Supplementary Materials: A Systematic Approach for the Selection of Optimization Algorithms including End-User Requirements Applied to Box-Type Boom Crane Design

Doris Entner [1], Philipp Fleck [2], Thomas Vosgien [1], Clemens Münzer [1], Steffen Finck [3,*], Thorsten Prante [1] and Martin Schwarz [4]

[1] Design Automation, V-Research GmbH, Stadtstr. 33, 6850 Dornbirn, Austria
[2] Heuristic and Evolutionary Algorithms Laboratory, University of Applied Sciences Upper Austria, Softwarepark 11, 4232 Hagenberg im Mühlkreis, Austria
[3] Josef Ressel Center for Applied Scientific Computing, Vorarlberg University of Applied Sciences, Hochschulstraße 1, 6850 Dornbirn, Austria
[4] Technology Management, Liebherr-Werk Nenzing GmbH, Dr.-Hans-Liebherr-Str. 1, 6710 Nenzing, Austria
* Correspondence: steffen.finck@fhv.at

S1. Decision Matrices

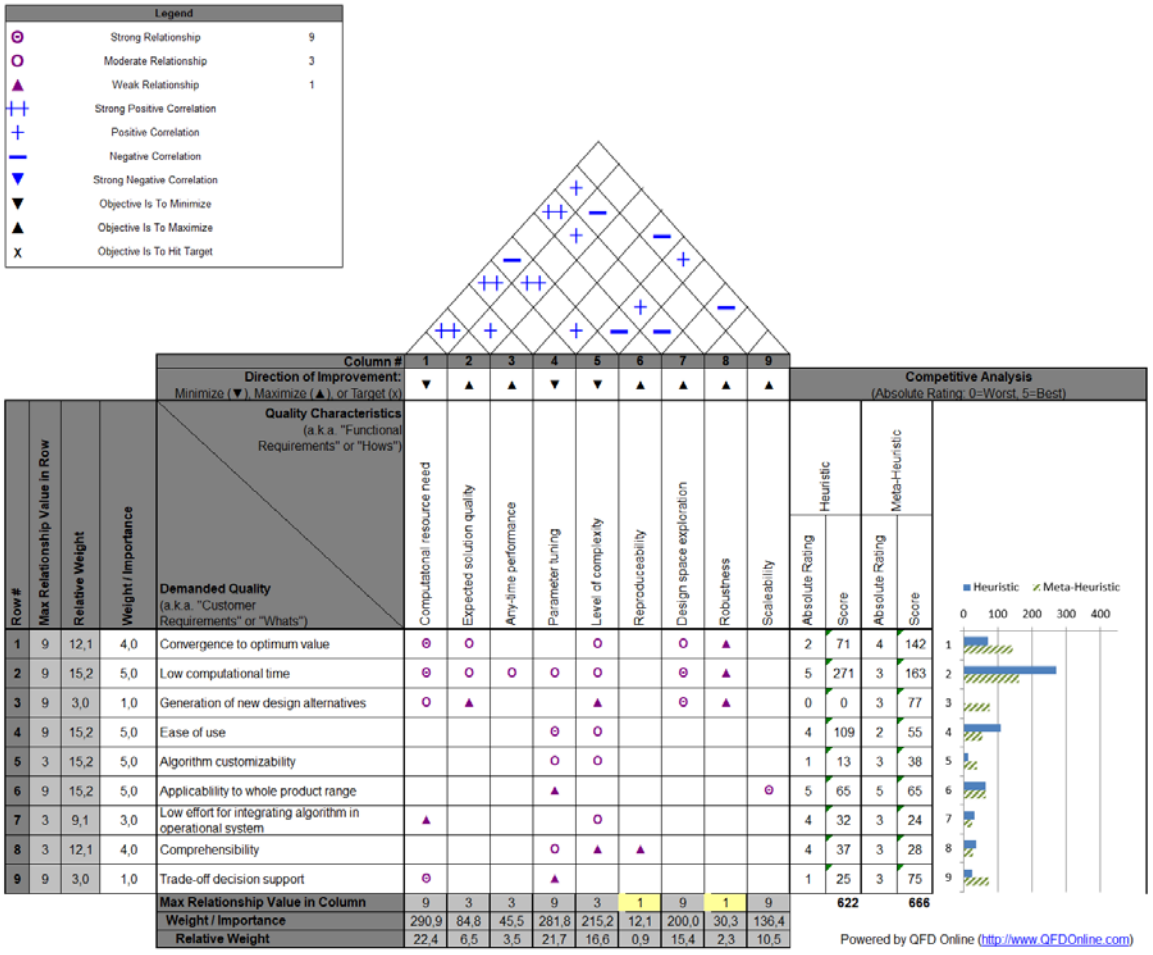
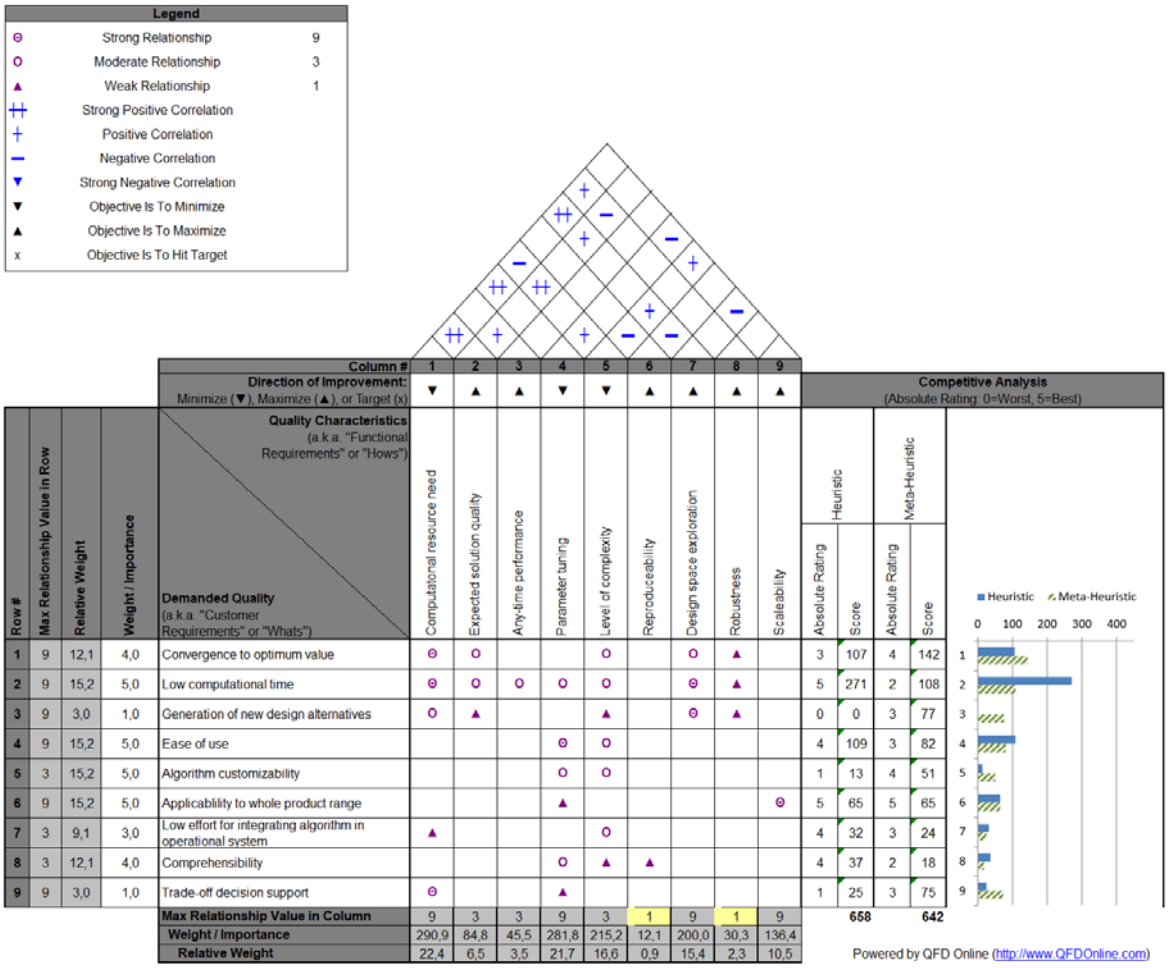


Figure S1. DM for boom configuration optimization before evaluating the results.



Legend		
⊖	Strong Relationship	9
o	Moderate Relationship	3
▲	Weak Relationship	1
++	Strong Positive Correlation	
+	Positive Correlation	
−	Negative Correlation	
▼	Strong Negative Correlation	
▼	Objective Is To Minimize	
▲	Objective Is To Maximize	
x	Objective Is To Hit Target	

Row #	Max Relationship Value in Row	Relative Weight	Weight / Importance	Quality Characteristics (a.k.a. "Functional Requirements" or "Hows") / Demanded Quality (a.k.a. "Customer Requirements" or "Whats")	1 Computational resource need	2 Expected solution quality	3 Any-time performance	4 Parameter tuning	5 Level of complexity	6 Reproduceability	7 Design space exploration	8 Robustness	9 Scaleability	Competitive Analysis (Absolute Rating: 0=Worst, 5=Best) Heuristic: Absolute Rating	Heuristic: Score	Meta-Heuristic: Absolute Rating	Meta-Heuristic: Score
				Direction of Improvement: Minimize (▼), Maximize (▲), or Target (x)	▼	▲	▲	▼	▼	▲	▲	▲	▲				
1	9	12,1	4,0	Convergence to optimum value	⊖	o			o		o	▲		3	107	4	142
2	9	15,2	5,0	Low computational time	⊖	o	o	o	o		⊖	▲		5	271	2	108
3	9	3,0	1,0	Generation of new design alternatives	o	▲			▲		⊖	▲		0	0	3	77
4	9	15,2	5,0	Ease of use				⊖	o					4	109	3	82
5	3	15,2	5,0	Algorithm customizability				o	o					1	13	4	51
6	9	15,2	5,0	Applicability to whole product range				▲					⊖	5	65	5	65
7	3	9,1	3,0	Low effort for integrating algorithm in operational system	▲				o					4	32	3	24
8	3	12,1	4,0	Comprehensibility				o	▲	▲				4	37	2	18
9	9	3,0	1,0	Trade-off decision support	⊖			▲						1	25	3	75
				Max Relationship Value in Column	9	3	3	9	3	1	9	1	9		658		642
				Weight / Importance	290,9	84,8	45,5	281,8	215,2	12,1	200,0	30,3	136,4				
				Relative Weight	22,4	6,5	3,5	21,7	16,6	0,9	15,4	2,3	10,5				

Powered by QFD Online (http://www.QFDOnline.com)

Figure S2. DM for boom configuration optimization after evaluating the results.

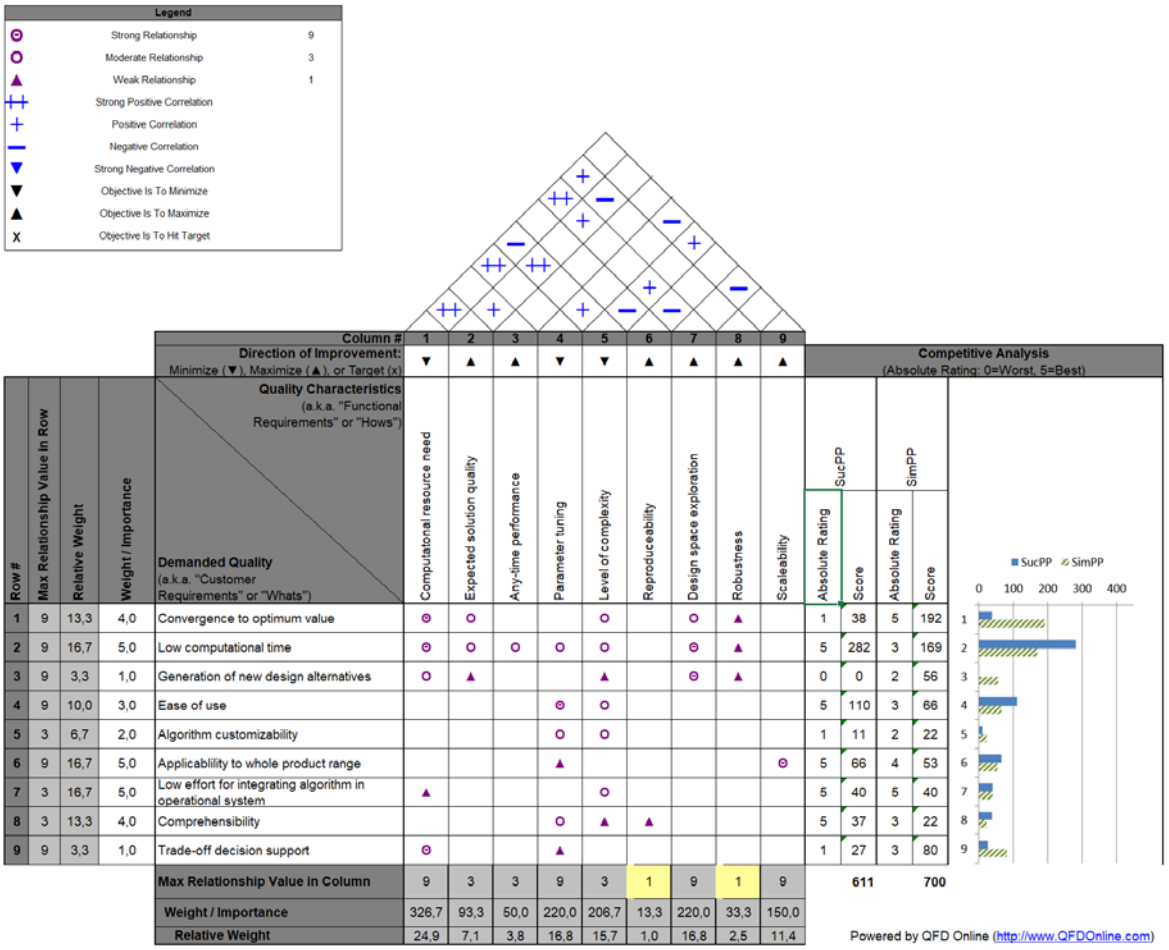


Figure S3. DM for plate partitioning before evaluating the results.

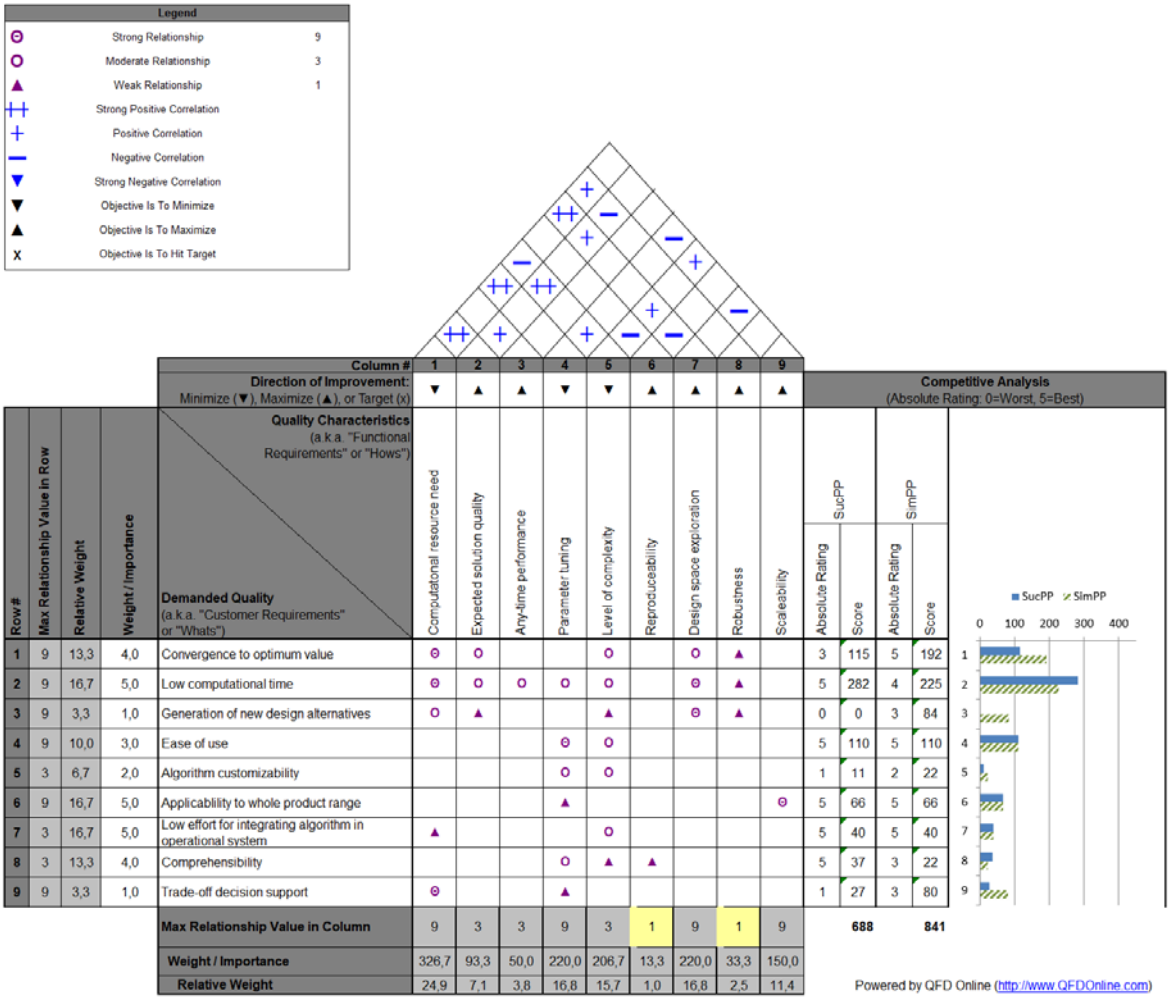


Figure S4. DM for plate partitioning optimization after evaluating the results.

S2. Cost Function Comparison

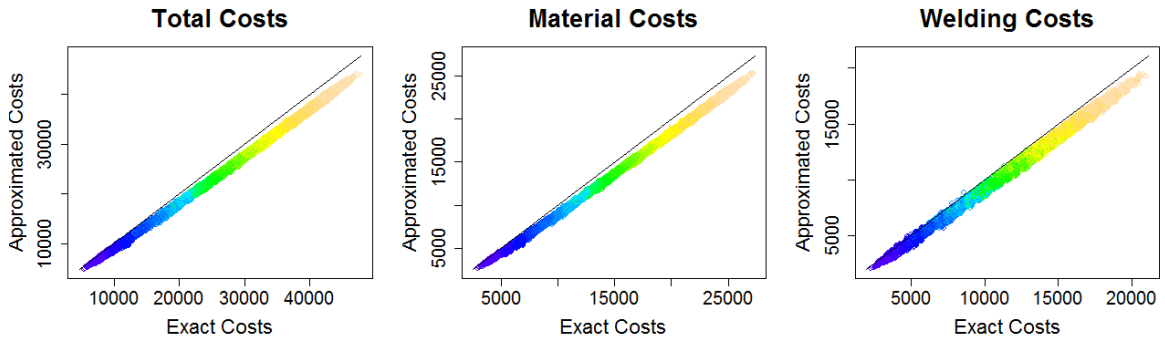


Figure S5. Comparison of cost approximations for metal sheets - total costs, material costs and welding costs; the colors indicate the number of segments, starting at the bottom left with 4 segments (dark blue) to the top right with 23 segments (yellow).

S3. Comparison of SucPP and SimPP for Plate Partitioning

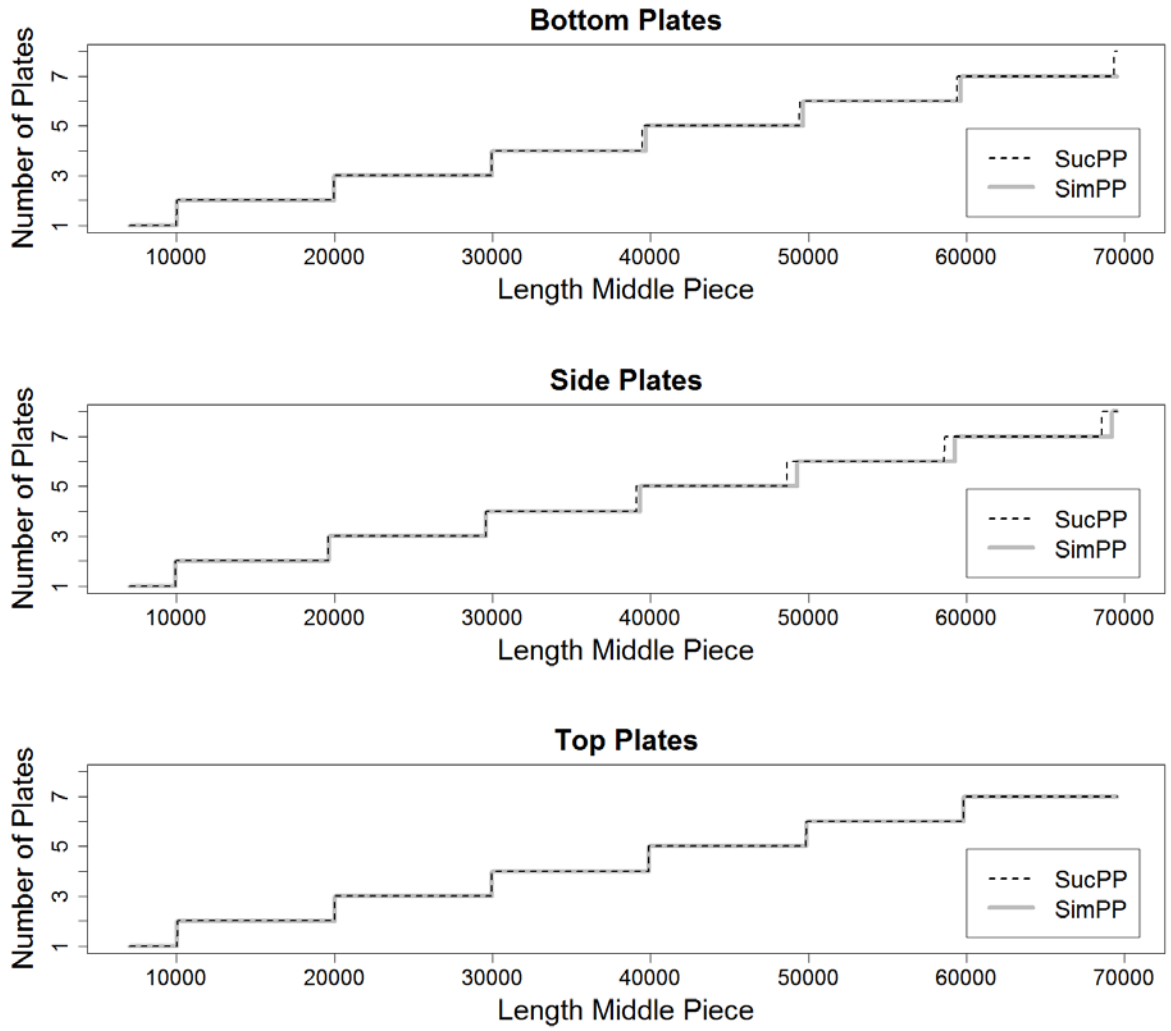


Figure S6. Comparison of the two approaches for calculating a plate partitioning.

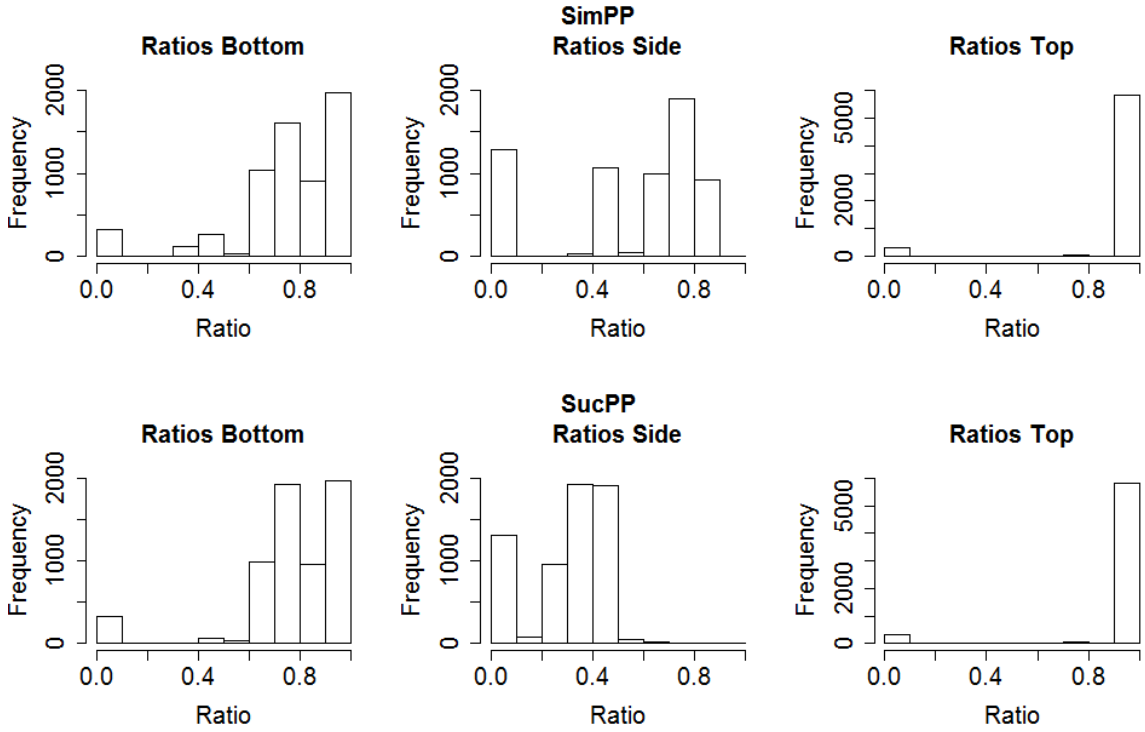


Figure S7. For each of 6250 BTBs with, the ratio of plate lengths of the first to the second last plate lying within 1% of the maximum length is shown.