Contents

Acknowledgments v

1 Introduction 1
   1.1 Service-oriented software engineering .................. 1
   1.2 The S-Cube project ...................................... 2
   1.3 Research questions and research design .................. 2
   1.4 Outline of this thesis .................................... 4
   1.5 Research methods ......................................... 9

I SOSE challenges 13

2 A literature review of SOSE challenges 15
   2.1 Introduction ............................................... 15
   2.2 Research method .......................................... 18
      2.2.1 Systematic review ..................................... 18
      2.2.2 Research questions .................................... 18
      2.2.3 Review protocol ....................................... 21
   2.3 Overview of the included studies ......................... 27
   2.4 Results of the systematic review ......................... 29
      2.4.1 RQ1 - Claimed SOSE challenges ..................... 29
      2.4.2 RQ2.1 - Topics of SOSE challenges ................ 31
      2.4.3 RQ2.2 - Types of SOSE challenges .................. 37
      2.4.4 RQ2.3 - On other ways to classify SOSE challenges . 43
      2.4.5 The SOSE challenges classified along two dimensions . 44
   2.5 Discussion .................................................. 44
      2.5.1 Threats to validity ................................... 44
      2.5.2 Quality assessment .................................... 47
   2.6 Conclusions ................................................ 47

3 On the differences between SOSE and TSE 49
   3.1 Introduction ................................................ 49
   3.2 Motivation and Research Approach ........................ 50
   3.3 The Framework ............................................. 52
   3.4 The Need For Service-oriented Viewpoints ............... 55
   3.5 Conclusions ................................................ 56
## CONTENTS

4 A stakeholder-driven Service Life Cycle Model for SOA 59
   4.1 Introduction ........................................... 59
   4.2 Related work ........................................... 60
   4.3 The Service aspects .................................... 63
      4.3.1 The relevance of cross-organizational collaboration ... 64
      4.3.2 Increased importance of the identification
            of stakeholders .................................. 65
   4.4 The proposed life cycle model .......................... 67
      4.4.1 Service provider .................................. 70
      4.4.2 Service broker ................................... 73
      4.4.3 Application builder (service consumer) ............ 74
   4.5 Conclusions ............................................ 76

5 A taxonomy of SOSE stakeholder types 79
   5.1 Introduction ............................................ 79
   5.2 The S-Cube service engineering lifecycle .............. 80
   5.3 Research method ....................................... 82
   5.4 A taxonomy of service engineering stakeholders .......... 84
   5.5 Coverage of the S-Cube service engineering lifecycle . 86
      5.5.1 Coverage of lifecycle phases by the stakeholder types . 87
      5.5.2 The participation of each type of stakeholders ...... 88
      5.5.3 Comparison between the evolution and adaptation cycles 88
   5.6 Related work .......................................... 89
   5.7 Conclusions ............................................ 91

6 Guiding the SOSE Process: the Importance of Service Aspects 93
   6.1 Introduction ............................................ 93
   6.2 Applying service aspects to a concrete methodology .... 94
      6.2.1 The SeCSE methodology ............................ 95
      6.2.2 The SOSE process model for the SeCSE methodology ... 95
   6.3 Related work .......................................... 102
   6.4 Conclusions ............................................ 103

7 Guiding the selection of service-oriented software engineering
   methodologies 105
   7.1 Introduction ............................................ 105
   7.2 A service aspects-driven evaluation framework .......... 107
      7.2.1 Generic evaluation criteria ........................ 107
      7.2.2 Service-specific criteria .......................... 108
   7.3 Comparison of existing SOSE methodologies using the evaluation
       framework ............................................. 114
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.3.1 Overview of the selected SOSE methodologies</td>
<td>114</td>
</tr>
<tr>
<td>7.3.2 Comparing the generic aspects of the SOSE methodologies</td>
<td>117</td>
</tr>
<tr>
<td>7.3.3 Comparing the service-specific aspects of the SOSE methodologies</td>
<td>125</td>
</tr>
<tr>
<td>7.4 Observations</td>
<td>134</td>
</tr>
<tr>
<td>7.5 Related work</td>
<td>136</td>
</tr>
<tr>
<td>7.6 Conclusions</td>
<td>138</td>
</tr>
<tr>
<td>8 Guiding the selection of service identification methods</td>
<td>141</td>
</tr>
<tr>
<td>8.1 Introduction and research questions</td>
<td>141</td>
</tr>
<tr>
<td>8.2 Review protocol</td>
<td>142</td>
</tr>
<tr>
<td>8.3 The results of the review</td>
<td>144</td>
</tr>
<tr>
<td>8.3.1 RQ 1 What are the existing SIMs?</td>
<td>144</td>
</tr>
<tr>
<td>8.3.2 RQ 2.a what are the different types of inputs?</td>
<td>145</td>
</tr>
<tr>
<td>8.3.3 RQ 2.b what are the different types of services being produced?</td>
<td>147</td>
</tr>
<tr>
<td>8.3.4 R2.c what types of strategies and techniques?</td>
<td>150</td>
</tr>
<tr>
<td>8.4 An input-output matrix for the selection of SIMs</td>
<td>153</td>
</tr>
<tr>
<td>8.5 Conclusions</td>
<td>156</td>
</tr>
<tr>
<td>9 A template for SOA design decision making in an educational setting</td>
<td>157</td>
</tr>
<tr>
<td>9.1 Introduction</td>
<td>157</td>
</tr>
<tr>
<td>9.2 Background</td>
<td>159</td>
</tr>
<tr>
<td>9.3 A template for documenting quality-driven SOA design decisions</td>
<td>160</td>
</tr>
<tr>
<td>9.4 Results on the use of the template</td>
<td>162</td>
</tr>
<tr>
<td>9.4.1 The evaluation of the software designs</td>
<td>164</td>
</tr>
<tr>
<td>9.4.2 Students feedback on the use of the template</td>
<td>167</td>
</tr>
<tr>
<td>9.5 Related work</td>
<td>169</td>
</tr>
<tr>
<td>9.6 Conclusions</td>
<td>170</td>
</tr>
<tr>
<td>10 SOA decision making - what do we need to know</td>
<td>173</td>
</tr>
<tr>
<td>10.1 Introduction</td>
<td>173</td>
</tr>
<tr>
<td>10.2 The service aspects</td>
<td>175</td>
</tr>
<tr>
<td>10.2.1 Temporary provision-consumption relationship</td>
<td>175</td>
</tr>
<tr>
<td>10.2.2 Different architecture types</td>
<td>176</td>
</tr>
<tr>
<td>10.2.3 Dealing with heterogeneity</td>
<td>179</td>
</tr>
<tr>
<td>10.2.4 Different perspectives of stakeholders</td>
<td>179</td>
</tr>
<tr>
<td>10.2.5 A summary of identified information</td>
<td>180</td>
</tr>
<tr>
<td>10.3 Two examples of SOA design issues</td>
<td>180</td>
</tr>
<tr>
<td>10.3.1 Example 1</td>
<td>180</td>
</tr>
<tr>
<td>10.3.2 Example 2</td>
<td>182</td>
</tr>
</tbody>
</table>
## CONTENTS

10.3.3 Foreseen benefits ............................................. 184  
10.4 SOA design decisions in the literature ........................... 186  
10.5 Related work .................................................... 187  
10.6 Conclusions ..................................................... 187


11.1 Introduction .................................................... 189  
11.2 Related work .................................................... 191  
11.3 Motivation ..................................................... 192  
11.4 The service aspects and examples of SOA Process Decisions ...... 194  
11.4.1 Shift of ownership of software ............................... 194  
11.4.2 The relevance of cross-organizational cooperation ......... 195  
11.5 Mapping SOA process decisions on the core model ............ 197  
11.5.1 Gaps in the existing architectural knowledge models ...... 197  
11.5.2 A suggestion to extend the core model ...................... 200  
11.6 Conclusions ..................................................... 200

12 3D Architecture Viewpoints on Service Automation 203

12.1 Introduction .................................................... 203  
12.2 An introduction to automation .................................. 205  
12.2.1 Automation and human interaction .......................... 205  
12.2.2 Automation in SBAs ....................................... 206  
12.3 The need for service automation viewpoints ................... 207  
12.3.1 A study on automation of service management and deployment ............................................. 207  
12.3.2 Documenting software architecture ......................... 209  
12.4 Research approach .............................................. 209  
12.5 3D service automation viewpoints ................................ 211  
12.5.1 An overview of 3D service automation viewpoints .......... 211  
12.5.2 Documenting architecture viewpoints ...................... 212  
12.5.3 A fragment of the SDCA service flow - running scenario ... 212  
12.5.4 Viewpoint ‘Decision on service automation’  
(Decision Viewpoint) ............................................. 214  
12.5.5 Viewpoint ‘Degree of service automation’ (Degree Viewpoint) 220  
12.5.6 Viewpoint ‘Data relating to service automation’  
(Data Viewpoint) ................................................. 223  
12.5.7 Summary ..................................................... 228  
12.6 Discussion ..................................................... 228
CONTENTS

12.6.1 The visual support of the 3D service automation viewpoints 228
12.6.2 The applicability of the 3D VP's 231
12.7 Conclusions 231

13 Conclusions 233

13.1 Contributions 235
13.1.1 What are the challenges in SOSE? (RQ 1) 235
13.1.2 How is the development process of SBAs different from that of traditional software systems? (RQ 2) 235
13.1.3 How is service-oriented architectural knowledge different from traditional architectural knowledge? (RQ 3) 237
13.2 Summary 238
13.3 Future research 239

Appendices 243

A The judgment scale to assess the methodology support for a feature 245

B The service lifecycle model 247

Samenvatting 249

SIKS Dissertation Series 253

References 271