

Results

Exploratory Factor Analysis

Factor Loadings

	Factor						Uniqueness
	1	2	3	4	5	6	
number-of-commits		0.901					0.17095
number-of-entities		0.858					0.18781
number-of-entities-changed		1.009					8.62e-4
number-of-authors		0.615					0.46677
max-age-months					0.861		0.23380
avg-age-months					0.600		0.49179
avg2-degree-coupling							0.86377
avg2-strength-communication			-0.317			0.464	0.55489
avg2-author-revs-effort	0.434					0.786	0.00263
avg2-total-revs-effort	1.000						8.88e-4
avg2-ownership-added			0.666	0.522			0.09784
avg2-ownership-deleted				0.943			0.05124
avg-author-churn-added			0.730				0.44538
avg-author-churn-deleted			0.324		0.485		0.48431
avg-author-churn-commits			0.349		0.605		0.45841
avg-entity-churn-added	0.549		0.550				0.20218
avg-entity-churn-deleted				0.942			0.10554
avg-entity-churn-commits	1.000						8.88e-4
avg-fragmentation-fractal-value	0.458					-0.651	0.34697
avg-fragmentation-total-revs	1.000						8.88e-4
avg-main-dev-ownership					-0.472		0.62184
avg-refactoring-main-dev-ownership			-0.625				0.40684
avg-revisions	1.000						8.88e-4
avg-soc		0.411	0.417				0.58239

Note: 'Minimum residual' extraction method was used in combination with a 'oblimin' rotation

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Factor Statistics

Summary

Factor	SS Loadings	% of Variance	Cumulative %
1	5.02	20.93	20.9
2	3.39	14.13	35.1
3	2.50	10.43	45.5
4	2.48	10.32	55.8
5	2.30	9.57	65.4
6	1.53	6.37	71.8

Assumption Checks

Bartlett's Test of Sphericity

χ^2	df	p
Inf	276	< .001

KMO Measure of Sampling Adequacy

	MSA
Overall	0.500
number-of-commits	0.500
number-of-entities	0.500
number-of-entities-changed	0.500
number-of-authors	0.500
max-age-months	0.500
avg-age-months	0.500
avg2-degree-coupling	0.500
avg2-strength-communication	0.500
avg2-author-revs-effort	0.500
avg2-total-revs-effort	0.500
avg2-ownership-added	0.500
avg2-ownership-deleted	0.500
avg-author-churn-added	0.500
avg-author-churn-deleted	0.500
avg-author-churn-commits	0.500
avg-entity-churn-added	0.500
avg-entity-churn-deleted	0.500
avg-entity-churn-commits	0.500
avg-fragmentation-fractal-value	0.500
avg-fragmentation-total-revs	0.500
avg-main-dev-ownership	0.500
avg-refactoring-main-dev-ownership	0.500
avg-revisions	0.500
avg-soc	0.500

Linear Regression

Model Fit Measures

Model	R	R ²
1	0.925	0.855

Model Coefficients - R1

Predictor	Estimate	SE	t	p
Intercept	0.63565	0.12784	4.9723	< .001
number-of-commits	-1.02e-5	2.68e-6	-3.7960	< .001
number-of-entities	-4.97e-7	6.62e-7	-0.7507	0.455
number-of-entities-changed	7.30e-8	3.38e-7	0.2159	0.830
number-of-authors	-5.68e-5	2.80e-5	-2.0321	0.045
max-age-months	2.27e-4	2.63e-4	0.8647	0.390
avg-age-months	2.45e-4	3.39e-4	0.7243	0.471
avg2-degree-coupling	0.00366	0.00167	2.1932	0.031
avg2-strength-communication	0.00365	0.00133	2.7507	0.007
avg2-author-revs-effort	-0.02799	0.02521	-1.1103	0.270
avg2-total-revs-effort	0.00588	0.00846	0.6943	0.489
avg2-ownership-added	-3.30e-4	4.66e-4	-0.7081	0.481
avg2-ownership-deleted	0.00131	0.00107	1.2259	0.224
avg-author-churn-added	9.98e-8	2.55e-7	0.3907	0.697
avg-author-churn-deleted	6.68e-8	8.25e-7	0.0809	0.936
avg-author-churn-commits	-3.34e-4	1.63e-4	-2.0413	0.044
avg-entity-churn-added	1.33e-4	1.45e-4	0.9225	0.359
avg-entity-churn-deleted	-7.87e-4	4.11e-4	-1.9139	0.059
avg-entity-churn-commits	NaN	NaN	NaN	NaN
avg-fragmentation-fractal-value	-0.14164	0.20457	-0.6924	0.491
avg-fragmentation-total-revs	NaN	NaN	NaN	NaN
avg-main-dev-ownership	0.07207	0.12714	0.5668	0.572
avg-refactoring-main-dev-ownership	-0.00495	0.13532	-0.0366	0.971
avg-revisions	NaN	NaN	NaN	NaN
avg-soc	-5.30e-6	3.90e-6	-1.3592	0.178

Note. Linear model contains aliased coefficients (singular fit)

Data Summary

Cook's Distance

Mean	Median	SD	Range	
			Min	Max
0.0946	0.00271	0.527	6.66e-6	4.51

Assumption Checks

Normality Tests

	Statistic	p
Shapiro-Wilk	0.962	0.004
Kolmogorov-Smirnov	0.117	0.104
Anderson-Darling	1.89	< .001

Note. Additional results provided by moretests

Heteroskedasticity Tests

	Statistic	p
Breusch-Pagan	40.2	0.007
Goldfeld-Quandt	3.10	0.002
Harrison-McCabe	0.404	0.090

Note. Additional results provided by moretests

Durbin-Watson Test for Autocorrelation

Autocorrelation	DW Statistic	p
-0.0641	2.12	0.580

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Correlation Matrix

Correlation Matrix

		R1	number-of-commits	number-of-entities	number-of-entities-changed	number-of-authors	max-age-months	avg-age-months	avg2-degree-coupling	avg2-strength-communication	avg2-author-revs-effort	avg2-total-revs-effort	avg2-ownership-added
R1	Pearson's r	—											
	df	—											
	p-value	—											
	Spearman's rho	—											
	df	—											
	p-value	—											
number-of-commits	Pearson's r	-0.854 ***	—										
	df	107	—										
	p-value	< .001	—										
	Spearman's rho	-0.927 ***	—										
	df	107	—										
	p-value	< .001	—										
number-of-entities	Pearson's r	-0.677 ***	0.832 ***	—									
	df	107	108	—									
	p-value	< .001	< .001	—									
	Spearman's rho	-0.856 ***	0.866 ***	—									
	df	107	108	—									
	p-value	< .001	< .001	—									
number-of-entities-changed	Pearson's r	-0.793 ***	0.949 ***	0.932 ***	—								
	df	107	108	108	—								
	p-value	< .001	< .001	< .001	—								
	Spearman's rho	-0.911 ***	0.932 ***	0.951 ***	—								
	df	107	108	108	—								
	p-value	< .001	< .001	< .001	—								
number-of-authors	Pearson's r	-0.632 ***	0.607 ***	0.424 ***	0.522 ***	—							
	df	107	108	108	108	—							
	p-value	< .001	< .001	< .001	< .001	—							
	Spearman's rho	-0.553 ***	0.627 ***	0.555 ***	0.618 ***	—							
	df	107	108	108	108	—							
	p-value	< .001	< .001	< .001	< .001	—							
max-age-months	Pearson's r	-0.041	0.113	-0.090	-0.000	-0.174	—						
	df	106	107	107	107	107	—						
	p-value	0.672	0.243	0.354	0.999	0.070	—						
	Spearman's rho	-0.058	0.222 *	0.138	0.137	-0.210 *	—						
	df	106	107	107	107	107	—						
	p-value	0.554	0.020	0.152	0.156	0.029	—						
avg-age-months	Pearson's r	0.259 **	-0.199 *	-0.211 *	-0.249 **	-0.385 ***	0.715 ***	—					
	df	106	107	107	107	107	107	—					
	p-value	0.007	0.038	0.027	0.009	< .001	< .001	—					
	Spearman's rho	0.268 **	-0.176	-0.157	-0.233 *	-0.444 ***	0.670 ***	—					
	df	106	107	107	107	107	107	—					
	p-value	0.005	0.068	0.102	0.015	< .001	< .001	—					
avg2-degree-coupling	Pearson's r	0.141	-0.114	0.134	0.007	-0.091	-0.218 *	-0.058	—				
	df	106	106	106	106	106	106	106	—				
	p-value	0.146	0.242	0.167	0.941	0.347	0.023	0.549	—				
	Spearman's rho	0.112	-0.130	0.055	-0.034	-0.103	-0.069	-0.015	—				
	df	106	106	106	106	106	106	106	—				
	p-value	0.248	0.179	0.573	0.728	0.291	0.476	0.880	—				
avg2-strength-communication	Pearson's r	0.419 ***	-0.290 **	-0.295 **	-0.307 **	-0.087	-0.168	0.008	-0.115	—			
	df	106	106	106	106	106	106	106	106	—			
	p-value	< .001	0.002	0.002	0.001	0.370	0.083	0.934	0.234	—			
	Spearman's rho	0.588 ***	-0.501 ***	-0.651 ***	-0.576 ***	-0.029	-0.213 *	-0.041	-0.121	—			
	df	106	106	106	106	106	106	106	106	—			
	p-value	< .001	< .001	< .001	< .001	0.763	0.027	0.674	0.210	—			

Note. * p < .05, ** p < .01, *** p < .001

Correlation Matrix

		R1	number-of-commits	number-of-entities	number-of-entities-changed	number-of-authors	max-age-months	avg-age-months	avg2-degree-coupling	avg2-strength-communication	avg2-author-revs-effort	avg2-total-revs-effort	avg2-ownership-added
avg2-author-revs-effort	Pearson's r	0.171	-0.147	-0.246 **	-0.161	-0.254 **	0.057	0.094	-0.133	0.440 ***	—		
	df	106	107	107	107	107	107	107	106	106	—		
	p-value	0.076	0.128	0.010	0.095	0.008	0.557	0.331	0.171	< .001	—		
	Spearman's rho	0.282 **	-0.160	-0.433 ***	-0.283 **	-0.312 ***	0.202 *	0.172	-0.229 *	0.386 ***	—		
	df	106	107	107	107	107	107	107	106	106	—		
	p-value	0.003	0.097	< .001	0.003	< .001	0.035	0.074	0.017	< .001	—		
avg2-total-revs-effort	Pearson's r	-0.020	0.020	-0.237 *	-0.032	-0.017	0.053	-0.110	-0.224 *	0.163	0.595 ***	—	
	df	106	107	107	107	107	107	107	106	106	107	—	
	p-value	0.841	0.836	0.013	0.741	0.857	0.581	0.254	0.020	0.092	< .001	—	
	Spearman's rho	-0.069	0.162	-0.229 *	0.037	0.138	0.058	-0.137	-0.286 **	0.269 **	0.584 ***	—	
	df	106	107	107	107	107	107	107	106	106	107	—	
	p-value	0.476	0.092	0.017	0.700	0.152	0.546	0.156	0.003	0.005	< .001	—	
avg2-ownership-added	Pearson's r	0.120	-0.186	-0.142	-0.151	-0.240 *	-0.055	0.030	0.079	-0.032	0.328 ***	0.138	—
	df	106	107	107	107	107	107	107	106	106	107	107	—
	p-value	0.216	0.052	0.141	0.117	0.012	0.567	0.759	0.415	0.744	< .001	0.151	—
	Spearman's rho	0.072	-0.159	-0.169	-0.146	-0.380 ***	0.088	0.245 *	-0.143	-0.096	0.303 **	0.051	—
	df	106	107	107	107	107	107	107	106	106	107	107	—
	p-value	0.461	0.098	0.080	0.130	< .001	0.363	0.010	0.141	0.324	0.001	0.600	—
avg2-ownership-deleted	Pearson's r	0.083	-0.106	-0.150	-0.121	-0.224 *	0.220 *	0.227 *	-0.070	0.099	0.423 ***	0.087	0.647 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.393	0.270	0.119	0.212	0.019	0.022	0.018	0.474	0.309	< .001	0.370	< .001
	Spearman's rho	0.030	0.014	-0.068	-0.039	-0.284 **	0.397 ***	0.426 ***	-0.198 *	-0.090	0.442 ***	0.151	0.746 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.755	0.885	0.481	0.686	0.003	< .001	< .001	0.040	0.355	< .001	0.116	< .001
avg-author-churn-added	Pearson's r	0.026	-0.081	0.018	-0.029	-0.166	-0.022	0.071	0.274 **	-0.128	0.016	-0.094	0.592 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.786	0.403	0.851	0.765	0.085	0.823	0.463	0.004	0.185	0.871	0.330	< .001
	Spearman's rho	-0.362 ***	0.277 **	0.429 ***	0.375 ***	-0.399 ***	0.366 ***	0.292 **	0.113	-0.676 ***	-0.017	-0.209 *	0.545 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	< .001	0.004	< .001	< .001	< .001	< .001	0.002	0.243	< .001	0.862	0.030	< .001
avg-author-churn-deleted	Pearson's r	-0.100	0.027	0.077	0.060	-0.228 *	0.331 ***	0.259 **	0.061	-0.221 *	0.099	-0.118	0.258 **
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.305	0.778	0.426	0.536	0.017	< .001	0.007	0.527	0.022	0.307	0.224	0.007
	Spearman's rho	-0.359 ***	0.315 ***	0.452 ***	0.386 ***	-0.372 ***	0.471 ***	0.375 ***	0.088	-0.667 ***	0.028	-0.192 *	0.492 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	< .001	0.366	< .001	0.774	0.045	< .001
avg-author-churn-commits	Pearson's r	-0.155	0.064	-0.011	0.001	-0.273 **	0.407 ***	0.354 ***	-0.031	-0.272 **	0.111	-0.037	0.200 *
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.109	0.510	0.911	0.994	0.004	< .001	< .001	0.751	0.004	0.252	0.704	0.037
	Spearman's rho	-0.377 ***	0.406 ***	0.380 ***	0.369 ***	-0.396 ***	0.541 ***	0.367 ***	-0.030	-0.561 ***	0.235 *	0.040	0.305 **
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	< .001	< .001	< .001	< .001	< .001	< .001	< .001	0.761	< .001	0.014	0.676	0.001
avg-entity-churn-added	Pearson's r	0.056	-0.127	-0.157	-0.093	-0.160	-0.008	0.002	-0.066	-0.033	0.496 ***	0.593 ***	0.763 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.564	0.190	0.103	0.338	0.096	0.937	0.986	0.500	0.736	< .001	< .001	< .001
	Spearman's rho	-0.025	-0.079	-0.198 *	-0.103	-0.261 **	0.057	0.113	-0.180	-0.081	0.269 **	0.328 ***	0.880 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.794	0.416	0.039	0.284	0.006	0.553	0.240	0.062	0.406	0.005	< .001	< .001
avg-entity-churn-deleted	Pearson's r	-0.000	-0.057	-0.183	-0.096	-0.163	0.259 **	0.229 *	-0.100	0.005	0.368 ***	0.274 **	0.518 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.996	0.559	0.056	0.318	0.091	0.007	0.017	0.303	0.956	< .001	0.004	< .001
	Spearman's rho	-0.075	0.099	-0.063	0.024	-0.170	0.379 ***	0.296 **	-0.237 *	-0.113	0.375 ***	0.375 ***	0.671 ***
	df	106	107	107	107	107	107	107	106	106	107	107	107

Note. * p < .05, ** p < .01, *** p < .001

Correlation Matrix

		R1	number-of-commits	number-of-entities	number-of-entities-changed	number-of-authors	max-age-months	avg-age-months	avg2-degree-coupling	avg2-strength-communication	avg2-author-revs-effort	avg2-total-revs-effort	avg2-ownership-added
avg-entity-churn-commits	p-value	0.443	0.307	0.514	0.803	0.078	< .001	0.002	0.014	0.244	< .001	< .001	< .001
	Pearson's r	-0.020	0.020	-0.237 *	-0.032	-0.017	0.053	-0.110	-0.224 *	0.163	0.595 ***	1.000 ***	0.138
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.841	0.836	0.013	0.741	0.857	0.581	0.254	0.020	0.092	< .001	< .001	0.151
	Spearman's rho	-0.069	0.162	-0.229 *	0.037	0.138	0.058	-0.137	-0.286 **	0.269 **	0.584 ***	1.000 ***	0.051
	df	106	107	107	107	107	107	107	106	106	107	107	107
avg-fragmentation-fractal-value	p-value	0.476	0.092	0.017	0.700	0.152	0.546	0.156	0.003	0.005	< .001	< .001	0.600
	Pearson's r	-0.177	0.163	-0.043	0.114	0.236 *	-0.008	-0.150	0.031	-0.192 *	-0.260 **	0.418 ***	-0.205 *
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.067	0.090	0.653	0.237	0.013	0.931	0.121	0.752	0.046	0.006	< .001	0.033
	Spearman's rho	-0.187	0.160	-0.009	0.121	0.331 ***	-0.002	-0.193 *	-0.010	-0.048	-0.091	0.503 ***	-0.135
	df	106	107	107	107	107	107	107	106	106	107	107	107
avg-fragmentation-total-revs	p-value	0.052	0.096	0.925	0.208	< .001	0.980	0.044	0.915	0.624	0.345	< .001	0.163
	Pearson's r	-0.020	0.020	-0.237 *	-0.032	-0.017	0.053	-0.110	-0.224 *	0.163	0.595 ***	1.000 ***	0.138
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.841	0.836	0.013	0.741	0.857	0.581	0.254	0.020	0.092	< .001	< .001	0.151
	Spearman's rho	-0.069	0.162	-0.229 *	0.037	0.138	0.058	-0.137	-0.286 **	0.269 **	0.584 ***	1.000 ***	0.051
	df	106	107	107	107	107	107	107	106	106	107	107	107
avg-main-dev-ownership	p-value	0.476	0.092	0.017	0.700	0.152	0.546	0.156	0.003	0.005	< .001	< .001	0.600
	Pearson's r	0.232 *	-0.214 *	-0.270 **	-0.238 *	-0.091	-0.425 ***	-0.142	0.089	0.282 **	0.140	0.016	0.022
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.016	0.026	0.005	0.013	0.345	< .001	0.141	0.358	0.003	0.145	0.870	0.823
	Spearman's rho	0.307 **	-0.372 ***	-0.475 ***	-0.437 ***	-0.108	-0.405 ***	-0.127	0.013	0.307 **	0.210 *	0.162	0.187
	df	106	107	107	107	107	107	107	106	106	107	107	107
avg-refactoring-main-dev-ownership	p-value	0.001	< .001	< .001	< .001	0.263	< .001	0.187	0.897	0.001	0.028	0.093	0.052
	Pearson's r	0.143	-0.041	-0.164	-0.082	0.017	0.044	0.107	-0.056	0.375 ***	0.422 ***	0.355 ***	-0.161
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.138	0.671	0.089	0.394	0.862	0.651	0.268	0.563	< .001	< .001	< .001	0.095
	Spearman's rho	0.217 *	-0.119	-0.324 ***	-0.211 *	0.141	-0.082	0.002	0.034	0.366 ***	0.501 ***	0.445 ***	0.032
	df	106	107	107	107	107	107	107	106	106	107	107	107
avg-revisions	p-value	0.024	0.218	< .001	0.028	0.145	0.396	0.983	0.724	< .001	< .001	< .001	0.738
	Pearson's r	-0.020	0.020	-0.237 *	-0.032	-0.017	0.053	-0.110	-0.224 *	0.163	0.595 ***	1.000 ***	0.138
	df	106	107	107	107	107	107	107	106	106	107	107	107
	p-value	0.841	0.836	0.013	0.741	0.857	0.581	0.254	0.020	0.092	< .001	< .001	0.151
	Spearman's rho	-0.069	0.162	-0.229 *	0.037	0.138	0.058	-0.137	-0.286 **	0.269 **	0.584 ***	1.000 ***	0.051
	df	106	107	107	107	107	107	107	106	106	107	107	107
avg-soc	p-value	0.476	0.092	0.017	0.700	0.152	0.546	0.156	0.003	0.005	< .001	< .001	0.600
	Pearson's r	-0.302 **	0.223 *	0.523 ***	0.470 ***	0.080	-0.113	-0.190 *	0.159	-0.204 *	0.101	0.215 *	0.159
	df	106	106	106	106	106	106	106	106	106	106	106	106
	p-value	0.001	0.020	< .001	< .001	0.408	0.245	0.049	0.101	0.034	0.298	0.026	0.100
	Spearman's rho	-0.631 ***	0.564 ***	0.671 ***	0.713 ***	0.251 **	0.038	-0.241 *	0.137	-0.522 ***	-0.192 *	0.019	-0.018
	df	106	106	106	106	106	106	106	106	106	106	106	106
	p-value	< .001	< .001	< .001	< .001	0.009	0.695	0.012	0.157	< .001	0.046	0.846	0.853

Note. * p < .05, ** p < .01, *** p < .001

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