

---

# Contents

---

<b>Preface</b> . . . . .	ix
<b>Acknowledgments</b> . . . . .	xv
<b>Introduction</b> . . . . .	xvii
<b>Chapter 1. Introduction to CESAM</b> . . . . .	1
1.1. CESAM: a mathematically sound system modeling framework . . . . .	1
1.2. CESAM: a framework focused on complex integrated systems . . . . .	8
1.3. CESAM: a collaboration-oriented architecting framework . . . . .	12
1.4. CESAM: a business-oriented framework . . . . .	16
<b>Chapter 2. Why Architecting Systems?</b> . . . . .	19
2.1. Product and project systems . . . . .	19
2.2. The complexity threshold . . . . .	22
2.3. Addressing systems architecting becomes key . . . . .	25
2.4. The value of systems architecting . . . . .	31
2.5. The key role of systems architects . . . . .	34
2.6. How to analyze a systems architect profile? . . . . .	36
<b>Chapter 3. CESAM Framework</b> . . . . .	39
3.1. Elements of systemics . . . . .	39
3.1.1. Interface . . . . .	39
3.1.2. Environment of a system . . . . .	41
3.2. The three architectural visions . . . . .	42
3.2.1. Architectural visions definition . . . . .	42
3.2.2. Architectural visions overview . . . . .	46
3.2.3. Relationships between the three architectural visions . . . . .	52

---

3.2.4. Organization of a system model . . . . .	55
3.3. CESAM systems architecture pyramid . . . . .	57
3.3.1. The three key questions to ask . . . . .	57
3.3.2. The last question that shall not be forgotten . . . . .	59
3.4. More systems architecture dimensions. . . . .	60
3.4.1. Descriptions versus expected properties . . . . .	60
3.4.2. Descriptions . . . . .	62
3.4.3. Expected properties. . . . .	73
3.5. CESAM systems architecture matrix . . . . .	78
<b>Chapter 4. Identifying Stakeholders: Environment Architecture . . . . .</b>	<b>83</b>
4.1. Why identify stakeholders? . . . . .	83
4.2. The key deliverables of environment architecture . . . . .	85
4.2.1. Stakeholder hierarchy diagram . . . . .	85
4.2.2. Environment diagram. . . . .	87
<b>Chapter 5. Understanding Interactions with Stakeholders: Operational Architecture . . . . .</b>	<b>91</b>
5.1. Why understand interactions with stakeholders? . . . . .	91
5.2. The key deliverables of operational architecture . . . . .	94
5.2.1. Need architecture diagram . . . . .	94
5.2.2. Lifecycle diagram. . . . .	95
5.2.3. Use case diagrams . . . . .	97
5.2.4. Operational scenario diagrams. . . . .	99
5.2.5. Operational flow diagram . . . . .	101
<b>Chapter 6. Defining What the System Shall Do: Functional Architecture . . . . .</b>	<b>103</b>
6.1. Why understand what the system does? . . . . .	103
6.2. The key deliverables of functional architecture . . . . .	105
6.2.1. Functional requirement architecture diagram. . . . .	106
6.2.2. Functional mode diagram . . . . .	108
6.2.3. Functional breakdown and interaction diagrams . . . . .	109
6.2.4. Functional scenario diagrams . . . . .	111
6.2.5. Functional flow diagram . . . . .	112
<b>Chapter 7. Deciding How the System Shall be Formed: Constructional Architecture . . . . .</b>	<b>115</b>
7.1. Understanding how the system is formed? . . . . .	115
7.2. The key deliverables of constructional architecture . . . . .	117
7.2.1. Constructional requirement architecture diagram . . . . .	118
7.2.2. Configuration diagram . . . . .	120
7.2.3. Constructional breakdown and interaction diagram . . . . .	121

---

7.2.4. Constructional scenario diagram. . . . .	123
7.2.5. Constructional flow diagram. . . . .	124
<b>Chapter 8. Taking into Account Failures: Dysfunctional Analysis</b> . . . . .	127
8.1. Systems do not always behave as they should. . . . .	127
8.2. The key deliverables of dysfunctional analysis . . . . .	134
8.2.1. Dysfunctional analysis from an operational perspective. . . . .	135
8.2.2. Dysfunctional analysis from a functional perspective . . . . .	136
8.2.3. Dysfunctional analysis from a constructional perspective. . . . .	138
<b>Chapter 9. Choosing the Best Architecture: Trade-off Techniques</b> . . . . .	141
9.1. Systems architecting does not usually lead to a unique solution. . . . .	141
9.2. Trade-off techniques. . . . .	143
9.2.1. General structure of a trade-off process. . . . .	143
9.2.2. Managing trade-offs in practice . . . . .	145
<b>Conclusion</b> . . . . .	149
<b>Appendices</b> . . . . .	157
<b>Appendix 1. System Temporal Logic</b> . . . . .	159
<b>Appendix 2. Classical Engineering Issues</b> . . . . .	163
<b>Appendix 3. Example of System Model Managed with CESAM</b> . . . . .	177
<b>Appendix 4. Implementing CESAM through a SysML Modeling Tool</b> . . . . .	199
<b>Appendix 5. Some Good Practices in Systems Modeling</b> . . . . .	209
<b>References</b> . . . . .	211
<b>Index</b> . . . . .	219