoption of ROS, and a comparison of the organisation and status of the different internal contexts for ePrescribing follows. The quality of the ROS content was found to be a key factor in the user experience, and in ePrescribing this includes EHR interoperability, ETP services and national support arrangements; a review of this area provides further insights. Finally, the ROS adoption process was found to be multi-faceted, and a review of the process in the leading countries may highlight similar or different adoption patterns and factors.

10.1.2. Interview Data Sources

In 2010, I interviewed national experts responsible for the implementation and management of national ePrescribing services in Sweden, Denmark, and the Netherlands. These interviewees are listed in Table 10-2, with abbreviated references used in this thesis.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Country/Interviewee</th>
<th>Position</th>
<th>Organisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DK-IV 1</td>
<td>Denmark Interviewee 1</td>
<td>Deputy Manager</td>
<td>MedCom</td>
</tr>
<tr>
<td>DK-IV 2</td>
<td>Denmark Interviewee 2</td>
<td>Data Consultant ePrescribing</td>
<td>MedCom</td>
</tr>
<tr>
<td>SE-IV 1</td>
<td>Sweden Interviewee 1</td>
<td>Manager-Prescription Service</td>
<td>Apoteket AB</td>
</tr>
<tr>
<td>SE-IV 2</td>
<td>Sweden Interviewee 2</td>
<td>Chief Information Officer</td>
<td>Stockholms Lans Landsting</td>
</tr>
<tr>
<td>NL-IV 1</td>
<td>Netherlands Interviewee 1</td>
<td>Senior Policy Adviser</td>
<td>Nictiz</td>
</tr>
<tr>
<td>NL-IV 2</td>
<td>Netherlands Interviewee 2</td>
<td>Project Manager ePrescribing</td>
<td>Nictiz</td>
</tr>
<tr>
<td>NL-IV 3</td>
<td>Netherlands Interviewee 3</td>
<td>Senior Project Manager</td>
<td>Nictiz</td>
</tr>
</tbody>
</table>
10.2. ePrescribing Leaders: Comparative Analysis – External Context

Any analysis of the external context must take into account the state of ICT developments in each country. In recent decades a vast amount of increasingly complex, accurate and comparable ICT data has become available for many countries and regions worldwide. This data is used for many purposes, especially by policy makers in planning regional, national and international projects. It is also used extensively in research. For example, the ITU (a special agency of the United Nations) publishes annual reports on “Measuring the Information Society” since 2009. This report includes the ICT Development Index (IDI), which benchmarks ICT infrastructure, use and skills using 11 core indicators in 166 countries and six regions (ITU 2014). In the 2014 report, six of the eight leading ePrescribing countries rank in the IDI top ten: Denmark (1), Sweden (3), Iceland (4), Norway (6), Netherlands (7) and Finland (8). Further down the rankings are Estonia (21), Ireland (26), and Croatia (37).

A similar benchmarking report that has been published annually since 2001 is the “Global Information Technology Report” which includes the Networked Readiness Index (NRI). The NRI includes 53 separate indicators for 143 countries under four categories: environment (political, regulatory, business); readiness (infrastructure, affordability, skills); usage (individual, business, government); and impact (economic, social) (Dutta et al. 2015). In the 2015 report, four of the eight leading ePrescribing countries rank in the NRI top ten: Finland (2), Sweden (3), Netherlands (4) and Norway (5). Further down the rankings are Denmark (15), Iceland (19), Estonia (22), Ireland (25) and Croatia (54); while Singapore is ranked number one.

Other benchmark studies and reports have combined national ICT and eHealth benchmarks in an attempt to measure the eHealth environment in different countries. The EC has been active in this area (cf. Appendix A(1)), and a recent article by Currie and Seddon (2014) describes a study where 13 combined indicators were selected to measure eHealth readiness in 27 EU countries (Croatia was not in the EU when the study started). Six indicators measured ICT infrastructure (broadband and Internet) and seven measured eHealth applications and use among GPs in primary care. This study used data from the TEMPEST project, which is an independent academic research project that provides health data from multiple sources for comparative research (Currie 2012). The study identified four groups: the forerunners, which include Denmark, Netherlands, Sweden and Finland with the UK; the followers group of six which includes Estonia; the
**leapfroggers** group of nine which includes Ireland; and the **laggards** group of seven. Norway and Iceland did not feature in this study as they are not EU members.

All of the data from these benchmarking studies indicates that the leading ePrescribing countries have the most developed national ICT infrastructures, and are among the most computer-literate populations worldwide. The innovators – Denmark, Sweden and the Netherlands – all feature at the top of international ICT rankings and are forerunners in the use of eHealth in primary care. Iceland, Norway and Finland also feature at the top of international ICT rankings, but Estonia, Ireland and Croatia are further down the ranks in terms of national ICT development.

The organisation of primary care services is a national issue, which is closely related to the national health model in operation. A brief analysis suggests that primary care in NHS countries is more organised and integrated that in countries with other national models, although there are exceptions to this, such as the Netherlands (Björnberg 2014). One of the most striking aspects of primary care in Europe is the difference in the community pharmacy model between the leading and the following countries. For example, in absolute terms, there are more community pharmacies in Ireland (1,701) than Sweden (1,303) or Denmark (314), and a similar number to the Netherlands (1,981) (PGEU 2014b). Yet the Netherlands has almost four times the population of Ireland, and Sweden has more than double the population of Ireland. One of the key reasons for this difference is the regulation of the pharmacy sector, as factors such as entry is regulated in many of the leading countries, but de-regulated in Ireland since 2002.

Other authors have observed these differences, including Van Mil and Schulz (2006, p157) who noted: “It is necessary to recognize that pharmacy practices in European countries are quite diverse because of the different languages and legal, political and healthcare systems in the nations involved and because practices have developed in different ways and at different paces in different countries. Roughly four different pharmacy systems can be recognized. The Scandinavian type of pharmacy has relatively large pharmacies, serving 10,000–18,000 people and focused mainly on medicines. Southern Europe, France, and Belgium have very small pharmacies that serve approximately 2,000–2,500 clients and that also sell parapharmaceuticals and cosmetics. In the UK and Ireland are Anglo-Saxon type pharmacies (resembling those in the USA and Australia), which sell many non-medical items in addition to medicines and which
serve approximately 3,500 people. Lastly, there are the pharmacies in Central and Eastern Europe (Germany, Switzerland, Austria and farther east), which focus on all kinds of healthcare amenities and serve 3,000–5,000 people.” An analysis of pharmacy models in each country is beyond the scope of this thesis, but it is interesting to note a similar community pharmacy model operates in six of the leading countries. These conform to roughly the same Scandinavian model, where “our pharmacy sector is very regulated” (DK-JV 2).

The data behind the national ICT context and the organisation of pharmacy in primary care is presented in Table 10-3.

<table>
<thead>
<tr>
<th>Country/ROS</th>
<th>National ICT Context IDI Rank</th>
<th>National ICT Context NRI Rank</th>
<th>TEMPEST Study Rank</th>
<th>Number of Pharmacies/ Population served per Pharmacy</th>
<th>Organisation of Pharmacy Sector in Primary Care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>1</td>
<td>15</td>
<td>Forerunner</td>
<td>314/17,828</td>
<td>Scandinavian Model; Regulated, focus on medicine</td>
</tr>
<tr>
<td>Sweden</td>
<td>3</td>
<td>3</td>
<td>Forerunner</td>
<td>1,303/7,299</td>
<td>Scandinavian Model; Regulated, focus on medicine</td>
</tr>
<tr>
<td>Netherlands</td>
<td>7</td>
<td>4</td>
<td>Forerunner</td>
<td>1,981/8,467</td>
<td>Scandinavian Model; Regulated, focus on medicine</td>
</tr>
<tr>
<td>Estonia</td>
<td>21</td>
<td>22</td>
<td>Follower</td>
<td>469/2,753</td>
<td>Health Amenities Model</td>
</tr>
<tr>
<td>Croatia</td>
<td>37</td>
<td>54</td>
<td>N/A</td>
<td>1,111/3,956</td>
<td>Health Amenities Model</td>
</tr>
<tr>
<td>Iceland *</td>
<td>4</td>
<td>19</td>
<td>N/A</td>
<td>55/5,872</td>
<td>Scandinavian Model; Regulated, focus on medicine</td>
</tr>
<tr>
<td>Norway *</td>
<td>6</td>
<td>5</td>
<td>N/A</td>
<td>738/6,767</td>
<td>Scandinavian Model; Regulated, focus on medicine</td>
</tr>
<tr>
<td>Finland</td>
<td>8</td>
<td>2</td>
<td>Forerunner</td>
<td>818/6,616</td>
<td>Scandinavian Model; Regulated, focus on medicine</td>
</tr>
<tr>
<td>Irl (ROS)</td>
<td>26</td>
<td>25</td>
<td>Leapfrogger</td>
<td>1,701/2,697</td>
<td>Anglo-Saxon Model</td>
</tr>
</tbody>
</table>

* non EU

The ICT data illustrates that the leading ePrescribing countries feature highly in world rankings and in the use of eHealth. Estonia and particularly Croatia are the exceptions, as they feature well down the rankings but have high adoption levels for ePrescribing. The community pharmacy model reveals a striking pattern, where six of the eight leading countries operate the Scandinavian model with regulated numbers of pharmacies focused on medicine serving high population cohorts (almost 18,000 in Denmark). By contrast, Estonia and Croatia operate a more unregulated model with more pharmacies serving less
people (almost 3,000 in Estonia). Yet Estonia and Croatia have high ePrescribing adoption rates which suggest that national ePrescribing systems and services can be developed even if the external context is substantially different from the leading countries. This finding is confirmed in Ireland, where the national ICT development indicators are lower than all the leaders except Croatia, yet the ROS system was successfully developed and adopted over 15 years. This suggests that the external context can be shaped to promote adoption, even if some factors in the external context are weak.

10.3. ePrescribing Leaders: Comparative Analysis – Internal Context
In national ePrescribing projects, the inner context comprises the national institution(s) responsible for the project and the actual users of the system or service. The users move from the outer context to the inner context when they adopt the system and begin to use it as a mainstream system in their normal workflow.

A national competence centre for eHealth and ePrescribing is the central feature of the inner context in the leading countries (cf. Table 6.5). In Denmark, Sweden, Finland, and Norway there are several national centres responsible for different aspects of eHealth. These competence centres are responsible for many aspects of national eHealth services including the management of national projects, the provision and management of national eHealth networks and registries, standard setting, software development, software certification, legislation drafting, and so forth. There are various models of competence centre, but most include representatives and experts from the health sector, for example “the Danish Doctors Association is on the board of MedCom as a stakeholder” (DK-IV 1).

A feature of the leading countries is the dynamic nature of these national competence centres, as one interviewee noted: “we are a learning organisation, and we have to think outside the box all the time” (SE-IV 1). Another striking aspect is the leadership – there are many experienced domain experts in positions of authority in the leading countries, such as medical consultants, pharmacists, pharmacy technicians, laboratory scientists, physicists, psychologists, and so forth, as “experienced people are the key - you cannot have IT people or ‘management’ people leading” (DK-IV 1). Experience is also desirable in the management of national services such as legislation, as one interviewee observed: “establish a legal department and drive legal changes from the bottom-up – do not leave it to public servants with no experience of ePrescribing” (SE-IV 1).
Another feature of the inner contexts of the leading countries is the degree of transparency about national eHealth projects such as ePrescribing. Most publish plans, strategies, annual reports, and provide information on-line for stakeholders and other interested parties, such as health authorities in Denmark, where “competition is important and we publish results by region every month” (DK-IV 1). This degree of transparency also extends to failures, as one interviewee observed “we openly admit mistakes” (SE-IV 1). For example in Denmark “MedCom have a policy of two-year projects, and if a project is not successful within that period it is terminated” (DK-IV 1). And in Sweden “we suspended the national ePrescribing project when a prescription for medication resulted in a pair of glasses being dispensed” (SE-IV 1).

Stakeholder management, consensus and collaboration are intrinsic elements of the inner context, as “consensus is the name of the game” (NL-IV 2). The national competence centres in the leading countries are key to stakeholder management in their respective countries, for example, in Denmark “MedCom has a huge network of medical, IT, government and international contacts, and social contact is key” (DK-IV 1), while in the Netherlands Nictiz (the national eHealth institute) employs “the polder model of consultation” (NL-IV 1).

There are close parallels between the inner contexts of the ePrescribing leaders and the ROS project, which was also managed by a small number of domain experts in a dynamic organisation. This was similar to the Swedish ePrescribing project where “for national projects a small experienced team works best” (SE-IV 1). Revenue has a legal department that drafts all legislation required for ROS, similar to the inner contexts in some leading countries. The ROS project was open and transparent from the start, with very detailed information provided to stakeholders about the project, including failures. The ROS inner context was very successful in engaging with and managing stakeholders, in a similar way to the leading countries.

What are the characteristics of a strong inner context? The evidence from the leading countries and ROS suggest that the inner context is dynamic, open, transparent, and accountable, with domain experts as leaders who engage in stakeholder management, and are prepared for success and failure. These factors are listed in Table 10-4.
Table 10-4: Internal context - comparison by leading countries and ROS

<table>
<thead>
<tr>
<th>Country/ROS</th>
<th>Transparency</th>
<th>Domain Experts as Leaders in ePrescribing</th>
<th>Evidence of Stakeholder Engagement</th>
<th>Strategy for Project Failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>Project and financial information in public domain</td>
<td>Doctors, laboratory scientists, pharmacists</td>
<td>Wide ranging stakeholder engagement</td>
<td>Terminate project &amp; publish lessons</td>
</tr>
<tr>
<td>Sweden</td>
<td>Project and financial information in public domain</td>
<td>Pharmacists, Physicians</td>
<td>Detailed stakeholder engagement</td>
<td>Suspend/terminate projects</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Project and financial information in public domain</td>
<td>Physicists, pharmacists</td>
<td>Ongoing activities, use polder model</td>
<td>Terminate projects publicly</td>
</tr>
<tr>
<td>Estonia</td>
<td>Project and financial information in public domain</td>
<td>Medical Doctors, Pharmacists</td>
<td>Permanent engagement with medical stakeholders</td>
<td>Suspend/terminate projects</td>
</tr>
<tr>
<td>Croatia</td>
<td>Project information in public domain</td>
<td>Medical experts</td>
<td>Ongoing engagement with stakeholders in Ecosystem</td>
<td>Not clear</td>
</tr>
<tr>
<td>Iceland *</td>
<td>Project and financial information in public domain</td>
<td>Pharmacists, GPs</td>
<td>Engagement with all medical stakeholders</td>
<td>Suspend/terminate projects</td>
</tr>
<tr>
<td>Norway *</td>
<td>Project and financial information in public domain</td>
<td>Doctors, Pharmacists</td>
<td>Formal engagement at national level</td>
<td>Suspend/terminate projects</td>
</tr>
<tr>
<td>Finland</td>
<td>Project and financial information in public domain</td>
<td>Doctors, pharmacists, psychologists,</td>
<td>Detailed stakeholder engagement</td>
<td>Suspend and publicly review</td>
</tr>
<tr>
<td>ROS</td>
<td>Information on ROS project in public domain; Revenue publish annual reports with financial details</td>
<td>ROS team selected for knowledge of Revenue business, not ICT expertise</td>
<td>Permanent stakeholder engagement activities</td>
<td>Publicly review/ publicly terminate</td>
</tr>
</tbody>
</table>

* non EU

10.4. ePrescribing Leaders: Comparative Analysis – Content

In national ePrescribing projects, the content comprises what the end user actually uses in practice - the EHR used by prescriber and dispenser, the ETP system that transmits ePrescriptions, the specific legal content embedded in the system and the user support services.

ePrescribing in primary care is complex. The prescription must be created in the prescriber’s EHR and then transmitted to the pharmacy’s EHR via an ETP service. The prescriber no longer produces a paper prescription, as there is “one workflow not two for GPs” (DK-IV 2), and the pharmacist may receive the ePrescription before the patient arrives, which is beneficial as “the pharmacist can prepare the drugs in advance” (DK-IV 2). These aspects have proven to be beneficial to stakeholders (Bridell 2010).
The provision of a national ETP service has proven difficult in most countries in Europe (cf. Chapter 4). In the leading countries, secure robust national networks have been developed for ETP purposes, because “doctors will not hang around waiting for the system to be ready – it must serve them immediately or not at all” (SE-IV 2). Some national networks have been developed specifically for the health sector such as Sweden’s Sjunet which was the first national broadband health network in the world separate from the Internet (Larson et al. 2004). Most other countries use the Internet as the communication platform, with security services, PKI and data encryption at all points, similar to the ROS architecture. These national ETP services require large scale national infrastructure to be available at all times, and this technical aspect of the national system “takes years of preparation and all elements under the tip of the iceberg must operate correctly from the beginning” (IV-SE 2).

The most common national model of ePrescribing (Stage 6, cf. Figure 2-4) contains a national ePrescribing database, where prescriptions transmitted by ETP may be stored and used again for clinical and other purposes. However, not every leading country has adopted this model. In the Netherlands, ePrescribing is still organised at a regional level, and no data is stored nationally or regionally; which could mean that “we have a problem if a GP or pharmacist goes out of business or retires – the data can be lost” (NL-IV 3).

Secure transmission of data requires national technical standards (cf. Section 6.4.1) and it is interesting that the leading countries use different technical standards such as EDIFACT, XML, HL7, and so forth (cf. Section 6.4). The evidence suggests that agreement among the stakeholders and the ICT industry about which standards to use is of more importance than the actual standards used, as one interviewee noted: “we do not get too excited about standards provided they work” (SE-IV 1).

The quality of the technical content in primary care ePrescribing and eHealth is a key adoption factor. Most EU countries have developed standardisation programmes for EHRs in recent years which include software certification activities (Empirica 2011), and all the leading countries have EHR software certification programmes in place, which include ePrescribing components. Most certification is provided free of charge. The leader in this area for many years has been Denmark, where MedCom coordinates and manages standard setting for all Danish health software (Castro 2009). MedCom has certified over 100 software products from over 60 software houses, and no clinical
software product can be sold in the Danish health sector without certification, as “the MedCom certification is the key for software suppliers” (DK-IV 1). MedCom certifies that the software uses MedCom technical data and communication standards, which guarantees that any software product in use in the Danish health sector is interoperable with any other (Protti and Johansen 2010). This arrangement is an excellent example of a strong inner context controlling the quality of the content by stakeholder engagement with the ICT industry, and may explain why Denmark enjoys the highest adoption rates for eHealth and ePrescribing in Europe (cf. Figure 6-3).

In some countries, national EHR projects to store certain minimum health data have also been under way in recent decades, and all of these projects are at different stages of development to the national e-Prescribing projects. A summary of these projects in the leading countries is shown in Table 10-5.

<table>
<thead>
<tr>
<th>Year Commenced</th>
<th>Country</th>
<th>National eHealth Organisation</th>
<th>National eHealth Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Finland</td>
<td>Ministry of Health /KELA</td>
<td>National EPR Project</td>
</tr>
<tr>
<td>2003</td>
<td>Denmark</td>
<td>MedCom</td>
<td>Basic EHR Project</td>
</tr>
<tr>
<td>2006</td>
<td>Sweden</td>
<td>National Board of Health &amp; Welfare</td>
<td>National Patient Summary</td>
</tr>
<tr>
<td>2007</td>
<td>Netherlands</td>
<td>Nictiz</td>
<td>Nationwide EPD Infrastructure</td>
</tr>
<tr>
<td>2008</td>
<td>Estonia</td>
<td>eHealth Foundation Board</td>
<td>National HIE/EHR</td>
</tr>
<tr>
<td>2007</td>
<td>Iceland *</td>
<td>Ministry of Health</td>
<td>Healthnet/EHR Saga system</td>
</tr>
<tr>
<td>2010</td>
<td>Norway *</td>
<td>Directorate of Health /NSEP</td>
<td>National core EHR project</td>
</tr>
<tr>
<td>2012</td>
<td>Croatia</td>
<td>Croatian Institute for Health Insurance</td>
<td>National EHR/CEZIH Project</td>
</tr>
</tbody>
</table>

* non EU; Source: (Sihna et al. 2013)

National EHR systems have been fully implemented in Denmark, Estonia, Finland, the Netherlands, and Sweden, while the remaining countries (who started latest) are at the planning and pilot stages. Most national EHR and ePrescribing systems store medical data for patients, but a surprising finding is that only Norway has plans to integrate these two national systems, and “at present, in most countries, ePrescriptions and EHRs constitute two parallel systems which are not being integrated” (European-Commission 2014b, p54).

In summary, all the leading countries have made substantial efforts to develop quality in the content of ePrescribing systems. This includes the development of secure networks for ETP, the provision of national infrastructure and databases for national ePrescribing purposes, software certification, and technical standard setting activities. Revenue also
took very similar steps to develop quality content for ROS, which is an interesting parallel. A summary list of these factors is shown in Table 10-6.

<table>
<thead>
<tr>
<th>Country/ROS</th>
<th>Secure National Network/ETP</th>
<th>Software Certification Activities</th>
<th>ePrescribing Integrated with National EHR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>Provided by Danish health data network</td>
<td>MedCom certify all eHealth software for use in Denmark</td>
<td>No</td>
</tr>
<tr>
<td>Sweden</td>
<td>Provided by national health network (Sjune)</td>
<td>Apoteket AB certifies pharmacy software</td>
<td>No</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Provided by regional networks (OZIS clusters)</td>
<td>Nictiz certifies eHealth software for HL7</td>
<td>No</td>
</tr>
<tr>
<td>Estonia</td>
<td>Based on Internet technology using PKI &amp; formal registration systems</td>
<td>National X-Road certification system</td>
<td>No</td>
</tr>
<tr>
<td>Croatia</td>
<td>Based on Internet technology using PKI &amp; formal registration systems</td>
<td>Croatian Standardisation Department certifies primary care software to connect to the central system</td>
<td>National strategy is to implement ePrescribing first, and integrate with EHR in future years</td>
</tr>
<tr>
<td>Iceland *</td>
<td>Provided by national Health network (Healthnet)</td>
<td>Ministry of Health certifies health ICT software</td>
<td>No</td>
</tr>
<tr>
<td>Norway *</td>
<td>Based on Internet technology using PKI &amp; formal registration systems</td>
<td>KITH AS and Norwegian directorate of Health certify all health software for messaging standards</td>
<td>ePrescription cannot be created without national EHR record when EHR goes live</td>
</tr>
<tr>
<td>Finland</td>
<td>Based on Internet technology using PKI &amp; formal registration systems</td>
<td>Ministry of Health certifies health ICT software</td>
<td>No</td>
</tr>
<tr>
<td>Irl (ROS)</td>
<td>Based on Internet technology using PKI &amp; formal registration systems</td>
<td>Revenue publishes lists of financial and tax software that is ROS compliant</td>
<td>N/A</td>
</tr>
</tbody>
</table>

* non EU

10.5. ePrescribing Leaders: Comparative Analysis - Process

The process of implementation and adoption was briefly reviewed at a high level in Chapter 6. This review found that nine countries have used the top-down approach; nine have used the middle-out approach, with two in the bottom-up category. Six countries are implementing national projects on a regional basis, and 15 on a national basis. Five countries have chosen the mandatory approach, while 15 use the voluntary basis. In the leading countries, the most popular implementation strategy is a middle-out approach, at a national level on a voluntary basis. The ROS project also used a very similar strategy,
including the approach to mandates as follows: “mandates are used to slowly improve functionality and use of the system over time, not for initial adoption” (DK-IV 1).

In this section, additional adoption factors for ePrescribing that came to light from the data and the interviews are explored in detail. These include consent management for patients, incentives, the use of social marketing and the provision of national support services to users.

Consent management in eHealth is a national issue, and has caused difficulty in some national EHR projects such as the Netherlands (Dutchhealthcare 2011), where “almost 460,000 people chose to opt out” (NL-IV 3). In simple terms, if a medical institution records and transmits data in electronic format, the patient must consent to that arrangement, and the data must be protected. Many people are uncomfortable with the idea that their health data is stored in EHRs, and a complex set of rules, regulations and laws have been developed in the health domain to manage consent, in a way that balances the rights of the patient, the obligations of health professionals and the efficiency of the healthcare system (European-Commission 2014b).

ePrescribing data is in digital format, transmitted electronically and shared between prescriber and dispenser; therefore the management of consent for a national ePrescribing service is a key factor. A review of the qualitative data found that in 12 of the 31 countries, the legislation requires explicit consent from patients for EHRs to be shared. This group consists of all the leading eight countries and France, Germany, Luxembourg, and England (Empirica 2010, European-Commission 2014b). In four of the leading countries (Denmark, Sweden, Norway, Estonia) the patient has the opportunity to opt-out at the point of care, but in many countries, explicit consent is not necessary for sharing data among health professionals if they have a medical or therapeutic relationship with the patient (European-Commission 2014b). These findings are interesting in that all of the leading countries have a legally-based consent management policy.

The use of incentives for adoption in national eHealth projects varies from country to country. For example, family physicians in the primary care sector in the USA were offered financial incentives to adopt ePrescribing between 2009 and 2013 under the Meaningful Use programme; and after 2013 those who had not adopted ePrescribing suffered financial penalties (Gabriel et al. 2013). A review of the leading countries found that the innovators offered some form of incentives to adopt; for example in Sweden the
policy was to “incentivise the stakeholders where possible” (SE-IV 2). In the Netherlands “GPs and pharmacists were given small financial incentives to use the systems” (NL-IV 2), and in Denmark all stakeholders receive an incentive payment from MedCom when a system is implemented, and GPs receive specific fees for using technology, for example telephone and eMail consultations (Protti and Johansen 2010).

In the early adopter group, there was little evidence of incentives except in Estonia (Parv et al. 2014), while in Finland a report into the pharmacy sector by Mossialos and Srivastava (2008) noted that incentives for physicians are weak, and financial incentives are not used in the sector to influence prescribing or other behaviour. This appears to be related to the regulation of the sector in Finland.

Social marketing was used to good effect in the ROS project, and a review of the leading ePrescribing countries found social marketing equally effective in the health sector, as one interviewee noted “you must explain the benefits of the ePrescribing system or you will never sell it” (SE-IV 1). All the leading countries used some form of social marketing in GP offices, pharmacies and among other stakeholders such as hospitals. There was little evidence of more extensive marketing campaigns using media such as newspapers, magazines, radio and television.

All the leading countries have well-established national support services for users such as GPs and pharmacists, and also for patients, as “you build credibility and confidence by having a system that is easy to access and by quickly responding to every support issue” (SE-IV 1). All eight countries have national helplines and websites with information about ePrescribing, and all provide support in several languages. In Sweden, for example the policy was “to establish one telephone number as a national point of contact and be prepared for difficult queries ” (SE-IV 1). Providing a national ePrescribing or ETP service is a complex undertaking and operational problems occur at GP clinics or at pharmacies; in these situations, the support services need to “be clear who is responsible in the chain of information when things go wrong, and be prepared to change or suspend a project” (SE-IV 1)

In the ROS project, 120 ROS liaison officers throughout Ireland were “the key to national adoption” (ROS-IV 3). In the same way, data consultants throughout Denmark provide a personal support service to GPs and pharmacists, and in Sweden the dedicated local project managers provide a support service as they “don’t just leave them with the
technology” (SE-IV 2). In the early adopters group, there was limited evidence that a similar strategy is used; instead, support and training services are provided centrally.

In summary, an analysis of the factors at play in the adoption process revealed interesting patterns. All the leading countries have a consent management strategy, and all use some form of social marketing. The use of incentives was evident in the innovators, Estonia, and ROS, but not in the other four countries. And while user supports were evident in all countries, there was no evidence in six countries of roles similar to data consultants in Denmark or liaison officers in the case of the ROS project. A summary of these factors is presented in Table 10-7.

<table>
<thead>
<tr>
<th>Country/ROS</th>
<th>Explicit Consent Management for Patients</th>
<th>Use of Incentives</th>
<th>User Supports</th>
<th>Social Marketing Campaigns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark</td>
<td>Yes, opportunity to opt-out at point of care</td>
<td>Financial incentives and subsidies for GPs</td>
<td>National helpline; data consultants; website;</td>
<td>Yes, at many levels, including MedCom</td>
</tr>
<tr>
<td>Sweden</td>
<td>Yes, opportunity to opt-out at point of care</td>
<td>Subsidies for ICT equipment</td>
<td>National helpline; dedicated local project managers; website;</td>
<td>Yes, extensive campaign in nine languages</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Yes</td>
<td>Financial incentives for using ICT for pharmacists and GPs</td>
<td>Nictiz national infrastructure support services; website;</td>
<td>Yes, Nictiz public information campaigns</td>
</tr>
<tr>
<td>Estonia</td>
<td>Yes, opportunity to opt-out at point of care</td>
<td>Estonian Health Insurance Fund provided financial incentives</td>
<td>National helpline; website; central training;</td>
<td>Yes, in GP offices and pharmacies</td>
</tr>
<tr>
<td>Croatia</td>
<td>Yes</td>
<td>No evidence</td>
<td>National helpline; website;</td>
<td>Yes, in GP offices and pharmacies</td>
</tr>
<tr>
<td>Iceland *</td>
<td>Yes</td>
<td>No evidence</td>
<td>National helpline; website;</td>
<td>Yes, in GP offices and pharmacies</td>
</tr>
<tr>
<td>Norway *</td>
<td>Yes, opportunity to opt-out at point of care</td>
<td>No evidence</td>
<td>National helpline; website;</td>
<td>Yes, in GP offices and pharmacies</td>
</tr>
<tr>
<td>Finland</td>
<td>Yes</td>
<td>No evidence</td>
<td>National helpline; Kan Ta centre provides technical support</td>
<td>Yes, in GP offices and pharmacies</td>
</tr>
<tr>
<td>ROS</td>
<td>Opt-in for ROS users, mandatory use for all taxpayers from 2016</td>
<td>No financial incentives; extended payment deadline; quicker tax refunds; tax calculators</td>
<td>National ROS helpline, free training, ROS liaison officers</td>
<td>Extensive marketing campaigns for ROS, detailed information provided to all stakeholders</td>
</tr>
</tbody>
</table>

* non EU
10.6. Summary
This chapter compared the ePrescribing leaders and ROS using the CCP framework, and several themes came to light from this comparison. All the leading countries have developed a positive outer context for ePrescribing over time, which includes the provision of nationwide ETP services to prescribers and dispensers in primary care. National ePrescribing projects are long term undertakings and some interviewees noted that “the time factor always seems to be underestimated” (NL-IV 1), and “we never thought it would take so long” (SE-IV 1).

The outer context was engineered in most cases by a strong inner context, where transparency and openness were features in most of the leading countries. The core content of the national ePrescribing systems in the leading countries are highly developed interoperable EHRs, supported by national ETP services. These systems are supported by common technical standards and secure national networks, operating in a secure technical-legal environment.

The process of adoption varied between the innovators and the early adopter groups, but common themes appeared. Some interviewees commented on the complexity of ePrescribing, for example: “beware of complexity in technology, interpretations, standards, laws, rules, and expect the unexpected” (SE-IV 1), and “do not try to do everything” (DK-IV 2). A middle-out approach at a national level was used in most of the leading countries, and the strategic use of social marketing, incentives and mandates all played a role.

The coordination of the context, content and process was achieved by active stakeholder management at all points on the ePrescribing journey, which is evident in all the leading countries. All interviewees commented on the degree of stakeholder management required in the adoption process, such as: “you must get into the mindset of doctors” (SE-IV 2), and “we spent most of our time on national projects building consensus among stakeholders” (NL-IV 1).

Many parallels were found between the national projects in the leading ePrescribing countries and the ROS project across all aspects of the CCP model. This suggests that national eHealth and eGovernment services share many common building blocks and critical success factors.
This chapter explored the factors behind the high adoption rates in the leading ePrescribing countries and found many parallels with the ROS project. Chapter 11 will discuss these findings and comparisons in the context of the literature.
11. Findings, Discussion and Policy Lessons

"If you have an apple and I have an apple and we exchange apples then you and I will still each have one apple. But if you have an idea and I have an idea and we exchange these ideas, then each of us will have two ideas." (George Bernard Shaw)

11.1. Introduction

The central research question is concerned with the development and adoption of national ePrescribing systems and services - the “what and the how” questions. What are the building blocks? What are the critical success factors? How are national systems and services developed? How did the leading countries achieve national adoption? What are the policy implications?

The findings indicate that national ePrescribing systems and services are still relatively underdeveloped worldwide. In Europe, eleven countries have managed to establish live national ePrescribing services which are in daily use by most prescribers and pharmacists in primary care; and another seven countries have launched national projects; but adoption is not widespread. A comparative analysis of the leading countries found that a strong inner context is the key factor common in all the leading countries. A strong inner context was associated with the development of a positive outer context without barriers to adoption; with the provision of high-quality technical and legal content; and with the management and support of the adoption process over time. These achievements correlated with long-term stakeholder management in the domain. A comparison with a successful eGovernment case study found many parallels with these findings. An overview of these findings is presented in Figure 11-1.

Figure 11-1: Overview of Findings
The topics that surfaced from the research, which are central to the findings, are explored in the discussion. Building blocks for the development and adoption of ePrescribing are then suggested, and critical success and failure factors are identified. To conclude the presentation of findings, specific areas for ePrescribing policy are proposed.

11.2. Emerging Topics and Challenges in ePrescribing

11.2.1. ePrescribing is a complex multi-stakeholder phenomena

It is clear from the literature and from the findings in this thesis that ePrescribing is a complex multi-stakeholder phenomenon and the stakeholder maps (cf. Figures 2-2 and 9-2) highlight the high number of stakeholder groups involved in ePrescribing. Stakeholder management has surfaced in this thesis as a key factor in national projects, and it appears that the leading countries have developed particular skills and techniques in this area. When stakeholders adopt ePrescribing they become part of the implementation process and move into the inner context (Hage et al. 2013). However, engaging with large groups of stakeholders over a long period has proved particularly difficult in eHealth and ePrescribing, especially in countries with large populations (Sheikh et al. 2011, Wicker et al. 2012), and may explain why adoption rates for eHealth are generally higher in countries with smaller populations (cf. Section 4.5). Authors such as Wager et al. (2009) have discussed the greater complexity of the healthcare sector in comparison to other industries, and have noted this degree of complexity makes the implementation and adoption of ICT systems among wide groups of stakeholders very challenging.

11.2.2. ePrescribing is context-specific

The ePrescribing literature suggests that the eHealth context in each country is unique, and that each of the leading countries has developed its own context for ePrescribing. The innovators each approached ePrescribing in a different way. In Sweden the government had a monopoly of the pharmacy sector until 2009, and that provided the context for a uniform national service. In the Netherlands, the GP associations were active at regional level to promote the use of EHRs and by default, ePrescribing. In Denmark, several stakeholders came together to create MedCom, which was the catalyst for developing national eHealth and ePrescribing solutions, while in Estonia, ePrescribing is part of a larger national eHealth and eGovernment project. In Finland, national pilot projects, changes to legislation and the construction of a national eHealth archive led to the national ePrescribing system, while in Norway the extensive use of
EHRs by GPs and the national “Healthnet” eHealth project combined to provide a firm foundation for a national ePrescribing system. Iceland also had pilot projects and changes to legislation before it launched a single national system in 2009.

Protti (2007) reached similar conclusions when comparing eHealth in primary care in 10 countries. He found that factors such as financial incentives, government mandates, peer influence, and supplier certification can work in some countries but not in others, and that each country must find its own solutions for its own unique contexts.

11.2.3. There are many different national ePrescribing solutions
The findings indicate that there is more than one way to achieve national level ePrescribing in primary care. While most of the leading countries have implemented a national prescription database solution with voluntary adoption over time, Croatia, Turkey and Romania are all countries that have recently implemented centralised mandatory top-down national systems and report high adoption rates, although these projects are at the early stages. While information about these projects is limited, it is clear that in Croatia and Romania the entire national ePrescribing system is provided by large multi-national private sector firms; Hewlett Packard in Romania and Ericsson in Croatia.

Another interesting finding was the case of the UK, where there are four separate health authorities. England was the pioneer and launched a top-down national ePrescribing project (EPS1) in 2004 based on barcode technology, where a barcode prescription replaced a written or printed prescription. Wales and Northern Ireland followed in subsequent years with similar national projects where “essentially all of the information on a paper prescription was encoded into the barcode using XML technologies, so rather than investing in electronic transmission of prescription from prescribers to pharmacists the paper prescriptions were used to transmit the information” (HIQA 2012, p29). In Scotland, an ETP solution was in development since 2001, and a national ePharmacy project was launched in 2008, which is a combination of ETP and barcode prescriptions. In England, a transition is now in progress from the barcode solution (EPS1) to an ETP solution (EPS2). The key reason for the use of barcode technology was the view that there was a high degree of risk in an ETP solution as it involved a change in workflow for GPs and pharmacists. This is in contrast to the view Revenue adopted about ROS initially (cf. Section 8.2.4), when stating the “Revenue is adamant that submission of paper documents defeats the objective of electronic filing”
(Revenue-Commissioners 1998, p7). These divergent views from two different
domains reflect the different approaches to risk, the relative complexity of the domains,
the degree of change for stakeholders, and the different inner contexts.

11.2.4. The rate of adoption is accelerating
The rate of adoption of ePrescribing is increasing over time. The findings show that the
early adopter group achieved high ePrescribing adoption rates in a shorter time than the
innovators - typically 3-5 years compared to 15-20 years. A general pattern has
emerged where countries undertake pilot projects for several years before launching a
national ePrescribing project. Examples are Austria, England, Estonia, Finland, France,
Greece, Iceland, Italy, Norway, Romania, Scotland, and Spain.
A related finding is the increase in the number of European countries that have launched
national ePrescribing strategies and projects in recent years; 27 countries are now active
in this area, an increase of almost 80% since 2007 (cf. Section 6.3.1). This appears to
be an example of the concept of critical mass, which Rogers (2003, p343) described as
“the point after which further diffusion becomes self-sustaining”.

11.2.5. An ePrescribing divide exists in Europe
It is clear that an ePrescribing divide exists in Europe between the leading group that
have achieved national adoption and the followers. This seems to include specific
“divides” that came to the surface in Chapter 6: for example an eHealth divide; a digital
divide; a legal divide; and a divide in technical standards.
Other authors have observed similar divides (Currie and Seddon 2014) including a
funding divide in healthcare between northern and southern Europe (Jakubowski and
Saltman 2013). It is a rational conclusion that individual countries in the lower ranks of
ePrescribing will struggle to launch national projects while the digital, legal, technical
and funding barriers exist. The review of the Irish ePrescribing domain in Chapter 7
provides a detailed case study of these barriers.

11.2.6. The advanced features of ePrescribing are not widely used
An interesting finding widely discussed in the literature is the fact that the use of CDSS
in ePrescribing – which is the most clinically useful aspect – is among the least used and
least developed component of national ePrescribing services. CDSS typically includes
drug contraindication alerts, allergy alerts, dose checking, diagnosis alerts, laboratory
alerts and so forth. More complex CDSS functions have been developed (e.g. for renal
impairment) but are not widely used (Van Doormaal et al. 2009), and some studies
report CDSS as difficult to use and time consuming (Hammar et al. 2014, Landerdahl 2010b, Pagliari et al. 2011). The balance between the unique individual clinical issue at the point of care, access to accurate prior clinical data, and access to objective evidence-based information is technically complex and difficult to achieve in primary care ePrescribing, where prescribers operate under a degree of uncertainty and time pressure. This finding suggests that even in the leading countries, the more advanced features of ePrescribing remain to be developed and adopted, which points to the conclusion that developments in primary care ePrescribing are still at the early stages.

11.2.7. ETP is the key challenge

The findings from all 31 case studies clearly indicate that ETP is the key challenge in ePrescribing. The provision of a reliable real-time ETP service depends on a variety of technical and non-technical components, and in the complex domain of primary care ePrescribing this is particularly challenging. Some authors have discussed semantic interoperability issues in eHealth as “the grand challenge” (Empirica 2011, p39), while others have discussed a reliable national technical infrastructure as a mandatory condition for eHealth and ePrescribing services (Castro 2009, Coiera 2003, Conrick 2006, IOM 2001). A finding from the ROS project is that the provision of a reliable service on a real-time basis took several years and a significant investment in central infrastructure. The delivery of an ePrescription in real-time is a different task to filing a tax return, and the provision of a national ETP service is a different challenge. In some countries (England, Northern Ireland, Wales) ETP was viewed as a risk, and an alternative national system was devised. In an evaluation of the second English national ePrescribing system (EPSR2) which includes ETP, pharmacists are sometimes “in a fog of uncertainty as to whether a day-to-day operational problem sits in their system, the spine or the GP’s system” (CFHEP 2012, p24). This is due, in part, to the organisation of the ETP service centrally, as community pharmacists do not have access to the spine (the English national health network). In other countries with live national ETP services such as Sweden, Denmark, Estonia and Croatia there are different agreed procedures to revert to printed paper or fax prescriptions in the event of ETP failure.

11.2.8. Few national ePrescribing and EHR databases are integrated

The integration of systems and data is a central issue in HI and a surprising finding is that most national ePrescribing services/data are not integrated with national EHR services/data; and only Norway, Croatia, Hungary and Luxembourg have plans to integrate these elements. This topic has regularly appeared in the HI literature, and
evaluations of national ePrescribing services such as the English national ePrescribing project suggests that such integration was not planned (Barber et al. 2014). Even in countries that have national prescription databases, the integration of this information with a summary care EHR seems difficult (Doupi et al. 2006). National EHR systems have been established for different reasons, for example to support emergency care in the Netherlands and Scotland, primary care in Denmark and Spain, and primary and secondary care in England (Morrison et al. 2011). This raises issues about national EHR and eHealth strategies and the national organisation of health data, as “the urgent clinical need for large-scale national sharing of complex patient data is sometimes questioned” (Empirica 2011, p (vii)).

11.2.9. eHealth and eGovernment services have little integration
A similar finding was apparent in the ROS case study, as the ROS data was not integrated with any other eGovernment service, which suggests that integration of services and data at a national level is also a problem in the eGovernment domain. A related issue is the connection and integration of eGovernment and eHealth services and data. Some authors such as Currie and Seddon (2014, p791) have observed that the use of eGovernment services is relevant for eHealth “because citizens and health professionals alike can search and retrieve health information for both clinical and nonclinical purposes”. Some examples of integrated systems and services appeared in this research such as the national eGovernment strategies in Denmark and Estonia, but overall there is little evidence in the research of integration between these domains.

11.2.10. Many Parallels between the national ePrescribing leaders and ROS
Although there is scant evidence of integration between the eGovernment and eHealth domains, there is ample evidence of close parallels between the ROS project and ePrescribing projects in the leading countries. In both cases, the inner context is strong, transparent and accountable, and led by domain experts. The inner contexts manage to develop positive outer contexts for adoption with specific legislation, secure national networks and social marketing, all of which are employed in both domains to good effect. The content is managed by software development, certification and standardisation activities, again with close similarities in both domains. And the process is supported in similar ways in the use of incentives, mandates, user supports and implementation approaches. And in both cases, there is a very clear engagement with all key stakeholders on an ongoing basis. These findings suggests that although the domains are different, the challenges are almost identical and there is a surprising
degree of similarity and commonality in the approach taken by the leading countries and ROS to the question of national electronic services.

11.3. Development of a Positive Context for Adoption

The creation of a positive context for ePrescribing is a theme that has come to light from the evidence and the analysis. In countries with very different external contexts, an environment has been developed to achieve the same end result: the development and adoption of national ePrescribing services. Managing and shaping the external context plays a key role in the development and adoption of ePrescribing, and some factors have surfaced which warrant discussion.

11.3.1. National health model

In the leading groups, ePrescribing is most common in NHS countries (Denmark, Finland, Iceland, Norway, Sweden), yet the Netherlands (SIS), Estonia and Croatia (both TC) have well developed national ePrescribing services, and the Netherlands was an innovator. This suggests that countries with an NHS model have the most favourable conditions for the development and adoption of ePrescribing, but this can be achieved with other models as well. The ROS case study also confirms this finding, as Revenue operates as a single national service, with a degree of autonomy.

11.3.2. Development of legislation

The evidence suggests that specific legislation is essential for ePrescribing, but less than half of the 31 countries studied have actually passed such legislation (cf. Table 6-4). Most of these countries are in the leading groups, suggesting that a legal divide exists in the eHealth domain in Europe (cf. Section 6.6). In the leading countries, legislation is a facilitator of the ePrescribing context and content, similar to the ROS project.

An interesting finding was that both Apoteket AB in Sweden and Revenue in Ireland draft legislation for national projects, as it was considered best to “establish a legal department and drive legal changes from the bottom-up – do not leave it to public servants with no experience of ePrescribing” (SE-IV 1). In the countries still struggling with eHealth legislation, it is a major contextual barrier. The area that seems to prove most difficult in national eHealth projects is the safe transmission of electronic data between institutions and medical professionals in primary care. This is not confined to Europe - for example, ePrescribing is illegal in Japan (Halamka 2011) as all
prescriptions must have a doctor's original seal, but these seals cannot be transmitted electronically.

11.3.3. National ICT infrastructure
The degree of ICT development in a country influences the journey of national eHealth projects. It is not a coincidence that most of the leading countries are also world leaders in international benchmarking measures of national ICT infrastructures. A related finding is that national eHealth and eGovernment systems can be successfully adopted in countries where ICT is not well developed, such as Croatia, Romania, Turkey and ROS in Ireland.

11.3.4. External events
Events in the external context can change national ePrescribing projects and change the inner context. For example, all pharmacies in Sweden were state-owned from 1971 until 2009, when an EU competition directive compelled the state to sell most pharmacies and de-regulate the market. This external event changed the landscape of community pharmacies in Sweden, but the Swedish pharmacy authorities created a new company to manage the ePrescribing service and all new pharmacies must use the national ETP service. In this way, the actions taken in Sweden are very similar to the actions taken by Revenue in dealing with external events. By way of contrast, the financial crisis in Greece and Portugal led to the mandatory implementation of ePrescribing for fiscal control purposes, and this external event had a direct impact on the inner context in both countries.

11.3.5. Social marketing
The role played by social marketing in the adoption of ePrescribing is an unusual finding. Social marketing is the use of commercial marketing strategies for the diffusion of non-profit products and services (Rogers 2003), and such techniques were widely used in the leading countries and for ROS. The observations from the interviews in both domains found that the marketing campaigns were a strategic investment which repaid many times over. The EU has observed that social marketing of eHealth solutions is effective and has recommended that member states should undertake education and awareness raising activities of ePrescribing for patients, health professionals and policy makers. The EU encourages awareness raising in the eHealth domain about interoperability, informed consent, data sharing and technical standards to support ePrescribing (European-Commission 2014a, Article 14).
11.3.6. Alignment of CCP elements
The evidence from the leading countries strongly suggests that alignment of all elements in the content, context and process is required for successful adoption of national ePrescribing services and if any one element is not aligned, there is a risk of failure. For example, the promotion of electric vehicles by General Motors in the USA in the 1990s failed because the supporting infrastructure (electrical outlets at fuel stations) was an element that was never developed (Rogers 2003). In the same way, a national ETP service is a supporting infrastructure required for ePrescribing in primary care. In the 13 European countries that have not established a national ePrescribing service, the ETP element is not yet developed for many different reasons.

The UK situation provides an interesting case study of the ETP issue. The UK comprises four separate health administrations, and the English NHS launched a national ePrescribing project (EPS1) in 2005; Scotland’s NHS launched a national ePharmacy project in 2008; and NHS Wales and NHS Northern Ireland both launched similar projects using barcodes in 2008, as an ETP solution was considered too risky (Davis 2006). Only Scotland developed an electronic ETP service as the other countries relied on printed barcode prescriptions. The second release of ePrescribing in England (EPS2) replaces the printed barcode with an electronic file, but the adoption of the ETP service has proved to be problematic (Barber et al. 2014), and the English national EHR “top-down strategy has now officially been abandoned” (Morrison et al. 2011, p37). This suggests that all elements for the development of ETP are not yet aligned.

Another case in point is the Austrian pilot project which started in 2009, but by 2011 “the e-Medikation pilot project was influenced by strong political concerns on the part of the Austrian Chamber of Physicians, leading to a two-month boycott of the pilot project... the resistance by stakeholder groups was high and endangered the pilot project.” (Ammenwerth et al. 2014, pp 24-25). The physicians and pharmacists in this study expressed dissatisfaction with the software, benefits, risks and costs, which again suggests that some of the CCP elements were not aligned in this project.

11.4. Building Blocks, Critical Success and Critical Failure Factors
11.4.1. Unique context of each country
The evidence suggests that the ePrescribing challenge is the same in each country, but the contexts are different and unique. This suggests that the national ePrescribing service in each country is context-specific, content-specific and process-specific, and
that the same solution will not work in every country. Consequently each country has to design and engineer its own national systems and services. However, the evidence also suggests that the building blocks and critical factors are similar in each country.

11.4.2. Building Blocks
There are common threads running through the comparative analysis of the ePrescribing leaders and ROS. All of the evidence highlights the fact that a strong inner context is the central force behind each success story. The common characteristics of a strong inner context are openness, transparency and accountability with domain experts as leaders. A strong inner context plays several key roles: national co-ordination; consensus-building; stakeholder management; governance and funding management; initiative management; software certification; standard setting; liaison with national and international projects; and so forth. The evidence suggests that the inner context is the catalyst for successful development and adoption of national systems and is consequently the key building block, or cornerstone.

The second building block is a positive external context without barriers to adoption, where a national system is “easy to use but difficult to avoid” (ROS-IV 4). This includes a supportive legal framework, the availability of secure ICT services, unique identification systems, and easy access to public information and support services.

The combination of external factors that shape the eHealth landscape can create a receptive context or a difficult context for adoption. The key factors include political and economic changes; the national health model in operation; the national legal framework for ePrescribing; the organisation of primary care; the level of ICT development in a country; and so forth. While the external context may not be ideal in many countries, the evidence from the leading countries and ROS suggests that the inner context can take action to shape and influence the external context, and create a positive environment without barriers to adoption.

The third building block is high quality content. The ETP service is the “tip of the iceberg and all elements under the tip of the iceberg must operate correctly from the beginning” (IV-SE 2). The content includes the ICT artefact (EHRs); the security of the system and of the data; the technical interoperability required for national ETP services; the legal content behind each transaction; and the various support services. All of these elements combine to provide the actual content that prescribers and dispensers experience. The evidence from the leading countries and ROS suggests that high
quality content leads to a high degree of satisfaction in the user experience, which is a key adoption factor. The evidence also indicates that a strong inner context can shape the content in a positive way with: agreed technical and data standards; software certification services; the provision of national ETP services; the drafting of specific laws; and the provision of various support services to users. For example, the certification of software for use in the Danish health sector can be seen as the inner context influencing the content through focused stakeholder management.

11.4.3. Critical Success Factors
There are many views in the literature about critical success factors for national eHealth and eGovernment systems. When the evidence from the successful countries and ROS in this research is considered, it can be argued that one critical success factor for ePrescribing stands out above all others: stakeholder management in the process of adoption. The process is not a building block; it is a process, and how it is managed is the critical factor. This includes the strategic approach (top-down, bottom-up, middle-out), the implementation strategy, incentives, mandates, consent, user support services and social marketing. It also includes the reaction to failure.

The evidence from the leading countries and ROS suggests that the management of a large number of stakeholder groups over a long period is the key factor in the adoption process. Stakeholder management in ePrescribing assumes a two-way interaction with several bodies: GP and pharmacy groups; national health authorities; regulatory bodies; health insurance companies; the ICT industry; the pharmaceutical industry; patient groups; and so forth (cf. Section 9.5). The evidence indicates that a strong inner context is the catalyst for stakeholder management, as one interviewee noted “we spent most of our time on national projects building consensus among stakeholders” (NL-IV 1).

11.4.4. Critical Failure Factors
Conversely, it can be argued that the key critical failure factor in countries where ePrescribing is not developed, adopted or diffused revolves around the inner context and stakeholder management throughout the entire process. Using the evidence from the 31 countries, it is possible to identify countries in the late majority and laggard groups where the inner context and stakeholder management are not well developed. There are various symptoms: for example, an outer context with barriers to adoption; poor quality content; poorly informed stakeholders; or inadequate support in the process. While specific CCP elements can be identified as failure factors, the evidence from the
comparative analysis and cross domain comparisons suggests that these elements are primarily indicators of a weak inner context and poor stakeholder management. This suggests that the most critical failure factors are to be found in the inner context.

11.5. Application of the Model

A framework that includes the different components and factors of national ePrescribing systems and services has been developed and suggested in this thesis, based on the work of Pettigrew, Whipp and Rogers. Cresswell and Sheikh (2013, p84) in a recent systematic review of this topic noted that this area is of crucial importance, but has received inadequate research attention, when commenting: “while there is at present no overarching conceptual framework in relation to the implementation and adoption of health information technology innovations, research consistently emphasizes the importance of technical, social and organizational factors, and the inter-relationships between these”.

The CCP framework could be applied in other situations for the analysis and evaluation of national eHealth or eGovernment systems. For example in Australia, in November 2013 the Federal Minister for Health announced a review of the national Personally Controlled Electronic Health Record system (PCEHR) by a panel of health and ICT experts dealing with the development and implementation of PCEHR, as adoption was poor and the rate of adoption was proving to be slow. The terms of reference for this review (Royle et al. 2013, p5) were as follows:

“On November 3, 2013 the Federal Minister for Health The Hon Peter Dutton MP announced a review of the Personally Controlled Electronic Health Record system (PCEHR) by a small Panel of Health and IT experts. The panel has conducted a review of the PCEHR, dealing with implementation, uptake and including, but not limited to the following:

- The gaps between the expectations of users and what has been delivered
- The level of consultation with end users during the development phase
- The governance and control systems that were applied during the development and implementation phases
- The level of use of the PCEHR by healthcare professionals in clinical settings
- Barriers to increasing usage in clinical settings
- Key clinician utility issues
- Key patient usability issues
- Work that is still required including new functions that improve the value proposition for clinicians and patients
- Drivers and incentives to increase usage for both industry and healthcare professionals
- The future role of the private sector in providing solutions
• *The policy settings required to generate private sector solutions*
• *The governance arrangements to set the ongoing future directions of the PCEHR in the context of other eHealth initiatives and timing of changes*”

These terms of reference can be analysed and re-presented in terms of the CCP framework. The role of the private sector, policies required to generate private sector solutions, and integration with other eHealth initiatives are all factors in the outer context. Governance and accountability systems during development and implementation refer to internal control issues in the inner context. Key utility and usability issues for clinicians and patients, the functionality of the system, and gaps between user expectations and the actual content of the system are all elements of the content. The actual usage by patients and professionals in clinical settings, drivers and incentives to increase adoption, barriers to adoption, and the level of consultation with users during development are all process factors.

This analysis makes it easier to make sense of national projects, and to identify where the central issues might be found. For example, in the PCEHR project, most issues seem to revolve around the content and the process, which might suggest a weak inner context. In a similar way to Roger’s general model of diffusion (Rogers 2003), the model that has come to light in this thesis could be used to analyse national eHealth projects for evaluation or research purposes.

Another example of the application of the model is the LPTx project that Revenue undertook in 2013. A one-page synopsis of this project is reproduced in full in Appendix E, and all the findings in this research are clearly present in this case study. In the first two paragraphs, plans to draft legislation, build a property register and develop a customer service model with a mix of experienced staff and an external call centre in a short period (nine months) are described. These are all examples of a strong inner context planning to shape the outer context and develop the content. The following three paragraphs discuss extensive consultations with a range of bodies, agencies and a public information campaign. This culminated in over one million telephone and eMail queries and postal notifications to two million properties. These are examples of social marketing and stakeholder management in action, and are all process factors. The fifth and sixth paragraph describe the on-line service including eight different payment options using three external service providers and also the option for tax deduction at source, which are descriptions of quality content. The remaining four paragraphs describe the adoption of the on-line system by 76% of
taxpayers within three months. The final paragraph describes the integration of LPTx into Revenue’s consolidated tax system, which is another aspect of quality content.

The LPTx was an unpopular tax at a time of austerity, and it is interesting to explore how Revenue developed a national system and service in such a short space of time, and then achieved such a high rate of compliance in a shorter space of time. The central planks of this achievement were a strong inner context that engaged in widespread stakeholder consultation, quality content and a well-supported process.

11.6. Recommendations for ePrescribing Policy

The development of ePrescribing and eHealth varies widely across countries, but progress is evident in the policy area. In the EU, for example, all member states have “developed policy statements on healthcare technology investment, adoption and diffusion, which taken as a whole is highly fragmented and patchy” (Currie and Seddon 2015, p533). As more data on the adoption and diffusion of eHealth becomes available a more complete picture is emerging from which policy makers can learn. In recent years researchers such as DesRoches et al. (2013, p36) have discussed the trend towards benchmarking and comparative analysis in eHealth, and observe that there is an “array of efforts to compare adoption, use and even impact of HIT across countries”.

Organisations such as the Commonwealth Fund, the European Consumer Powerhouse, EC, OECD, the TEMPEST project, WHO, and the international HI academic community are providing increasingly useful data for international comparison purposes in the public domain. However, the difficulties of cross-country comparisons have also been noted, as different measures are used by different organisations for comparison purposes. This is, in part, a reflection of the complexity of the domain, as the contexts of each country are different, in areas such as national health models, governance and funding models, the organisation of primary and secondary care, ICT developments, and so forth. These factors have become apparent in this thesis also.

Others including Adler-Milstein et al. (2014, p115) have suggested common benchmarks to measure and evaluate EHR progress in a country as follows: “As countries move to develop and implement strategies to increase the use of ICTs to promote health goals, there is a historic opportunity to enable cross-country learning. This learning occurs when countries share a common understanding of what others have done and how they got there. Doing so requires detailed attention to creating
benchmark measures in ways that allow for a granular picture of each country’s status and progress”. In this thesis, every effort was made to create common and comparable benchmark measures in the comparative analysis of ePrescribing in primary care in 31 countries. This comparative analysis brings to light several adoption groups and patterns, and the combination of complex adoption factors at play. The analysis of ROS also reveals similar patterns and the presence of many similar adoption factors in the Irish eGovernment domain.

The findings from this research may be expressed in terms of policy recommendations. A sample list of policies has been identified in the CCP areas from the comparative analysis of the leading countries and ROS, and these are presented in the remainder of this section.

11.6.1. ePrescribing Policy – Outer Context
Policy for national eHealth projects can be devised to provide a positive external environment for ePrescribing, described in the following subsections.

11.6.1.1. Stakeholder Engagement Policy
The research has found that engagement with stakeholders in the outer context is a key issue in developing and adopting successful national services. A policy of continuous formal stakeholder engagement and awareness raising activities can be adopted for all national eHealth services.

11.6.1.2. Legal and Regulatory Policy
A legal and regulatory framework which accommodates supports and promotes ePrescribing is a key policy area. The research has clearly demonstrated that the countries that have not provided specific legislation for all aspects of ePrescribing are among the late majority or laggards. It is also clear from the research that the existing legal and regulatory framework may be a barrier to the development and adoption of ePrescribing in some countries. The legal requirement to write prescriptions in ink (e.g. for controlled medication), the legal status of electronic prescriptions at all stages of the journey, the legal status of electronic signatures, and the national regulations for dispensing medication are all areas that require clear policy.

11.6.2. ePrescribing Policy - Inner Context
The inner context is where national ePrescribing projects are developed and managed. These are typically national eHealth institutes or divisions of a national health authority.
Policy areas can be identified to support a strong inner context in the following subsections.

11.6.2.1. Stakeholder Management Policy
The key critical success factor in the leading countries and ROS was identified as stakeholder management by the inner context in the process of adoption. Consequently, active stakeholder management is a key policy recommendation. This includes activities in the outer context, such as awareness raising and marketing campaigns. It also includes ongoing activities in the inner context with the adopter groups as they adopt national systems and services. A clear engagement with the ICT industry is vital for development of quality content, and Revenue, for example, initially underestimated this factor (cf. Section 8.4.2). Close stakeholder management in the process of adoption was found to be essential with a variety of user support policies. There is clearly an overlap in policy recommendations for stakeholder management across the CCP dimensions, but the evidence suggests that stakeholder management is a key factor across all dimensions.

11.6.2.2. Policy for Integrated eHealth, ePrescribing and eGovernment Strategies
The evidence from the leading countries suggests that there is little integration between ePrescribing, eHealth and eGovernment. In the leading countries, a national ePrescribing strategy proved useful, but it may be more beneficial to patients and citizens to develop a policy of integrated national eHealth and eGovernment services.

11.6.2.3. National Competence Centre with a policy of Transparency and Accountability
The successful national ePrescribing organisations and Revenue all play the role of national coordinators, and they all share policy of openness, transparency and accountability. MedCom, Apoteket AB, Nictiz and Revenue are all national publicly funded organisations. They publish information on national projects – both successes and failures - on a regular basis. This policy of accountability through open public information and transparency seems to encourage a culture of trust among stakeholders.

11.6.2.4. Formal Project Management Policy
The leading countries use formal project management methods for national eHealth projects against which results can be measured. The ROS project, Apoteket AB and MedCom all use formal project management methods such as PRINCE in national eHealth and ePrescribing projects.
11.6.2.5. Policy on Project Failure
The leading countries and ROS have an explicit or implicit policy of responding to a changing situation as it develops, and also to project failure. All were prepared to terminate projects if they were unsuccessful or if unexpected events occurred. Revenue terminated the first release of PAYE on-line and MedCom have a two-year policy for projects, whereby a project is terminated if it is not successful within that period. This enables national pilot projects to be evaluated and lessons learned without incurring large costs.

11.6.3. ePrescribing Policy - Content
The content of national systems is the technical artefact, comprising hardware, software, communications infrastructure, data and associated legal and support services. Policy in this area is required to support the development of quality content, and revolves around software development, technical standards and ownership.

11.6.3.1. System Development and Public Ownership Policy
ROS is an excellent example of a system that was jointly developed in a public-private partnership where Revenue was the senior partner. The national system that evolved – with central databases, embedded security, authentication services and a range of modules for users available on a variety of platforms – is a complex technical artefact. The development policy enabled Revenue to secure ownership of the developed software, and over time Revenue staff learned to develop the system without the need for external expertise. Consequently the ROS development is under public ownership and public control. Similar public-private policies for national systems have been employed, for example in Denmark and New Zealand (Protti et al. 2009a).

11.6.3.2. Policy for Consultation with ICT Industry
A policy is required to engage with the ICT industry to develop quality content. Software suppliers and ICT companies are key stakeholders in a national system where third party products are required. In both the Danish ePrescribing project and the ROS project, there are examples of close collaboration with the ICT industry in a non-commercial environment. In Denmark for example, MedCom regularly consult and explain to software suppliers the new specifications and standards required for national systems: “For several years in winter, when the weather is bad in Denmark, a few programmers from each software supplier were invited to a special workshop on the
Mediterranean coast. These workshops achieved high levels of attendance, collaboration and bonding” (Benson 2010, pp 17-19).

11.6.3.3. Software Certification Policy
Software products for eHealth and ePrescribing are becoming subject to certification and regulation, and this is a developing policy area. In the Netherlands, Nictiz works with software suppliers to develop their software using the new standards of HL7 and SNOMED CT. In Sweden, Apoteket AB has certified all pharmacy systems for use in the new unregulated market since 2009, while in Denmark MedCom provides a national service to certify all eHealth software for use in Denmark. This amounts to over 60 suppliers with over 100 software products, and if the software does not meet the defined MedCom standards, then it will not receive the stamp of approval and cannot be used in the Danish eHealth sector (Protti and Johansen 2010).

11.6.3.4. System and Data Security Policy
One of the greatest concerns among users of national on-line services is the security of the system and of the sensitive data that is recorded, transmitted, processed and stored in such systems. For example, in ROS the security, privacy and confidentiality of the data were the highest priority in the development project. Policies to develop and maintain secure systems and protect data can be developed, and these have included such areas as legal safeguards for data, secure login when using an open platform such as the Internet, agreed technical interoperability standards, data encryption policies and formal user registration procedures.

11.6.3.5. Policy for Technical Standards
There are many different types of technical standards required for interoperability, and a policy for the use of common technical standards is a key building block. It is interesting that in the leading ePrescribing countries, similar technical standards (based on EDIFACT standards) for ePrescribing messages and communications were agreed between fifteen and twenty years ago. These standards are in everyday use, with a gradual shift to XML, HL7 and SNOMED CT in most of the leading countries. Another data standard common in the leading countries is the national medication data file produced by the national pharmaceutical authority in each country (e.g. ATC codes and G-codes). Following the results of the EPSOS project, the EU has recommended a standard medication data file for use across all EU countries to support cross border interoperability in ePrescribing.
In Ireland, it was the policy of Revenue to use open technical standards in the
development of ROS. The ROS website uses a standard web browser and has been
developed to international web standards for content design and usability. These
standards include the “World Wide Web – Content Standard”, and the “World Wide
Web Consortium (W3C) - Website Content Accessibility Guidelines”. The use of such
open standards increases the interoperability of its components, and facilitates the re-use
of Revenue’s existing frameworks and systems (Foscarini 2008).

11.6.3.6. Reliable Real-Time ETP Policy
The key technical challenge in ePrescribing is ETP, and the evidence suggests that a
policy is required to design, provide and manage a reliable real-time national ETP
service. This policy could cover arrangements for an alternative service in the event of
a failure in the ETP service, which may include the use of mobile technology, and
printed, faxed or written prescriptions.

11.6.4. ePrescribing Policy – Process
Policy in the process of development and adoption of national services is perhaps the
most difficult area, as there are many variables in the adoption of national ePrescribing
systems and services. Policies can be devised to support the adoption and diffusion
process which are context-specific, process-specific and stakeholder-specific.

11.6.4.1. Long Term Policy for National Projects
This research found that national ePrescribing and eGovernment projects are long term
undertakings. As two interviewees observed: “we never thought it would take so long”
(SE-IV 1); and “the time factor always seems to be underestimated” (NL-IV 1). Long
term planning was evident in the case of ROS, where Revenue’s goal was to have 50%
of taxes filed on-line after five years, and then progress to the second phase of the
project. Any policy for national projects must take the long term view into account.

11.6.4.2. Implementation Policy
The evidence from the leading countries and ROS suggests that an incremental
implementation policy over the long term leads to stable systems and sustainable
adoption. This approach gives the stakeholders in different adoption groups time to
adapt, and creates a low-risk project. The evidence also suggests that a combination of
top-down and bottom-up approaches by means of intensive stakeholder involvement
with a strong inner context creates a national project that is nationally managed and
provided (from the top) but locally agreed (from the bottom), which is closer to the

177
middle-out approach. Some countries such as Croatia, Romania and Turkey have implemented top-down, mandatory national systems in recent years, but there is not enough information available yet to evaluate these projects.

11.6.4.3. Policy on Incentives
The evidence from some countries such as the Netherlands and Denmark suggests financial incentives can make a difference to adoption. In other cases such as ROS, non-financial incentives were used to some effect. A policy on incentives (such as the recent USA Meaningful Use programme) can be very effective in certain contexts.

11.6.4.4. Mandatory Use Policy
The evidence from the leading countries and ROS suggests the mandatory use of a system can be a useful policy instrument, but only when a tipping point has been reached. This occurred in Finland, the Netherlands, and Denmark where it was noted that: “mandates are used to slowly improve functionality and use of the system over time, not for initial adoption” (DK-IV 1). In the ROS project, the approach to mandates was described as the “carrot approach” (ROS-IV 1).

11.6.4.5. Consent Management Policy
The management of patient consent to the use of ePrescribing and eHealth varies from country to country. The evidence suggests that an opt-out policy works best, where all patients are automatically registered unless they actively oppose it, and can opt-out with appropriate information provided at the point of care. The evidence also points to the fact that consent management works best where clear legislation and secure systems are in place to support data transmission between healthcare institutions, and this is clearly explained to patients. In Sweden, for example, there are patient information leaflets in every pharmacy that explain the technical-legal arrangements for ePrescribing in nine languages.

11.6.4.6. User Support Policy
A policy to support users was found in all the leading countries and ROS. This incorporates the provision of information, training, national helplines, and local experts such as data consultants in Denmark or ROS liaison officers in Ireland, who were the “key to national adoption” (ROS-IV 3). One interviewee from Sweden observed: "You build credibility and confidence by having a system that is easy to access and by quickly responding to every support issue" (SE-IV 1).
11.6.4.7. Social Marketing Policy
A surprising finding from the research was the policy of marketing. A common feature of the most successful projects was the approach to marketing and publicity, and can be seen as another aspect of stakeholder management. In all cases marketing was seen as a necessary investment, and professional marketing campaigns were devised to target the niche sectors, similar to campaigns for products and services in the commercial sector. This may seem unusual for national health authorities and national tax authorities, but as one interviewee observed “you must sell the benefits of the ePrescribing system or nobody will use it” (SE-IV 1).

11.7. Summary
Developments in ePrescribing at national level in Europe are dynamic with an increasing level of adoption over time, but many more innovations are required before this domain matures. While national ePrescribing services are diffusing, various divides are evident between the leaders and the followers in Europe. The findings suggest that ETP is the key challenge for most countries, and in the 11 countries where ePrescribing is a reality, the advanced clinical features are not well developed, and integration with national EHRs is practically unknown. These findings indicate that the ePrescribing and eHealth domains in general are still at the early developmental stages.

The evidence and analysis in this thesis found that a strong inner context that engages in long-term stakeholder management is the key factor behind the adoption of ePrescribing in the leading countries. A strong inner context is the cornerstone, and was found to be central in the creation of the two other building blocks - a positive outer context for adoption and the provision of quality content. ePrescribing was found to be a complex multi-stakeholder phenomenon, and the key critical success factor was found to be stakeholder management in the process of adoption over a long period.

Several themes came to light from the discussion, and lessons from the leading countries suggest that a positive context for adoption can be developed through policy measures. An interesting finding is the close parallels between the leading ePrescribing countries and the ROS project, which validates many of the lessons. The findings suggest that the contexts of each country are unique; therefore each must develop its own national policies, systems, and services for its own individual circumstances. Consequently, twenty sample policy measures for the development and adoption of
national ePrescribing services are suggested across all CCP areas. These policies have particular reference to countries where ePrescribing is undeveloped, such as Ireland.

The CCP conceptual framework that emerged in this thesis was found to be applicable to other similar national eHealth and eGovernment services for evaluation and other purposes, and may be useful in the HI research field.

In Chapter 12 final conclusions are presented and the contributions and limitations of the research are discussed.
12. Conclusions

“The best doctor gives the least medicines”. (Benjamin Franklin)

12.1. Review of Research Question and Research Design

The research question posed in Chapter 1 was as follows:

*What are the building blocks and critical success factors for the development and adoption of national ePrescribing services in primary care in Europe, and what are the policy lessons for countries such as Ireland?*

This question is concerned with the factors surrounding the development of structures at national level to facilitate the adoption of ePrescribing in primary care. In addressing the question, I attempted to establish the prevalence of ePrescribing in primary care in Europe, and to identify the leading countries. This led to an investigation of the building blocks and critical success factors in the leading countries. A detailed case study of a successful Irish eGovernment project (ROS) was also carried out, in order to compare with the ePrescribing findings, and to explore the Irish context.

The research design included the case study and comparative analysis methods, supported by interviews with national experts in ePrescribing and ROS. A cross-domain comparison was undertaken between the Revenue and ePrescribing domains in order to explore similarities and differences, and identify common success factors. The conceptual frameworks employed were Pettigrew and Whipp’s CCP framework, and Roger’s diffusion of innovation model.

12.2. Review of Findings

There is a great deal of activity and progress in the field at this time. Many European countries have launched national eHealth and ePrescribing projects in the last decade, as ICT continues to develop, mature and diffuse. The EU has expanded from 15 to 28 countries since 2000, and has played a key role in promoting eHealth at national level in member states.

In primary care, adoption patterns in 31 European countries were explored, and approximately one third of European GPs are using ePrescribing with ETP in 2015. A further analysis of this data found that 11 countries have launched successful national ePrescribing services in the primary care sector. Sweden, Denmark and the Netherlands emerged as the innovators, while Iceland, Estonia, Finland, Norway and Croatia were
classified as the early the adopters. The rate of adoption is increasing over time, as the evidence shows that high adoption rates have been achieved by the early adopter group in a shorter time than the innovators, typically 3-5 years compared to 15-20 years.

The evidence suggests that most of the 31 countries are developing their capacity for national eHealth and ePrescribing. However, the provision of national ETP services continues to be the major organisational, technical and legal challenge for most countries. A digital divide and a legal divide were found in ePrescribing in Europe, roughly between the north and the south, where there are few examples of complete national ePrescribing services equivalent to those of Denmark or Sweden, for example.

A comparative analysis of the leading ePrescribing countries identified many common factors in the context, content and process. This analysis found that ePrescribing is a very complex service, and all three CCP dimensions must be aligned for adoption. The national health model was found to be a key external factor, with NHS countries achieving higher rates of adoption in eHealth and ePrescribing. The evidence from the leading countries and ROS pointed to a strong, dynamic and transparent inner context as the architect of the external context, and the findings suggested that a positive external context for ePrescribing adoption can be crafted and developed. This includes the legal, technical, marketing, and user support areas.

The provision of ETP services is the central plank of a national ePrescribing service in primary care, and ETP comprises technical, security, legal, operational and consent components. ETP is a complex undertaking, and in the leading countries the security and usability of the system played a crucial role in adoption by prescribers and pharmacists. The evidence suggests that a shared public-private software development approach and agreement on national technical standards were key issues in providing user-friendly, interoperable systems, which support the professional relationships between prescriber, patient and pharmacist.

The findings from the leading countries that have achieved working national ePrescribing services (and ROS) suggest that a degree of central control combined with extensive two-way stakeholder consultation is a strategy that bears fruit. This approach is close to what Coiera has described as “middle-out”. Incremental implementation methods, voluntary use by prescribers and pharmacists, and an opt-out policy for patients were also found to be a successful combination. An element of incentives for
adoption also played a part in the leading countries and for ROS, while the careful use of mandates was evident in all the leading countries.

When a close examination of the adoption process was undertaken, most of the evidence pointed to stakeholder management as the key factor behind successful national ePrescribing services and ROS. Two-way stakeholder communication was found in the legal, regulatory, technical and the organisational areas of all the leading countries. It was found in the inner and outer contexts and at the fringes where stakeholders engage with the content when adoption occurs.

The golden thread of national ePrescribing is the collaboration of stakeholders to bind together the organisational, legal, regulatory and technical infrastructures to achieve a working solution that can be trusted, developed and expanded. A strong inner context with ongoing two-way stakeholder engagement was identified as the cornerstone of success in all the leading countries examined.

12.3. Conclusions and Contributions to Policy
To conclude, a national ePrescribing model for primary care is slowly emerging over time. This model includes local EHR integration, interoperability between prescribers and pharmacists through a national ePrescription database, and a trend towards patient access to prescription information via the Internet. While a similar national model is emerging in some countries, the evidence suggests that ePrescribing systems and services are country-specific, context-specific and content-specific. This implies that each country must develop its own outer context, inner context, content and processes for national ePrescribing in primary care.

The findings and conclusions provide the basis for policy recommendations. These recommendations may be viewed as an overall policy package for the development of national ePrescribing systems and ETP services. The evidence suggests that a positive national environment for the development and adoption of ePrescribing can be created. This can occur in a country with a strong well-organised inner context; where stakeholder engagement and management are routine in the domain; where the content is secure, interoperable, useable, and of high quality; where national ePrescribing and ETP services are developed and provided from a legal, technical, organisational, economic, social and user perspective.
Specific policy recommendations for each of the CCP dimensions were presented in Chapter 11 and a summary is presented in Table 12-1. The challenge of developing ePrescribing is similar in all countries as Mackenbach and McKee (2013, p362) note: “Despite the rich diversity of Europe, the health challenges are similar. We urge policymakers from all of Europe to combine efforts, through mutual learning and mutual assistance, to implement what we know to be possible and thereby improve the health and well-being of their citizens in the coming decades”.

<table>
<thead>
<tr>
<th>Policy Area</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stakeholder management policy</td>
<td>A policy for continuous engagement with key stakeholders and users is required; stakeholder management in the outer context develops trust; is a central feature of the inner context; and helps to develop quality content, and supports the process of adoption</td>
</tr>
<tr>
<td>Legal &amp; regulatory policy</td>
<td>A policy for digital signatures and data transmission and storage is required for a supportive legal environment for ePrescribing,</td>
</tr>
<tr>
<td>Policy for integrated eHealth, ePrescribing and eGovernment services</td>
<td>A policy is required to integrate national ePrescribing services with other eHealth services, and also eHealth with eGovernment services</td>
</tr>
<tr>
<td>Policy for a transparent and accountable national competence centre</td>
<td>A national coordinating body with a policy of transparency and accountability is essential to build trust among stakeholder, including openness about failures</td>
</tr>
<tr>
<td>Formal project management policy</td>
<td>A project management policy is required for national projects</td>
</tr>
<tr>
<td>Policy on project failure</td>
<td>The inner context must be responsive to changes and be prepared to adjust or terminate projects</td>
</tr>
<tr>
<td>System development and public ownership policy</td>
<td>A shared systems development policy with public ownership of national assets</td>
</tr>
<tr>
<td>Policy for consultation with ICT industry</td>
<td>A policy is required for communication with the ICT industry as a key stakeholder</td>
</tr>
<tr>
<td>Software certification policy</td>
<td>A policy is necessary to regulate the quality of EHRs and ePrescribing software at a national level</td>
</tr>
<tr>
<td>System and data security policy</td>
<td>A policy for a safe national network for ETP is required using a combination of technical, legal &amp; organisational factors</td>
</tr>
<tr>
<td>Policy for technical standards</td>
<td>A policy is required to agree and build future-proof interoperable ePrescribing and ETP systems, and to agree and communicate these standards to stakeholders in a non-commercial way</td>
</tr>
<tr>
<td>Reliable real-time ETP policy</td>
<td>A policy to provide a reliable real-time ETP service is essential</td>
</tr>
<tr>
<td>Long term policy for national projects</td>
<td>National ePrescribing projects require long-term planning, for at least a decade or more</td>
</tr>
<tr>
<td>Implementation policy</td>
<td>National implementation policy required; centrally managed, locally agreed, middle-out, and incremental was most successful</td>
</tr>
<tr>
<td>Policy on incentives</td>
<td>A policy on financial and non-financial incentives may promote adoption</td>
</tr>
<tr>
<td>Mandatory use policy</td>
<td>A policy for mandatory use may be very useful to promote adoption; e.g. after the tipping point is reached</td>
</tr>
<tr>
<td>Consent management policy</td>
<td>A national policy is required for patients; e.g. option to opt-out at the point of care</td>
</tr>
<tr>
<td>User support policy</td>
<td>A policy for national user support systems is required for all users/stakeholders</td>
</tr>
<tr>
<td>Social marketing policy</td>
<td>ePrescribing needs to be clearly explained; a policy for social marketing is required for stakeholders in the domain and the wider public</td>
</tr>
</tbody>
</table>
12.4. Contribution to Theory
Rogers developed a “general diffusion model” (Rogers 2003, Preface, p (xvii)) to understand adoption and diffusion patterns across many domains, and using a similar concept, a national ePrescribing model is suggested. This conceptual model for understanding national ePrescribing is built on the frameworks developed by Pettigrew and Whipp, and Rogers. The model suggests a longitudinal approach, where the context (environment and organisation), content (technology and legislation), and process (implementation and adoption) are examined as a whole. This model may provide a framework to make sense of and understand the development and adoption of national ePrescribing systems and services. It may also have some application in the broader national eHealth and eGovernment domains.

12.5. Areas for Future Research
This research has identified a gap in the literature regarding the development and adoption of national eHealth services such as ePrescribing. The evidence indicates that national eHealth services are in the early stages of development, and many future eHealth services will be organised and developed at national level. This finding suggests that this field will remain fertile for future research for many years.

Areas for future research emerging from this thesis include: the co-evolution of national health models and the development of national ePrescribing services; the eHealth interface between primary and secondary/tertiary care; stakeholder management in the eHealth and eGovernment domains; the impact of social marketing on the adoption of eHealth and eGovernment; integration and synergy between eHealth and eGovernment services; and the evaluation of public-private software development in eHealth and eGovernment applications.

12.6. Limitations of Research
It is necessary to acknowledge the limitations of the research. This research focused on ePrescribing in the health domain, using a single comparison with ROS from the eGovernment domain. A broader range of comparative cases from the eGovernment domain in different countries may have provided deeper insights at the individual country level.

Much of the data gathered on the adoption of ePrescribing was from secondary sources such as research carried out by the EC, PGEU, the TEMPEST project and so forth.
While this data was confirmed and explained by national experts in interviews, and in published research and statistics in each country, it is necessary to acknowledge this limitation.

The research methods used - qualitative, explorative and longitudinal - may be open to biases such as confirmation bias or publication bias. While every effort was made to analyse all the evidence over a long period and arrive at conclusions based on all the evidence, this limitation must be acknowledged.

I have been a registered user of ROS as a taxpayer and tax agent since April 2002. While this experience provides insight to the operations of ROS, the possibility of bias from this experience must be acknowledged.

12.7. Final Thoughts

It is evident that ePrescribing is spreading and at some point in the future most countries may develop national models with all the associated changes, challenges and benefits and risks that this paradigm shift will bring. What changes will this herald?

Will prescribing be safer in primary care? Will the clinical benefits of ePrescribing be reaped or will new risks appear? Will the risks to patients from polypharmacy be reduced with access to ePrescribing data? Will adverse drug events diminish? Will prescription fraud become a thing of the past? Will some patients manage and order their medication on-line? Will a critical mass of prescribing data be available to quickly perform research into new medicines and issues of medical concern such as Ebola or AIDS? Who will benefit from the research that will be possible with such volumes of data? Will on-line health records become as common as on-line banking?

I suspect that the ePrescription and eReceipt may eventually become as ubiquitous and universal in the health domain as penicillin, and that many of these things may come to pass in the years ahead.

Final thought: the life work of Everett Rogers was in trying to understand the adoption of innovations across many domains. His methods were typically case studies and his findings were grounded in the evidence he gathered and reported with scientific and academic rigour. Rogers is a giant of adoption research, and in this niche academic area I found myself standing on his shoulders while involved in a similar quest. It is unfortunate that Everett Rogers passed away in 2004, as I would certainly have tried to
meet him to discuss the adoption of ePrescribing in primary care. Would our views have been similar or different?
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200


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Appendix A: Data Sources and Data Analysis Categories

(1) Sample EC Reports on eHealth
A list of sample eHealth reports from the EC and other European sources over the previous five years is outlined in Tables A-1 and A-2. A sample list of organisations that publish data on eHealth and ePrescribing is shown in Table A-3.

<table>
<thead>
<tr>
<th>Year</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Benchmarking Deployment of eHealth among General Practitioners</td>
</tr>
<tr>
<td>2013</td>
<td>European Hospital Survey: Benchmarking Deployment of eHealth Services</td>
</tr>
<tr>
<td>2011</td>
<td>European countries on their journey towards national eHealth infrastructures</td>
</tr>
<tr>
<td>2011</td>
<td>A composite index for the benchmarking of eHealth Deployment in European acute Hospitals</td>
</tr>
<tr>
<td>2011</td>
<td>eHealth Benchmarking III</td>
</tr>
<tr>
<td>2010</td>
<td>Interoperable eHealth is Worth it</td>
</tr>
<tr>
<td>2009</td>
<td>eHealth in Action : Good Practice in European Countries</td>
</tr>
<tr>
<td>2009</td>
<td>The socio-economic impact of interoperable electronic health record (EHR) and ePrescribing systems in Europe and beyond</td>
</tr>
<tr>
<td>2009</td>
<td>The socio-economic impact of Diraya, the regional EHR and ePrescribing system of Andalucía’s public health service</td>
</tr>
<tr>
<td>2009</td>
<td>The European Files: eHealth in Europe</td>
</tr>
<tr>
<td>2009</td>
<td>eHealth Benchmarking II</td>
</tr>
<tr>
<td>2008</td>
<td>Benchmarking ICT use among General Practitioners in Europe</td>
</tr>
<tr>
<td>2007</td>
<td>Pilot on eHealth indicators : Country Profiles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Report</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Atlas eHealth country profiles (World Health Organization)</td>
</tr>
<tr>
<td>2010</td>
<td>National policies for EHR implementation in the European area: social and organizational issues (EHR Implement)</td>
</tr>
<tr>
<td>2010</td>
<td>Political and organisational factors influencing large scale implementation of electronic health records (EHR Implement)</td>
</tr>
<tr>
<td>2010</td>
<td>Achieving Efficiency Improvements in the Health Sector through the Implementation of Information and Communication Technologies (OECD)</td>
</tr>
<tr>
<td>2010-2014</td>
<td>Measuring the Information Society (International Telecommunication Union)</td>
</tr>
<tr>
<td>2010</td>
<td>Hospital Pharmacy and Community Pharmacy: Use Cases and Standards White Paper (Integrating the Healthcare Enterprise – Europe)</td>
</tr>
<tr>
<td>2009</td>
<td>ePrescribing: the Path to Physician Adoption of HIT (Siemens Medical Solutions)</td>
</tr>
<tr>
<td>2009</td>
<td>Accomplishing EHR/HIE (eHealth): Lessons from Europe (CSC Corporation)</td>
</tr>
<tr>
<td>2009</td>
<td>Explaining International IT Application Leadership: Health IT (The Information Technology &amp; Innovation Foundation)</td>
</tr>
<tr>
<td>2009-2014</td>
<td>European Health Consumer Index (Health Consumer Powerhouse AB)</td>
</tr>
<tr>
<td>2009</td>
<td>Electronic Prescribing in Hospitals - Challenges and Lessons Learned (NHS UK)</td>
</tr>
<tr>
<td>2009</td>
<td>eHealth for a Healthier Europe! : Opportunities for a better use of healthcare resources (Ministry of Health and Social Affairs Sweden)</td>
</tr>
<tr>
<td>Name</td>
<td>Organisation</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>WHO Global Observatory on eHealth</td>
<td>World Health Organisation</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>Health Policy Monitor</td>
<td>Bertelsmann Foundation</td>
</tr>
<tr>
<td>Eurohealth</td>
<td>European Observatory on Health Systems and Policies</td>
</tr>
<tr>
<td>Good Practice eHealth</td>
<td>European Commission funded project</td>
</tr>
<tr>
<td>eHealth ERA</td>
<td>European Commission funded project</td>
</tr>
<tr>
<td>eHealth Benchmarking</td>
<td>European Commission funded project</td>
</tr>
<tr>
<td>ePractice.eu</td>
<td>European Commission funded project</td>
</tr>
<tr>
<td>Euro Health Consumer Index</td>
<td>Health Consumer Powerhouse</td>
</tr>
<tr>
<td>Agency for Healthcare Research and Quality</td>
<td>U.S. Dept of Health and Human Services</td>
</tr>
<tr>
<td>The Information Technology and Innovation Foundation</td>
<td>The Information Technology and Innovation Foundation</td>
</tr>
</tbody>
</table>

Source: (EU 2011)
(2) Qualitative Literature and Interview Analysis: Categories and Sub-Categories

The key categories and associated sub-categories for the analysis of qualitative literature and interviews for ePrescribing are shown in Table A4, and for ROS in Table A-5.

<table>
<thead>
<tr>
<th>Organisation &amp; Environment</th>
<th>Legislation &amp; Regulation</th>
<th>ICT &amp; Technology</th>
<th>Projects &amp; Adoption</th>
<th>Actors &amp; Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>National health model</td>
<td>e-Health law</td>
<td>National standards</td>
<td>Mandatory &amp; voluntary</td>
<td>Collaborate &amp; co-operation</td>
</tr>
<tr>
<td>Organisation of primary care</td>
<td>Consent rules</td>
<td>Interoperability</td>
<td>Critical success factors</td>
<td>Management &amp; Engagement</td>
</tr>
<tr>
<td>Organisation of pharmacy service</td>
<td>Laws on Data transmission/ETP</td>
<td>System security</td>
<td>ePrescribing leaders</td>
<td>National health authorities</td>
</tr>
<tr>
<td>ePrescribing/eHealth strategy</td>
<td>Laws on Data protection</td>
<td>EHRs &amp; eHealth infrastructure</td>
<td>National projects</td>
<td>Regulators</td>
</tr>
<tr>
<td>National eHealth institute</td>
<td>Unique Identifiers</td>
<td>Usability</td>
<td>Barriers &amp; enablers</td>
<td>Patients</td>
</tr>
<tr>
<td>Governance model</td>
<td>Patient safety</td>
<td>Other eHealth systems</td>
<td>Success &amp; failure</td>
<td>Prescribers &amp; pharmacists</td>
</tr>
<tr>
<td>Funding &amp; economics</td>
<td></td>
<td>National/regional networks</td>
<td>Top-down, bottom- up, middle-out</td>
<td>ICT industry</td>
</tr>
<tr>
<td>Accountability &amp; transparency</td>
<td></td>
<td>National ICT profile</td>
<td>Incentives &amp; penalties</td>
<td>Professional bodies</td>
</tr>
<tr>
<td>External events</td>
<td></td>
<td></td>
<td>Publicity &amp; marketing</td>
<td>Industry &amp; commerce</td>
</tr>
<tr>
<td>Political &amp; top management support</td>
<td></td>
<td></td>
<td>Pilot projects</td>
<td>Policy makers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organisation &amp; Environment</th>
<th>Legislation &amp; Regulation</th>
<th>ICT &amp; Technology</th>
<th>Projects &amp; Adoption</th>
<th>Actors &amp; Stakeholders</th>
</tr>
</thead>
<tbody>
<tr>
<td>National revenue model</td>
<td>eGovernment &amp; eTax laws</td>
<td>National standards</td>
<td>Mandatory &amp; voluntary</td>
<td>Collaborate &amp; co-operation</td>
</tr>
<tr>
<td>Organisation of Government</td>
<td>Consent rules</td>
<td>Interoperability</td>
<td>Critical success factors</td>
<td>Management &amp; Engagement</td>
</tr>
<tr>
<td>Organisation of revenue service</td>
<td>Laws on Data transmission</td>
<td>System security</td>
<td>eGovernment leaders</td>
<td>Revenue authorities</td>
</tr>
<tr>
<td>eGovernment strategy</td>
<td>Laws on Data protection</td>
<td>eGovernment infrastructure</td>
<td>National projects</td>
<td>Regulators</td>
</tr>
<tr>
<td>National eGovernment institute</td>
<td>Unique Identifiers</td>
<td>Usability</td>
<td>Barriers &amp; enablers</td>
<td>Taxpayers</td>
</tr>
<tr>
<td>Governance</td>
<td></td>
<td>Other systems for eGovernment</td>
<td>Success &amp; failure</td>
<td>Accountants &amp; Tax agents</td>
</tr>
<tr>
<td>Funding &amp; economics</td>
<td></td>
<td>National/Regional Networks</td>
<td>Top-down, bottom- up, middle-out</td>
<td>ICT industry</td>
</tr>
<tr>
<td>Accountability &amp; transparency</td>
<td></td>
<td>National ICT profile</td>
<td>Incentives &amp; penalties</td>
<td>Trade unions</td>
</tr>
<tr>
<td>External events</td>
<td></td>
<td></td>
<td>Publicity &amp; marketing</td>
<td>Industry &amp; commerce</td>
</tr>
<tr>
<td>Political &amp; top management support</td>
<td></td>
<td></td>
<td>Pilot projects</td>
<td>Policy makers</td>
</tr>
</tbody>
</table>
(3) Informal Consultation with National Experts

Informal consultation with authors, national experts and other researchers interested in the same niche area (ePrescribing, eHealth and eGovernment) took place at various conferences which are listed in Table A-6.

<table>
<thead>
<tr>
<th>Year</th>
<th>Organisation</th>
<th>Conference Title</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>Healthcare Information &amp; Management Systems Society (HIMMS) Europe</td>
<td>European Telemedicine Conference</td>
<td>Rome</td>
</tr>
<tr>
<td>2013</td>
<td>Institute of Healthcare Management UK</td>
<td>Electronic Prescribing in Hospitals – Moving Forward</td>
<td>London</td>
</tr>
<tr>
<td>2013</td>
<td>Healthcare Information &amp; Management Systems Society (HIMMS) Europe</td>
<td>2013 eHealth Week</td>
<td>Dublin</td>
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<tr>
<td>2013</td>
<td>The Irish Computer Society</td>
<td>The 9th Public Sector IT Conference</td>
<td>Dublin</td>
</tr>
<tr>
<td>2013</td>
<td>University Hospital Limerick (UHL)</td>
<td>University Hospital Limerick Research Symposium</td>
<td>Limerick</td>
</tr>
<tr>
<td>2012</td>
<td>European Federation for Medical Informatics (EFMI)</td>
<td>Special Topic Conference - Large Scale projects in eHealth</td>
<td>Moscow</td>
</tr>
<tr>
<td>2012</td>
<td>Health Informatics Scotland</td>
<td>2012 National Conference</td>
<td>Glasgow</td>
</tr>
<tr>
<td>2011-2014</td>
<td>Health Informatics Society of Ireland (HISI)</td>
<td>HISI National Conferences 2011-2014</td>
<td>Dublin</td>
</tr>
<tr>
<td>2011</td>
<td>European Federation for Medical Informatics (EFMI)</td>
<td>Medical Informatics Europe International Conference</td>
<td>Oslo</td>
</tr>
</tbody>
</table>
Appendix B: Interview Questions (ePrescribing)

University of Limerick - M.Sc. in Health Informatics

<table>
<thead>
<tr>
<th>Research Project Title:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Research Question:</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the building blocks for a national electronic prescribing system for Ireland?</td>
</tr>
<tr>
<td>Including: (1) Are there successful models for electronic prescribing in other countries that Ireland could adopt or learn from? (2) Are there examples of successful public eGovernment systems already in Ireland that could inform and guide a national ePrescribing project?</td>
</tr>
</tbody>
</table>

Research Issues for the Swedish National ePrescribing System

(A) Organisation & Regulation Issues

1) National Health ICT governance structures – what are the structures and how do they work?

2) Is there a national ICT or eHealth strategy, and what is the role of ePrescribing in this national strategy? What is the current plan for developing the national ePrescribing system?

3) Legal environment – are there specific laws for health data protection, ePrescribing, and EHR use? Are more planned or in progress?

4) National health ICT authority/organisation (Apotekens Service AB) – how did this come about and what role does it now play?

5) Unique identification & authentication of patients, doctors, pharmacists, hospitals, insurance bodies, national health bodies, etc – how is this achieved and managed? Is it national or regional? Are patient ID cards used?

(B) Technical Issues

6) System security and data privacy of ePrescriptions – how is this achieved in practice?

7) Is a secure national health network used? Is the internet used anywhere in the national system? Do patients use the Internet to access medication records?

8) What technical (messaging) standards are in operation for interoperability? Is there any plan to change these standards? Is HL7 version 3 used? Is interoperability semantic?

9) How is the ePrescribing and dispensed medication data stored? Locally, regionally, nationally or a combination?

10) Is drug information coded? What codes are used? Is free text allowed in messaging? Are decision support systems for drug interactions commonly used by doctors?

11) Is there a national drug database? How is it updated? How frequently? Are there any technical issues with this update?
12) Does a patient have to choose a pharmacy at the point of prescribing with the doctor, or can 
the prescription be downloaded by any pharmacy that the patient walks into? How are 
repeat prescriptions managed (by a record in the pharmacy? or return to doctor?)

13) Has there been any issue with hackers? Security breaches? Fraud?

(C) Adoption of National ePrescribing System

14) Were there incentives for stakeholders (doctors/software suppliers/pharmacists) to get 
involved? What were these? Was anything compulsory? How were stakeholders consulted? 
Is this an ongoing process?

15) Is there a quality mark or quality system for medical software which complies with national 
ePrescribing standards? Who controls the standards? Does this work?

16) Have the software suppliers of pharmacy systems/doctor practice systems/hospital systems 
adopted their software for national ePrescribing? Did this take much time?

17) Is there any difference in ePrescribing adoption between acute hospitals and primary 
care/community doctors? How does ePrescribing work in hospitals generally?

18) Are the medication records integrated with EHR’s in doctor practice systems, hospital 
systems and national systems (e.g. as in the EPSOS report)? How does this integration work 
in practice?

19) Is there a national database/system for ePrescriptions/eReceipts, dispensed medication and a 
medication summary? Who can access these records? How? Is patient consent required? 
Can patients access these records by the internet?

20) Are written prescriptions still in use? In what circumstances?

(D) Supporting Information

21) Are there any statistics available on the adoption, growth and prevalence of ePrescribing in 
Sweden?

22) Is there any cost information available for managing the national ePrescribing system?

23) Is there any cost-benefit analysis information available? Or clinical-benefit research?

24) What are the key challenges in developing the national ePrescribing system in the next ten 
years?

25) How has the recent de-regulation of the Swedish pharmacy market affected ePrescribing? 
Will new pharmacies continue to operate ePrescribing using the same system?
Appendix C: Interview Questions (ROS)

University of Limerick - PhD in Health Informatics

Research Project - Working Title:
National Electronic Prescribing Systems – Building blocks for a National System in Ireland

Research Question:
What are the building blocks for a national electronic prescribing system in Ireland?

Sub-Questions:
(1) Are there successful models for electronic prescribing in other countries that Ireland could adopt or learn from? (2) Are there examples of successful public eGovernment systems already in Ireland that could inform and guide a national ePrescribing project? (ROS has been selected for review)

Research questions for the Revenue On-Line Service (ROS)

(A) Organisation & Regulation Issues

1) Irish Government/Public Service/Dept of Finance/Revenue Commissioners/Collector General – were there or are there governance structures for ICT projects? What are these structures and how do they work?

2) Was there or is there a national ICT or eGovernment strategy? What is the role of the Revenue commissioners in this national strategy? What is the current strategy/plan for developing the national ROS system?

3) Legal environment – the 1999 Finance Act established the legal basis for ROS. Are there any more specific laws for data protection or e-signatures in the context of the use of ROS? Are more planned or in progress? How are the legal issues managed?

4) National ROS organisation/department (within Revenue) – how did this come about, how is it organised, and what role does it now play? Are there sections for strategy/planning / software development / systems testing/ operations/ support/ etc?

5) Were formal requirement documents used in the development of ROS over time? Were pilot projects used much?

6) Unique identification & authentication of taxpayers, agents, revenue offices, tax returns, payments, correspondence, etc – how is this achieved and managed in ROS? Are ID cards used anywhere in ROS?

(B) Technical Issues

7) What is the organisation of the technical IT service for ROS? Has this changed over time?

8) System security and data privacy of ROS data – how is this achieved in practice? Has the original PKI system been replaced over time?

9) Is a secure network used? (e.g. within Revenue) Or is the internet used everywhere in the national system? Can Revenue staff, agents or taxpayers access records in any way other than the ROS system?
10) What technical standards are in operation to support ROS? What standards are used for systems interoperability (e.g. with the Dept of Social Welfare for PPS numbers)? Is there any plan to change these standards or move to a single standard?

11) Is there a ROS applications section? (e.g. for PAYE anytime, ROS offline application, etc?) How are these applications developed and updated? How frequently? Are there any technical issues with these updates?

12) Systems and software development was shared between Revenue staff and outsourced firms (Accenture, Baltimore, more?) How did this work over time? Is it ongoing?

13) How is the ROS data stored? Locally, regionally, nationally or a combination? In a single virtual database, or a number of linked databases? In a single national physical data centre? Is there an image or diagram of the infrastructure?

14) Is ROS information coded? Why? Automatically? What codes are used? Is free text used?

15) How long is ROS data available on-line? Is the data archived over time? Is any data destroyed? Is there any “secondary use” of ROS data?

16) Are business intelligence systems for tax compliance using ROS data in place? Is this a different database to the “live” ROS database?

17) Has there been any issue with hackers? Security breaches? Fraud? Data integrity?

18) What is the plan for iXBRL?

(C) Adoption of ROS System (national level)

19) Were there any incentives for stakeholders (accountants/tax agents/software suppliers/etc) to get involved? What were these? Was anything compulsory? How were stakeholders consulted? Is this an ongoing process?

20) Why are some returns now becoming compulsory on ROS? What is the idea behind this?

21) Is there a quality mark or quality system for ROS software which complies with national or international standards? Who creates the standards? Does this work?

22) Have the software suppliers of financial systems/tax practice systems/accounting systems adopted their software for ROS? Did this take much time? Was there much consultation?

23) Are the ROS returns and records integrated with financial or tax practice systems? Do you have any feedback about how this integration works in practice?

24) Was there a difference in ROS adoption between tax agents and taxpayers? How is ROS used by taxpayers generally?

25) Was there a publicity campaign for ROS? A PR department? Public material? How did this work?

26) Who can access ROS data and records? Any access allowed to other Government departments? Is taxpayer consent ever required? Does this arise?

27) Are written tax returns still in use? To what extent? Is there a plan to have a fully electronic tax return system?
(D) Supporting Information

28) Are there any statistics available on the adoption, growth and prevalence of ROS (besides those published annually by the Revenue Commissioners)?

29) Is there any cost information available for developing the ROS system over time? Or supporting and managing the ROS on an annual basis?

30) Is there any cost-benefit analysis information available? Or any research into this?

31) Is there published information available from Revenue on different aspects ROS? e.g. research papers, master’s thesis, conference presentations, newspaper articles, magazine articles, tax briefings, revenue guides, etc? Is there a Revenue library? (I have been to the Revenue Museum in Dublin Castle).

32) What are the key challenges in developing the ROS system in the next ten years?

33) Has the recent Troika agreement affected the operation or strategy of ROS in any way? (e.g. the provision of information, the analysis of sectors, policies for greater compliance?)
**Appendix D: The Functions of Public Key Infrastructure (ROS)**

Extract from Tax Briefing, no 40, June 2000 (pp 15-16)

### The Functions of PKI

PKI is designed to fulfil the following requirements:

**Integrity of data** It is essential that Revenue can be guaranteed that the information transmitted to and from the customer arrives at its destination in an unaltered state i.e. that the information sent is exactly the same as the information received.

**Identification and Authentication** Communicating parties using the internet must be able to verify the identities of each other.

**Non-repudiation** The sender of a transmission should not be able to deny or repudiate the transmission subsequently. On a paper document a signature generally gives proof of identity and validity to any declaration thereon. The authentication of an electronic transmission for legal purposes will require that it should carry some sort of signature that binds the person making the transmission to what is received at the other end.

**Confidentiality or privacy of data** Since personal information is being transmitted over the internet there is fear of unauthorised capture or reading of that information. The confidentiality and privacy of personal data travelling to and from the customer must be assured.

### Terms used in PKI

**Registration:** Parties who wish to communicate confidentially and securely on the internet identify themselves to a Trusted Third Party known as a Registration Authority. In ROS, Revenue will act as the Registration Authority.

**Certification:** The Registration Authority satisfies itself as to the identity of the applicant and authorises the Certification Authority (CA) to generate a Digital Certificate and issue it to the applicant. A CA administers and is legally responsible for the authentication of the senders of messages and the issuing of Public and Private Keys to customers.

**Digital Certificate:** A Digital Certificate uniquely identifies the holder and consists of a ‘Key Pair’ – a Public Key and a Private Key. These are algorithms which are related mathematically although neither can be derived from the other. Therefore, a customer’s Public Key is uniquely equivalent to his or her Private Key.

**Public and Private Keys:** The Public Key is normally published on an open directory. Hence its name ‘Public Key’. However, in the case of ROS this will not be required, given that the keys will only be used for communications between the user and Revenue. The Private Key never leaves the possession of the user. If it is lost or compromised, the certificate is revoked, with the precise time of revocation being published in the directory.

**Security of Root Key:** The Certification Authority uses a ‘root key’ to generate the key pairs. Because the root key could be used to ‘break’ the Private Keys, they are held in maximum security facilities with military level physical, personnel and data protection.

**Digital Signature:** When a sender signs a document digitally, his Private Key algorithm is applied to all the data in the document to produce a ‘digest’ or mathematical string. This is the ‘Digital Signature’.

**Encryption:** In common with Digital Signature, encryption also operates on a Public Key/Private Key pair system. However, the operation of encryption and decryption operates in a different way to Digital Signature. In the case of Digital Signatures, a customer attaches a Digital Signature using his/her own Private Key. This Digital Signature is then subsequently
decoded by the receiver of the message using the customer’s Public Key. Encryption uses the Public and Private Keys in reverse to the way they are used for Digital Signatures.

For example, in ROS the customer encrypts their message being sent to Revenue using Revenue’s Public Key and sends the message to Revenue. The encrypted message can only be decrypted using the Revenue’s Private Key which corresponds to the Revenue Public Key used to encrypt the message by the customer. This ensures the confidentiality of the transmitted message.

**How ROS will use PKI**

The following example of sending a tax return using ROS will show the steps a customer will take, the automatic processes completed by the ROS system and the follow up action in Revenue.

(a) Customer accesses ROS, completes a tax return and prepares to transmit it.

(b) The customer will be asked by the ROS system to attach a Digital Signature.

(c) The transaction is encrypted by the Revenue Public Key, transmitted to and received by ROS.

(d) ROS decrypts the transaction using the Revenue Private Key.

(e) To authenticate the Digital Signature, Revenue retrieves the customer’s Public Key from the Public Key Directory and decrypts the customer’s Digital Signature with that Public Key.

(f) Revenue will accept the transaction if the Public Key is successful in decrypting the Digital Signature. The customer is notified if the transaction fails at this stage.

(g) To check the integrity of the transaction contents, Revenue recreates the coded summary that the customer created. Revenue compares the new coded summary with the coded summary in the Digital Signature. If they are identical then the transaction was not altered in any way in transit and the message sent is identical to the message received.

(h) An acknowledgement that the transaction has been successful is sent electronically back to the customer.

(i) Revenue then processes the ‘return’.

**Note:** The processes (c) to (h) inclusive are automatic and unseen by ROS Customers and will only take 1 - 2 seconds to complete.

**Why PKI works**

**Integrity** ROS applies the sender’s Public Key to the message to produce a comparable digest. If there has been even the most minute change in transit, or the Public Key does not match the Private Key used, the digests will not match. This means that the message/signature i.e. the integrity of the data has been compromised.

**Identification and Authentication** A Private Key is unique to the person to whom it was issued. The fact that the Public Key matches the Private Key used identifies the sender as the person who purportedly holds the Private Key. It serves the same function as a signature although it is not similar in nature to a hand-written signature. By means of matching Public and Private Keys a customer authenticates the identity of the ROS server, and has his or her own identity authenticated in turn by ROS. A ‘secure session’ is then established. Communications are transmitted in encrypted form and information so transmitted can be trusted to arrive privately and unaltered to the specified recipient and no other.

**Non-repudiation** The guaranteed integrity of the data and the uniqueness of the Private Key prevent the sender from subsequently repudiating the data sent. 

218
**Confidentiality or Privacy of Data** Confidentiality is defined as protecting data, either in files on a computer or in transmission between computers, from unauthorised access and disclosure. Confidentiality of data in transit is assured by cryptography. This is distinct from digital signing, but uses the same principal of the key pair. Encryption is the process of transforming data into a complex meaningless code which is unintelligible to anyone who does not have the decode ‘key’. The data cannot be read without using a decryption process. The strength of the encryption used is described in terms of ‘bits’ e.g. 40 bit, 56 bit, 128 bit etc. No encryption is unbreakable, however, and these standards are being continuously revised in light of the ability of new powerful computers to break these codes.

The 128 bit encryption standard is currently regarded as providing virtually unbreakable encryption security due to the computing power required to test all permutations in a brute force attack. 128 bit encryption will, therefore, be used in ROS. It improves protection exponentially. When the length of the decryption key is increased by one bit, the amount of effort required to break the code doubles. Constant security reviews will be an essential feature of ROS (and all sensitive internet applications) to ensure that its security policies keep abreast of current developments.

**Summary**

ROS PKI will:

- Identify the ROS server to the customer. When the user signs on to ROS his or her browser will recognise the ROS server’s ‘identity’. ROS will have its own unique digital identity, or certificate.

- Identify the customer to the ROS server. The customer’s certificate will uniquely identify him/her to the ROS server.

- Ensure that the data transmitted is not changed en route. Even minute changes to the data transmitted (e.g. the position of a full stop) will produce a different digest, thus showing that the data has been altered. If there is a match, ROS can be confident that the data to which the digest attached is unchanged. Where a document has been digitally signed by the sender and both document and signature are encrypted, all four requirements for ROS data security are met i.e. Integrity, Authentication, Non repudiation and Confidentiality.
Appendix E: Overview of Local Property Tax System (ROS)

Extract from the 2013 Annual Report of the Revenue commissioners (p12)

Feature Article - Administration and Collection of Local Property Tax

The introduction of Local Property Tax (LPT), the largest extension of the self-assessment system in the history of the State, was a major administrative challenge for Revenue during 2013. The timescale for its introduction required us to draft the necessary legislation, build a new Property Register and develop a customer service model capable of providing assistance to a very large volume of taxpayers within a nine-month period.

Our customer service model for LPT is built on flexible deployment, which includes a mix of experienced existing staff, additional staff on a temporary basis, and an external call centre service to provide an information help line. This flexible mix of resources was vital to the successful delivery of a fully functioning tax within such a short period of time and will continue to play a key role into the future as we ‘bed’ LPT into normal tax collection and compliance operations.

From the outset, we recognised that a comprehensive information and consultation process would be an integral part of Revenue’s administration of LPT. From early January 2013 we met with a range of representative bodies to explore in advance issues of relevance to the design of the new tax. In addition Revenue consulted widely with Government departments and State agencies central to the development of the Property Register and to the administration of the tax. A close working relationship was established with the Citizens Information Service (CIS) and their staff were briefed so that they could assist property owners with LPT enquiries.

We supplemented this consultation process with an extensive public information campaign involving radio and newspaper advertising. Revenue spokespeople took part in national and local radio interviews explaining the new tax and dealing with enquiries from property owners. Attendance at trade shows such as the Ideal Homes Exhibition also proved to be effective, with over 10,000 callers to the Revenue stand over the two days of the exhibition.

In the period from March to December 2013, we issued notifications in respect of almost 2 million properties for the 2013 (half year) and again for the 2014 tax year. During the same period we answered in excess of 800,000 phone queries and replied to in excess of 250,000 letters/emails. We also introduced a very successful on-line service facility that allows taxpayers to manage their LPT requirements at a time that suits them. The on-line service was utilised by 78% of our customers in respect of 2013 and continues to be extensively used for 2014.

We introduced 9 different payment options, including the use of 3 external service providers and a voluntary deduction at source facility from salary/pension to ensure property owners had as many options as possible to pay the tax in a way that best suited individual circumstances.

We lodged €318 million to the Exchequer in respect of LPT for 2013, €242 million was in respect of 2013 and the remaining €76 million in respect of 2014. Revenue also took over responsibility for Household Charge arrears from 1 July 2013 and collected €2.7 million up to the end of 2013.

Approximately 42% of property owners self-assessed the same LPT valuation band as the Revenue Estimate and 58% of property owners self-assessed a different LPT valuation band compared to the Revenue Estimate. 44% returned a lower valuation band than the Estimate: 27% reduced by 1 band, 10% by 2 bands and 7% by 3 or more bands. 14% returned a higher valuation band: 7% increased by 1 band, 3% by 2 bands and 4% by 3 or more bands. Overall, 76% of property owners self-assessed within one valuation band of the Revenue estimate.

Some initial compliance work was carried out in 2013. This involved issuing 150,000 reminder notifications, 29,000 mandatory deductions at source instructions to employers/pension providers, 3,500 tax clearance refusals and 6,700 Income Tax surcharges. Our compliance campaign is now focusing on 2013 and 2014 non-empters, 2012 arrears of Household Charge, and undervaluation of property.

Our mantra from the outset of LPT was to make the tax as easy as possible to pay but hard to avoid. Specifically, the use of deduction at source from salaries or occupational pensions has played a major part in this regard because it operates a ‘dual role’ as a voluntary option for those who wish to comply and as a compliance option that Revenue can quickly activate against non-compliers. LPT is also a fully fledged tax in Revenue’s consolidated cross-taxhead profile of every taxpayer. It is always reviewed for any outstanding liabilities before tax repayments in any other taxhead are processed. Where any liability exists in LPT the outstanding amount is offset before the tax repayment is issued.

Source: (Revenue-Commissioners 2013b)
Appendix F: Stakeholder Analysis (ROS)

A stakeholder analysis was carried out for the ROS project. The key stakeholder roles and classes were identified using the onion model framework (Ian Alexander 2006). These are described in detail in Table F-1. An analysis was carried out against sixteen criteria in Table F-2. The results are shown in Table F-3 and ranked in Table F-4.

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Table F-2: ROS knowledge class and involvement

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<tr>
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<td>ROS Legal Issues</td>
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<td>5</td>
<td>ROS Cost</td>
</tr>
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<td>ROS Upgradability</td>
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Table F-3: ROS stakeholder analysis - score by stakeholder class and role

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## Table F-4: ROS stakeholder groups ranked by total score

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<td>Revenue Computer Branch</td>
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<td>25</td>
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Appendix G: ePrescribing References by European Country

Austria


Belgium
Carnicero, J. and Rojas, D. (2010) Application of information and communication technologies for health systems in Belgium, Denmark, Spain, the United Kingdom and Sweden, UN Social Development Division, Santiago, Chile.


Bulgaria


Croatia


Cyprus


Czech Republic


Denmark

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Estonia


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Finland


France
IHE (2013) IHE Implementation Case Study: French Electronic Health Record Program, ASIP Santé

Germany

Greece

Hungary

Iceland (Non-EU)
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Ireland
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Italy

\textbf{Latvia}


\textbf{Lithuania}


\textbf{Luxembourg}


\textbf{Malta}


\textbf{Netherlands}


Norway (Non-EU)


Poland


Portugal


Romania


Slovakia


Slovenia


Spain


Sweden


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**Turkey (Non-EU)**


United Kingdom


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