
Contents

Acknowledgments	ix
General Introduction	xi
Chapter 1. Introduction to BIM Integration into Railway	1
1.1. Introduction	2
1.2. Methodology	3
1.3. Railway – formulation of the problem	4
1.4. BIM development	8
1.5. BIM integration into railway projects	13
1.6. Feedback from real project experiences	16
1.6.1. Project Mälarbanan, Sweden	16
1.6.2. TUC/Infrabel experience, Belgium	17
1.6.3. BIM at SNCF maintenance department, France	18
1.6.4. Crossrail, UK	18
1.6.5. ONCF electrical substation, Morocco	20
1.7. Discussion of the results	22
1.8. Conclusions and perspectives	23
Chapter 2. BIM into Railway: Optimization of Cost by Using BIM	27
2.1. Introduction	27
2.2. Methodology	29

2.3. Cost structure of a tram – assumptions fixed for the analysis	29
2.3.1. Cost structure of a tramway – construction phase: comparative analysis	30
2.3.2. Hypotheses made for the fixed and studied sub-costs in the construction phase	31
2.3.3. Cost of facility maintenance	32
2.3.4. Summary of costs studied – basic hypotheses of the analysis	33
2.4. Optimization of cost of a tram through the integration of BIM: a theoretical analysis	34
2.4.1. Theoretical analysis of cost optimization	34
2.4.2. Summary	36
2.4.3. Discussion and analysis	37
2.4.4. Limitations	37
2.5. Conclusions and perspectives	38
Chapter 3. BIM and Sustainability	41
3.1. Introduction	41
3.2. Optimizing the use of materials for durability	42
3.3. Energy efficiency	44
3.4. Sustainability in the management of the life cycle	47
3.5. Sustainability BIM and railway?	50
3.6. Discussion of the results	52
3.7. Conclusions and perspectives	54
Chapter 4. BIM Integration to Railway Projects – Case Study	55
4.1. Introduction	56
4.2. Methodology	57
4.3. Integrating BIM into railway projects: review of experiences	58
4.3.1. Focus on BIM	58
4.3.2. Building information modeling: a literature review	59
4.3.3. BIM software examples	61
4.4. Integrating BIM into railway projects: review of experiences	64
4.4.1. Crossrail, UK	64
4.4.2. Infrabel, Belgium	65

4.4.3. STA, Sweden	66
4.4.4. BIM France, France	66
4.4.5. NNRA, Norway	67
4.4.6. Summary and discussion of the review of experiences	68
4.5. ONCF/Colas Rail Maroc electrical substation – BIM integration	68
4.5.1. Context of the collaboration	69
4.5.2. Methodology	69
4.5.3. Key step and planning of realization	70
4.5.4. Comments on the results	71
4.5.5. Recommendations	73
4.6. General discussion	74
4.7. Conclusions and perspectives	75
Chapter 5. How to Successfully Integrate BIM into a Railway Project – Framework	79
5.1. Framework for the adoption and implementation of BIM – literature review	79
5.2. Summary	83
5.3. Framework for the adoption and implementation of BIM – experience review	84
5.3.1. BIM charter	87
5.4. Conclusions of the case study	91
5.4.1. Systra	91
5.4.2. Egis	93
5.4.3. Setec	94
5.4.4. Colas Rail	95
5.5. Discussion of the results	97
5.6. Conclusions and perspectives	97
Chapter 6. Railway Information Modeling – Project Management	99
6.1. Reminder of the fundamentals of BIM	100
6.2. BIM and legal environment of the projects	102
6.3. Prerequisites and integration framework of BIM	104
6.4. Railway project management with BIM	106
6.4.1. Background and project description with BIM integration	106
6.4.2. BIM project management – feedback	110

6.5. BIM dimensions	112
6.5.1. 3D modeling – design	112
6.5.2. 4D – scheduling	113
6.5.3. 5D – cost estimation	114
6.5.4. 6D – sustainability	114
6.5.5. 7D – life cycle, operation and maintenance	115
6.6. BIM, prefabrication and construction	115
6.7. The BIM life cycle	117
6.8. Conclusions – general discussion	119
General Conclusion	121
References	125
Index	141