



Universiteit
Leiden
The Netherlands

Grip on software: understanding development progress of SCRUM sprints and backlogs

Helwerda, L.S.

Citation

Helwerda, L. S. (2024, September 13). *Grip on software: understanding development progress of SCRUM sprints and backlogs*. SIKS Dissertation Series. Retrieved from <https://hdl.handle.net/1887/4092508>

Version: Publisher's Version

[Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

License: <https://hdl.handle.net/1887/4092508>

Note: To cite this publication please use the final published version (if applicable).

Grip on Software: Understanding development progress of SCRUM sprints and backlogs

Proefschrift
ter verkrijging van
de graad van doctor aan de Universiteit Leiden,
op gezag van rector magnificus prof.dr.ir. H. Bijl,
volgens besluit van het college voor promoties
te verdedigen op vrijdag 13 september 2024
klokke 11:30 uur
door

Leon Sebastiaan Helwerda

geboren te Voorburg, Nederland
in 1992

Promotores:

Prof.dr.ir. F.J. Verbeek
Dr. W.A. Kosters

Promotiecommissie:

Prof.dr. M.M. Bonsangue
Prof.dr. H.C.M. Kleijn
Prof.dr. S. Manegold
Prof.dr. M.R.V. Chaudron (Eindhoven University of Technology)
Dr. C. Soomlek (Khon Kaen University)
Dr. F. Niessink (Stichting ICTU)

Copyright © 2024 Leon Helwerda

Cover art by Marian Helwerda, based on photograph by Leon Helwerda

Printed by: NBD Biblion

Funded by Stichting ICTU as part of a collaboration between Leiden University and ICTU

SIKS Dissertation Series No. 2024-28

The research reported in this thesis has been carried out under the auspices of SIKS, the Dutch Research School for Information and Knowledge Systems.



Contents

1	Introduction	1
1.1	Preface	3
1.2	Context	3
1.2.1	Software development, Agile and SCRUM	4
1.2.2	Machine learning, pattern recognition and predictive analytics	7
1.2.3	Case studies of workflows	9
1.3	Design scope	11
1.4	Problem statement	14
1.5	Pipeline components	17
1.5.1	Instances	18
1.5.2	Non-functional requirements	19
1.6	Structure of this thesis	20
2	Data pipeline	23
2.1	Introduction	25
2.1.1	Ecosystem	26
2.1.2	Structure	27
2.2	Design	27
2.2.1	Distributed data systems	27
2.2.2	Agent-based communication	28
2.2.3	Organizational approaches	28
2.3	Method	29
2.3.1	Data acquisition	30
2.3.2	Further pipeline steps	33
2.4	Technical considerations	36
2.4.1	Generalizability	36
2.4.2	Continuous integration	37
2.4.3	Documentation	37
2.4.4	Novelty	38
2.5	Results	39
2.6	Discussion	40
3	Database construction	41
3.1	Introduction	43
3.2	Relevant work	45

3.3	Method	45
3.3.1	Data model	47
3.3.2	Linking data sources	57
3.4	Architecture	59
3.5	Experiments	63
3.5.1	Setup	63
3.5.2	Results	64
3.6	Discussion	66
4	Pattern recognition methods	69
4.1	Proposition	71
4.2	Background	72
4.2.1	Framework	73
4.2.2	Story points and adaptations	74
4.3	Related work	75
4.4	Approach	76
4.4.1	Feature extraction	77
4.4.2	Data set	79
4.4.3	Models	80
4.5	Analysis strategy	83
4.6	Results	84
4.6.1	Sprint classification and estimation	84
4.6.2	Backlog size estimation	85
4.7	Conclusions	89
4.7.1	Threats to validity	90
4.7.2	Proposed additions	91
5	Information visualization	93
5.1	Preamble	95
5.2	Purpose	96
5.3	Relevant concepts	97
5.4	Dashboard framework	99
5.5	Visualizations for analytical decision support	102
5.5.1	Sprint report	102
5.5.2	Prediction results	111
5.5.3	Timeline	114
5.5.4	Leaderboard	118
5.6	Visualizations for ecosystem management	121
5.6.1	Collaboration graph	121
5.6.2	Process flow	125
5.6.3	Heat map	128
5.6.4	Platform status	131
5.7	Novel backlog visualizations	134
5.7.1	Product backlog burndown chart	134
5.7.2	Product backlog progression chart	135
5.7.3	Product backlog relationship chart	137

5.8	Evaluation	138
5.8.1	Assessment	138
5.8.2	Adoption	141
5.8.3	Conclusion	142
6	Discussion	145
6.1	Retrospective	147
6.1.1	Technical overview	147
6.1.2	Main contributions	149
6.2	Overall conclusion	151
6.2.1	Problem statement	151
6.2.2	Research questions	152
6.3	Future work	159
6.3.1	Further research	159
6.3.2	Generalizability	161
	Glossary	163
	Bibliography	169
	Appendices	183
	A Code repositories of the Grip on Software pipeline	185
	B Queries used in database performance experiments	189
	Summary	203
	Samenvatting	207
	Curriculum Vitae	211
	Acknowledgments	213
	SIKS Dissertation Series	215