

A Total cost results

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-------------|-----------------|----|----|----|----|----|------|------|------|----|----|-----|-------|-------|
| VFRF | | | | | | | | | | | | | | |
| Inst3WS1 | 91777 (0%) | 3 | 0 | 1 | 0 | 5 | 0.10 | 0.03 | 0.02 | 1 | — | — | 2 | 34 |
| Inst3WS2 | 51037 (0%) | 5 | 0 | 1 | 0 | 3 | 0.01 | 0.05 | 0.02 | 1 | — | — | 2 | 117 |
| Inst3WS3 | 224741 (0%) | 6 | 0 | 2 | 0 | 5 | 0.17 | 0.03 | 0.02 | 1 | — | — | 3 | 1156 |
| Inst3WS4 | 166455 (0%) | 2 | 1 | 3 | 0 | 4 | 0.14 | 0.18 | 0.16 | 1 | — | — | 5 | 277 |
| Inst3WS5 | 200286 (0%) | 11 | 2 | 1 | 0 | 2 | 0.10 | 0.04 | 0.03 | 1 | — | — | 4 | 12989 |
| Inst3WS6 | 83504 (6.90%) | 5 | 0 | 4 | 0 | 6 | 0.03 | 0.07 | 0.05 | 1 | — | — | 5 | 43200 |
| Inst4WS1 | 184107 (0%) | 4 | 0 | 2 | 0 | 6 | 0.28 | 0.04 | 0.05 | 1 | — | — | 3 | 212 |
| Inst4WS2 | 113298 (0%) | 3 | 0 | 3 | 0 | 4 | 0.03 | 0.06 | 0.05 | 1 | — | — | 4 | 1606 |
| Inst4WS3 | 314874 (0%) | 9 | 0 | 4 | 0 | 5 | 0.10 | 0.11 | 0.11 | 1 | — | — | 5 | 30823 |
| Inst4WS4 | 146116 (3.26%) | 7 | 0 | 4 | 0 | 5 | 0.06 | 0.04 | 0.04 | 1 | — | — | 5 | 43200 |
| Inst4WS5 | 51466 (0%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.07 | 0.04 | 1 | — | — | 4 | 543 |
| Inst4WS6 | 190577 (2.55%) | 8 | 0 | 5 | 0 | 5 | 0.09 | 0.09 | 0.07 | 1 | — | — | 6 | 43200 |
| Inst5WS1 | 284831 (0.69%) | 10 | 1 | 4 | 0 | 5 | 0.13 | 0.09 | 0.10 | 1 | — | — | 6 | 43200 |
| Inst5WS2 | 239178 (0%) | 6 | 0 | 3 | 0 | 7 | 0.83 | 0.04 | 0.03 | 1 | — | — | 4 | 2564 |
| Inst5WS3 | 375284 (0%) | 11 | 2 | 3 | 0 | 5 | 0.18 | 0.16 | 0.16 | 1 | — | — | 6 | 30476 |
| Inst5WS4 | 253280 (0%) | 10 | 0 | 2 | 0 | 4 | 0.25 | 0.05 | 0.04 | 1 | — | — | 3 | 11359 |
| Inst5WS5 | 344215 (0.49%) | 12 | 1 | 3 | 0 | 4 | 0.46 | 0.06 | 0.04 | 1 | — | — | 5 | 43200 |
| Inst5WS6 | 138745 (0%) | 2 | 0 | 6 | 0 | 2 | 0 | 0.09 | 0.10 | 1 | — | — | 7 | 1154 |
| Inst6WS1 | 198632 (0%) | 12 | 0 | 1 | 0 | 3 | 0.15 | 0.02 | 0.04 | 1 | — | — | 2 | 16355 |
| Inst6WS2 | 213153 (6.16%) | 9 | 2 | 3 | 0 | 4 | 0.14 | 0.04 | 0.06 | 1 | — | — | 6 | 43200 |
| Inst6WS3 | 257564 (1.51%) | 15 | 1 | 3 | 0 | 4 | 0.19 | 0.03 | 0.04 | 1 | — | — | 5 | 43200 |
| Inst6WS4 | 338198 (1.52%) | 15 | 2 | 3 | 0 | 5 | 0.51 | 0.03 | 0.03 | 1 | — | — | 6 | 43200 |
| Inst6WS5 | 268133 (3.64%) | 7 | 2 | 5 | 0 | 4 | 0.20 | 0.17 | 0.19 | 1 | — | — | 8 | 43200 |
| Inst6WS6 | 232150 (20.54%) | 10 | 1 | 7 | 0 | 5 | 0.07 | 0.07 | 0.06 | 1 | — | — | 9 | 43200 |
| Inst7WS1 | 236071 (0%) | 15 | 0 | 2 | 0 | 4 | 0.16 | 0.03 | 0.04 | 1 | — | — | 3 | 7247 |
| Inst7WS2 | 476960 (1.71%) | 16 | 1 | 5 | 0 | 6 | 0.59 | 0.05 | 0.06 | 1 | — | — | 7 | 43200 |
| Inst7WS3 | 568819 (1.60%) | 10 | 0 | 7 | 0 | 5 | 3.47 | 0.15 | 0.15 | 4 | — | — | 8 | 43200 |
| Inst7WS4 | 499294 (6.96%) | 12 | 1 | 6 | 0 | 7 | 0.79 | 0.19 | 0.13 | 2 | — | — | 8 | 43200 |
| Inst7WS5 | 442575 (9.82%) | 16 | 2 | 6 | 0 | 6 | 0.29 | 0.06 | 0.09 | 1 | — | — | 9 | 43200 |
| Inst7WS6 | 407585 (17.80%) | 13 | 3 | 5 | 1 | 4 | 0.27 | 0.16 | 0.12 | 1 | — | — | 10 | 43200 |
| VORF | | | | | | | | | | | | | | |
| Inst3WS1 | 91777 (0%) | 3 | 0 | 1 | 0 | 5 | 0.10 | 0.03 | 0.02 | 1 | 0 | 0 | 2 | 153 |
| Inst3WS2 | 51037 (0%) | 5 | 0 | 1 | 0 | 3 | 0.01 | 0.05 | 0.02 | 1 | 0 | 0 | 2 | 425 |
| Inst3WS3 | 224741 (0%) | 6 | 0 | 2 | 0 | 5 | 0.17 | 0.03 | 0.02 | 1 | 0 | 0 | 3 | 1808 |
| Inst3WS4 | 157277 (0%) | 3 | 0 | 3 | 0 | 4 | 0.02 | 0.58 | 0.46 | 1 | 0 | 1 | 4 | 609 |
| Inst3WS5 | 200350 (6.35%) | 11 | 1 | 2 | 0 | 2 | 0.33 | 0.05 | 0.06 | 0 | 0 | 1 | 4 | 43200 |
| Inst3WS6 | 83504 (0%) | 5 | 0 | 4 | 0 | 6 | 0.03 | 0.07 | 0.05 | 1 | 0 | 0 | 5 | 10081 |
| Inst4WS1 | 182764 (0%) | 4 | 0 | 2 | 0 | 6 | 0.90 | 0.06 | 0.06 | 1 | 0 | 1 | 3 | 1058 |
| Inst4WS2 | 113298 (0%) | 3 | 0 | 3 | 0 | 4 | 0.03 | 0.06 | 0.05 | 1 | 0 | 0 | 4 | 5875 |
| Inst4WS3 | 313270 (0.30%) | 9 | 0 | 4 | 0 | 5 | 0.34 | 0.28 | 0.34 | 0 | 0 | 1 | 5 | 43200 |
| Inst4WS4 | 146116 (4.11%) | 7 | 0 | 4 | 0 | 5 | 0.06 | 0.04 | 0.04 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS5 | 51466 (0%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.07 | 0.04 | 1 | 0 | 0 | 4 | 6405 |
| Inst4WS6 | 190014 (5.75%) | 7 | 0 | 6 | 0 | 5 | 0.19 | 0.29 | 0.29 | 0 | 0 | 1 | 7 | 43200 |
| Inst5WS1 | 281845 (0%) | 11 | 0 | 4 | 0 | 5 | 0.46 | 0.23 | 0.31 | 0 | 0 | 1 | 5 | 17314 |
| Inst5WS2 | 239178 (1.64%) | 6 | 0 | 3 | 0 | 7 | 0.83 | 0.04 | 0.03 | 1 | 0 | 0 | 4 | 43200 |
| Inst5WS3 | 372998 (3.66%) | 12 | 1 | 3 | 0 | 5 | 0.23 | 0.41 | 0.53 | 1 | 0 | 1 | 5 | 43200 |
| Inst5WS4 | 253280 (4.47%) | 10 | 0 | 2 | 0 | 4 | 0.25 | 0.05 | 0.04 | 1 | 0 | 0 | 3 | 43200 |
| Inst5WS5 | 343992 (3.17%) | 12 | 0 | 4 | 0 | 4 | 1.10 | 0.09 | 0.03 | 1 | 0 | 1 | 5 | 43200 |
| Inst5WS6 | 138745 (0%) | 2 | 0 | 6 | 0 | 2 | 0 | 0.09 | 0.10 | 1 | 0 | 0 | 7 | 4239 |
| Inst6WS1 | 198633 (0%) | 13 | 0 | 1 | 0 | 3 | 0.15 | 0.02 | 0.04 | 1 | 0 | 0 | 2 | 2151 |
| Inst6WS2 | 212852 (5.79%) | 10 | 2 | 2 | 0 | 4 | 0.49 | 0.11 | 0.15 | 0 | 0 | 1 | 5 | 43200 |
| Inst6WS3 | 256933 (1.69%) | 15 | 0 | 4 | 0 | 4 | 0.66 | 0.08 | 0.11 | 0 | 0 | 1 | 5 | 43200 |
| Inst6WS4 | 337722 (13.67%) | 14 | 3 | 3 | 0 | 5 | 0.33 | 0.43 | 0.63 | 1 | 0 | 1 | 7 | 43200 |

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| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-------------|-----------------|----|----|----|----|----|------|------|------|----|----|-----|-------|-------|
| Inst6WS5 | 259228 (17.42%) | 6 | 3 | 5 | 0 | 4 | 0.03 | 0.84 | 0.30 | 1 | 0 | 1 | 9 | 43200 |
| Inst6WS6 | 232150 (27.77%) | 10 | 1 | 7 | 0 | 5 | 0.07 | 0.07 | 0.06 | 1 | 0 | 0 | 9 | 43200 |
| Inst7WS1 | 236071 (0%) | 15 | 0 | 2 | 0 | 4 | 0.16 | 0.03 | 0.04 | 1 | 0 | 0 | 3 | 22611 |
| Inst7WS2 | 477507 (1.23%) | 16 | 2 | 4 | 0 | 6 | 0.59 | 0.05 | 0.06 | 1 | 0 | 0 | 7 | 43200 |
| Inst7WS3 | 566011 (2.93%) | 11 | 0 | 6 | 0 | 5 | 3.47 | 0.44 | 0.53 | 4 | 0 | 1 | 7 | 43200 |
| Inst7WS4 | 492406 (19.11%) | 16 | 0 | 6 | 0 | 4 | 0.99 | 0.28 | 0.33 | 1 | 0 | 1 | 7 | 43200 |
| Inst7WS5 | 443118 (12.09%) | 16 | 2 | 6 | 0 | 6 | 0.67 | 0.20 | 0.26 | 1 | 0 | 1 | 9 | 43200 |
| Inst7WS6 | 404583 (26.33%) | 14 | 2 | 6 | 0 | 4 | 0.28 | 0.42 | 0.57 | 1 | 0 | 1 | 9 | 43200 |
| VFRO | | | | | | | | | | | | | | |
| Inst3WS1 | 91309 (0%) | 3 | 0 | 1 | 0 | 5 | 0.09 | 0.03 | 0.02 | 1 | — | — | 2 | 184 |
| Inst3WS2 | 50839 (0%) | 5 | 0 | 1 | 0 | 3 | 0.01 | 0.05 | 0.02 | 1 | — | — | 2 | 1431 |
| Inst3WS3 | 224507 (0%) | 7 | 0 | 2 | 0 | 5 | 0.16 | 0.03 | 0.02 | 1 | — | — | 3 | 2187 |
| Inst3WS4 | 165343 (0%) | 2 | 1 | 3 | 0 | 4 | 0.13 | 0.17 | 0.16 | 1 | — | — | 5 | 32536 |
| Inst3WS5 | 200142 (0.77%) | 11 | 2 | 1 | 0 | 2 | 0.10 | 0.04 | 0.03 | 1 | — | — | 4 | 43200 |
| Inst3WS6 | 83331 (9.62%) | 5 | 1 | 3 | 0 | 6 | 0.03 | 0.07 | 0.04 | 1 | — | — | 5 | 43200 |
| Inst4WS1 | 183901 (0%) | 4 | 0 | 2 | 0 | 6 | 0.27 | 0.04 | 0.05 | 1 | — | — | 3 | 2239 |
| Inst4WS2 | 113032 (2.30%) | 3 | 0 | 3 | 0 | 4 | 0.03 | 0.06 | 0.05 | 1 | — | — | 4 | 43200 |
| Inst4WS3 | 314332 (1.36%) | 9 | 0 | 4 | 0 | 5 | 0.10 | 0.10 | 0.11 | 1 | — | — | 5 | 43200 |
| Inst4WS4 | 145957 (4.65%) | 7 | 0 | 4 | 0 | 5 | 0.06 | 0.04 | 0.04 | 1 | — | — | 5 | 43200 |
| Inst4WS5 | 51255 (8.49%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.07 | 0.04 | 1 | — | — | 4 | 43200 |
| Inst4WS6 | 190158 (17.09%) | 8 | 0 | 5 | 0 | 5 | 0.08 | 0.08 | 0.07 | 1 | — | — | 6 | 43200 |
| Inst5WS1 | 284444 (1.96%) | 10 | 1 | 4 | 0 | 5 | 0.13 | 0.09 | 0.10 | 1 | — | — | 6 | 43200 |
| Inst5WS2 | 237908 (2.30%) | 6 | 0 | 3 | 0 | 7 | 0.78 | 0.04 | 0.05 | 1 | — | — | 4 | 43200 |
| Inst5WS3 | 374323 (2.13%) | 10 | 2 | 3 | 0 | 4 | 0.17 | 0.15 | 0.16 | 1 | — | — | 6 | 43200 |
| Inst5WS4 | 252390 (3.94%) | 10 | 0 | 2 | 0 | 4 | 0.24 | 0.05 | 0.04 | 1 | — | — | 3 | 43200 |
| Inst5WS5 | 343205 (1.71%) | 12 | 1 | 3 | 0 | 4 | 0.44 | 0.06 | 0.04 | 1 | — | — | 5 | 43200 |
| Inst5WS6 | 138451 (0%) | 2 | 0 | 6 | 0 | 2 | 0 | 0.09 | 0.10 | 1 | — | — | 7 | 32474 |
| Inst6WS1 | 198004 (0%) | 12 | 0 | 1 | 0 | 3 | 0.14 | 0.02 | 0.04 | 1 | — | — | 2 | 5046 |
| Inst6WS2 | 213004 (6%) | 9 | 2 | 3 | 0 | 4 | 0.14 | 0.04 | 0.06 | 1 | — | — | 6 | 43200 |
| Inst6WS3 | 256816 (2.21%) | 15 | 1 | 3 | 0 | 4 | 0.17 | 0.03 | 0.04 | 1 | — | — | 5 | 43200 |
| Inst6WS4 | 337688 (12.41%) | 15 | 2 | 3 | 0 | 5 | 0.50 | 0.03 | 0.03 | 1 | — | — | 6 | 43200 |
| Inst6WS5 | 267778 (16.15%) | 6 | 3 | 5 | 0 | 4 | 0.16 | 0.18 | 0.19 | 1 | — | — | 9 | 43200 |
| Inst6WS6 | 231879 (31.58%) | 10 | 1 | 7 | 0 | 5 | 0.07 | 0.06 | 0.06 | 1 | — | — | 9 | 43200 |
| Inst7WS1 | 235491 (2.16%) | 15 | 0 | 2 | 0 | 4 | 0.15 | 0.03 | 0.04 | 1 | — | — | 3 | 43200 |
| Inst7WS2 | 475198 (18.55%) | 17 | 1 | 4 | 0 | 6 | 0.55 | 0.04 | 0.06 | 1 | — | — | 6 | 43200 |
| Inst7WS3 | 557577 (3.34%) | 10 | 1 | 6 | 0 | 5 | 3.22 | 0.15 | 0.15 | 4 | — | — | 8 | 43200 |
| Inst7WS4 | 494249 (17.55%) | 16 | 1 | 5 | 0 | 4 | 0.84 | 0.08 | 0.13 | 2 | — | — | 7 | 43200 |
| Inst7WS5 | 444387 (23.32%) | 17 | 4 | 6 | 0 | 3 | 0.26 | 0.08 | 0.12 | 1 | — | — | 11 | 43200 |
| Inst7WS6 | 407196 (22.66%) | 14 | 3 | 6 | 0 | 3 | 0.26 | 0.16 | 0.15 | 1 | — | — | 10 | 43200 |
| VORO | | | | | | | | | | | | | | |
| Inst3WS1 | 91309 (0%) | 3 | 0 | 1 | 0 | 5 | 0.09 | 0.03 | 0.02 | 1 | 0 | 0 | 2 | 729 |
| Inst3WS2 | 50839 (0%) | 5 | 0 | 1 | 0 | 3 | 0.01 | 0.05 | 0.02 | 1 | 0 | 0 | 2 | 2893 |
| Inst3WS3 | 223737 (0%) | 7 | 0 | 2 | 0 | 5 | 0.42 | 0.06 | 0.07 | 0 | 0 | 1 | 3 | 4673 |
| Inst3WS4 | 154536 (0%) | 3 | 0 | 3 | 0 | 4 | 0.06 | 0.57 | 0.38 | 1 | 0 | 1 | 4 | 15229 |
| Inst3WS5 | 199503 (1.76%) | 11 | 1 | 2 | 0 | 2 | 0.26 | 0.04 | 0.06 | 0 | 0 | 1 | 4 | 43200 |
| Inst3WS6 | 83331 (11.81%) | 5 | 1 | 3 | 0 | 6 | 0.03 | 0.07 | 0.04 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS1 | 178898 (0%) | 4 | 0 | 2 | 0 | 6 | 0.71 | 0.04 | 0.06 | 0 | 0 | 1 | 3 | 4873 |
| Inst4WS2 | 113032 (0%) | 3 | 0 | 3 | 0 | 4 | 0.03 | 0.06 | 0.05 | 1 | 0 | 0 | 4 | 27769 |
| Inst4WS3 | 311895 (1.91%) | 9 | 0 | 4 | 0 | 5 | 0.26 | 0.26 | 0.29 | 0 | 0 | 1 | 5 | 43200 |
| Inst4WS4 | 145957 (5.69%) | 6 | 0 | 4 | 0 | 5 | 0.06 | 0.04 | 0.04 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS5 | 51255 (0%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.07 | 0.04 | 1 | 0 | 0 | 4 | 15721 |
| Inst4WS6 | 188944 (16.60%) | 7 | 0 | 6 | 0 | 5 | 0.15 | 0.23 | 0.29 | 0 | 0 | 1 | 7 | 43200 |
| Inst5WS1 | 280403 (21.35%) | 11 | 0 | 4 | 0 | 5 | 0.36 | 0.20 | 0.29 | 0 | 0 | 1 | 5 | 43200 |
| Inst5WS2 | 231479 (2.04%) | 5 | 1 | 3 | 0 | 7 | 0.33 | 1.35 | 0.31 | 0 | 0 | 2 | 5 | 43200 |
| Inst5WS3 | 370693 (7.67%) | 12 | 1 | 3 | 0 | 5 | 0.28 | 0.39 | 0.45 | 1 | 0 | 1 | 5 | 43200 |

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Table continued from previous page

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|----------|-----------------|----|----|----|----|----|------|------|------|----|----|-----|-------|-------|
| Inst5WS4 | 250273 (5.09%) | 10 | 0 | 2 | 0 | 4 | 0.69 | 0.10 | 0.13 | 0 | 0 | 1 | 3 | 43200 |
| Inst5WS5 | 341174 (18.06%) | 12 | 0 | 4 | 0 | 4 | 1.06 | 0.07 | 0.04 | 1 | 0 | 1 | 5 | 43200 |
| Inst5WS6 | 138451 (9.27%) | 2 | 0 | 6 | 0 | 2 | 0 | 0.09 | 0.10 | 1 | 0 | 0 | 7 | 43200 |
| Inst6WS1 | 198004 (0%) | 13 | 0 | 1 | 0 | 3 | 0.14 | 0.02 | 0.04 | 1 | 0 | 0 | 2 | 35620 |
| Inst6WS2 | 211664 (6.81%) | 10 | 2 | 2 | 0 | 4 | 0.39 | 0.09 | 0.15 | 0 | 0 | 1 | 5 | 43200 |
| Inst6WS3 | 255461 (2.61%) | 15 | 0 | 4 | 0 | 4 | 0.53 | 0.06 | 0.11 | 0 | 0 | 1 | 5 | 43200 |
| Inst6WS4 | 332880 (15.28%) | 15 | 2 | 3 | 0 | 5 | 0.95 | 0.36 | 0.67 | 0 | 0 | 2 | 6 | 43200 |
| Inst6WS5 | 257243 (24.48%) | 9 | 0 | 5 | 0 | 4 | 0.18 | 0.59 | 0.23 | 1 | 0 | 1 | 6 | 43200 |
| Inst6WS6 | 231879 (44.98%) | 10 | 1 | 7 | 0 | 5 | 0.07 | 0.06 | 0.06 | 1 | 0 | 0 | 9 | 43200 |
| Inst7WS1 | 235491 (2.37%) | 15 | 0 | 2 | 0 | 4 | 0.15 | 0.03 | 0.04 | 1 | 0 | 0 | 3 | 43200 |
| Inst7WS2 | 472843 (23.09%) | 17 | 1 | 4 | 0 | 6 | 1.72 | 0.11 | 0.16 | 0 | 0 | 2 | 6 | 43200 |
| Inst7WS3 | 551178 (3.33%) | 11 | 0 | 6 | 0 | 5 | 4.03 | 0.35 | 0.45 | 3 | 0 | 2 | 7 | 43200 |
| Inst7WS4 | 491230 (7.37%) | 12 | 2 | 5 | 0 | 7 | 0.32 | 1.01 | 0.14 | 1 | 0 | 1 | 8 | 43200 |
| Inst7WS5 | 445180 (46.39%) | 18 | 3 | 6 | 0 | 3 | 0.72 | 0.15 | 0.20 | 1 | 0 | 1 | 10 | 43200 |
| Inst7WS6 | 405466 (25.96%) | 13 | 1 | 6 | 3 | 3 | 0.45 | 0.36 | 0.34 | 1 | 0 | 1 | 9 | 43200 |

Table 1: Results overview small layout. Shown for each instance: total cost (MIP gap), number of part families assigned to LS, BS, SQ, SK, TK, fractional number of vehicles required for LS, RP and TR, the total integer number of tow trains, forklifts and AGVs to be acquired, number of cell constructed and the total runtime.

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-------------|-----------------|----|----|----|----|----|------|------|------|----|----|-----|-------|-------|
| VFRF | | | | | | | | | | | | | | |
| Inst3WS1 | 98496 (0%) | 3 | 0 | 1 | 0 | 5 | 0.20 | 0.05 | 0.03 | 1 | — | — | 2 | 42 |
| Inst3WS2 | 53912 (0%) | 5 | 0 | 1 | 0 | 3 | 0.02 | 0.09 | 0.03 | 1 | — | — | 2 | 2835 |
| Inst3WS3 | 235304 (0%) | 6 | 0 | 2 | 0 | 4 | 0.34 | 0.05 | 0.04 | 1 | — | — | 3 | 1401 |
| Inst3WS4 | 185529 (0%) | 2 | 1 | 3 | 0 | 4 | 0.24 | 0.28 | 0.29 | 1 | — | — | 5 | 353 |
| Inst3WS5 | 207821 (1.37%) | 11 | 2 | 1 | 0 | 2 | 0.20 | 0.07 | 0.05 | 1 | — | — | 4 | 43202 |
| Inst3WS6 | 89427 (5.24%) | 5 | 0 | 4 | 0 | 6 | 0.06 | 0.12 | 0.09 | 1 | — | — | 5 | 43200 |
| Inst4WS1 | 201825 (0%) | 4 | 0 | 2 | 0 | 6 | 0.57 | 0.06 | 0.10 | 1 | — | — | 3 | 342 |
| Inst4WS2 | 119410 (0%) | 3 | 0 | 3 | 0 | 4 | 0.07 | 0.10 | 0.10 | 1 | — | — | 4 | 1766 |
| Inst4WS3 | 328614 (1.50%) | 7 | 0 | 3 | 0 | 4 | 0.21 | 0.18 | 0.21 | 1 | — | — | 5 | 43200 |
| Inst4WS4 | 152496 (4.23%) | 7 | 0 | 4 | 0 | 5 | 0.12 | 0.07 | 0.08 | 1 | — | — | 5 | 43200 |
| Inst4WS5 | 56007 (0%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.12 | 0.07 | 1 | — | — | 4 | 648 |
| Inst4WS6 | 200974 (3.49%) | 8 | 0 | 5 | 0 | 5 | 0.18 | 0.15 | 0.13 | 1 | — | — | 6 | 43200 |
| Inst5WS1 | 327088 (0%) | 12 | 3 | 0 | 0 | 4 | 0.36 | 0.42 | 0.12 | 1 | — | — | 4 | 43200 |
| Inst5WS2 | 299605 (0%) | 6 | 0 | 3 | 0 | 7 | 1.71 | 0.33 | 0.06 | 3 | — | — | 4 | 3136 |
| Inst5WS3 | 433147 (0%) | 12 | 3 | 1 | 0 | 5 | 0.66 | 0.31 | 0.23 | 2 | — | — | 6 | 9203 |
| Inst5WS4 | 282676 (0%) | 10 | 0 | 2 | 0 | 4 | 0.55 | 0.28 | 0.08 | 1 | — | — | 3 | 547 |
| Inst5WS5 | 390450 (0.43%) | 12 | 1 | 3 | 0 | 4 | 0.95 | 0.47 | 0.07 | 2 | — | — | 5 | 43200 |
| Inst5WS6 | 164575 (0%) | 3 | 0 | 5 | 0 | 2 | 0.09 | 0.42 | 0.12 | 1 | — | — | 6 | 1832 |
| Inst6WS1 | 208706 (0%) | 12 | 0 | 2 | 0 | 3 | 0.31 | 0.04 | 0.05 | 1 | — | — | 3 | 1171 |
| Inst6WS2 | 224652 (4.59%) | 9 | 3 | 2 | 0 | 4 | 0.29 | 0.07 | 0.10 | 1 | — | — | 6 | 43200 |
| Inst6WS3 | 271012 (2.54%) | 14 | 1 | 4 | 0 | 4 | 0.40 | 0.06 | 0.07 | 1 | — | — | 6 | 43200 |
| Inst6WS4 | 370077 (1.05%) | 15 | 2 | 3 | 0 | 5 | 1.08 | 0.06 | 0.06 | 2 | — | — | 6 | 43200 |
| Inst6WS5 | 296421 (3.76%) | 9 | 0 | 5 | 0 | 4 | 0.48 | 0.25 | 0.32 | 2 | — | — | 6 | 43200 |
| Inst6WS6 | 241364 (22.80%) | 10 | 1 | 7 | 0 | 5 | 0.15 | 0.12 | 0.12 | 1 | — | — | 9 | 43200 |
| Inst7WS1 | 248664 (2.06%) | 15 | 0 | 2 | 0 | 4 | 0.36 | 0.05 | 0.07 | 1 | — | — | 3 | 43200 |
| Inst7WS2 | 518172 (0.61%) | 15 | 2 | 5 | 0 | 6 | 1.30 | 0.09 | 0.12 | 2 | — | — | 8 | 43200 |
| Inst7WS3 | 795264 (1.36%) | 10 | 0 | 7 | 0 | 5 | 7.73 | 0.26 | 0.34 | 9 | — | — | 8 | 43200 |
| Inst7WS4 | 560389 (11.99%) | 14 | 2 | 6 | 0 | 4 | 1.71 | 0.33 | 0.26 | 3 | — | — | 9 | 43200 |
| Inst7WS5 | 465713 (15.57%) | 15 | 3 | 6 | 0 | 6 | 0.61 | 0.13 | 0.16 | 1 | — | — | 10 | 43200 |
| Inst7WS6 | 437667 (19.30%) | 13 | 3 | 5 | 1 | 4 | 0.61 | 0.27 | 0.26 | 2 | — | — | 10 | 43200 |
| VORF | | | | | | | | | | | | | | |

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Table continued from previous page

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-------------|-----------------|----|----|----|----|----|------|------|------|----|----|-----|-------|-------|
| Inst3WS1 | 98496 (0%) | 3 | 0 | 1 | 0 | 5 | 0.20 | 0.05 | 0.03 | 1 | 0 | 0 | 2 | 208 |
| Inst3WS2 | 53912 (0%) | 5 | 0 | 1 | 0 | 3 | 0.02 | 0.09 | 0.03 | 1 | 0 | 0 | 2 | 187 |
| Inst3WS3 | 235304 (0%) | 7 | 0 | 2 | 0 | 5 | 0.34 | 0.05 | 0.04 | 1 | 0 | 0 | 3 | 1890 |
| Inst3WS4 | 182776 (0%) | 2 | 1 | 3 | 0 | 4 | 0.01 | 1.09 | 0.29 | 1 | 0 | 1 | 5 | 1949 |
| Inst3WS5 | 207821 (0%) | 11 | 2 | 1 | 0 | 2 | 0.20 | 0.07 | 0.05 | 1 | 0 | 0 | 4 | 34173 |
| Inst3WS6 | 89427 (0%) | 5 | 0 | 4 | 0 | 6 | 0.06 | 0.12 | 0.09 | 1 | 0 | 0 | 5 | 29481 |
| Inst4WS1 | 201825 (0%) | 4 | 0 | 2 | 0 | 6 | 0.57 | 0.06 | 0.10 | 1 | 0 | 0 | 3 | 790 |
| Inst4WS2 | 119410 (0%) | 3 | 0 | 3 | 0 | 4 | 0.07 | 0.10 | 0.10 | 1 | 0 | 0 | 4 | 24489 |
| Inst4WS3 | 328614 (2.78%) | 9 | 0 | 4 | 0 | 5 | 0.21 | 0.18 | 0.21 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS4 | 152496 (4.96%) | 7 | 0 | 4 | 0 | 5 | 0.12 | 0.07 | 0.08 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS5 | 56007 (0%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.12 | 0.07 | 1 | 0 | 0 | 4 | 7166 |
| Inst4WS6 | 200974 (10.31%) | 8 | 0 | 5 | 0 | 5 | 0.18 | 0.15 | 0.13 | 1 | 0 | 0 | 6 | 43200 |
| Inst5WS1 | 306378 (1.32%) | 9 | 1 | 4 | 0 | 5 | 0.28 | 0.84 | 0.21 | 1 | 0 | 1 | 6 | 43200 |
| Inst5WS2 | 290783 (0%) | 6 | 0 | 3 | 0 | 7 | 1.71 | 0.24 | 0.06 | 2 | 0 | 1 | 4 | 3475 |
| Inst5WS3 | 409780 (5.18%) | 11 | 3 | 2 | 0 | 5 | 0.49 | 0.98 | 0.24 | 1 | 0 | 1 | 6 | 43200 |
| Inst5WS4 | 276082 (2.35%) | 10 | 0 | 2 | 0 | 4 | 0.52 | 0.47 | 0.08 | 1 | 0 | 1 | 3 | 43200 |
| Inst5WS5 | 375974 (0.87%) | 12 | 0 | 4 | 0 | 4 | 1.02 | 0.31 | 0.11 | 1 | 0 | 1 | 5 | 43200 |
| Inst5WS6 | 153523 (0%) | 2 | 0 | 6 | 0 | 2 | 0.01 | 0.84 | 0.20 | 1 | 0 | 1 | 7 | 6060 |
| Inst6WS1 | 208706 (0%) | 12 | 0 | 2 | 0 | 3 | 0.31 | 0.04 | 0.05 | 1 | 0 | 0 | 3 | 6747 |
| Inst6WS2 | 224652 (2.71%) | 9 | 3 | 2 | 0 | 4 | 0.29 | 0.07 | 0.10 | 1 | 0 | 0 | 6 | 43200 |
| Inst6WS3 | 271012 (2.92%) | 14 | 1 | 4 | 0 | 4 | 0.40 | 0.06 | 0.07 | 1 | 0 | 0 | 6 | 43200 |
| Inst6WS4 | 370170 (15.08%) | 14 | 2 | 4 | 0 | 5 | 1.08 | 0.06 | 0.06 | 2 | 0 | 0 | 7 | 43200 |
| Inst6WS5 | 295638 (17.99%) | 9 | 0 | 5 | 0 | 4 | 0.14 | 1.58 | 0.32 | 1 | 0 | 2 | 6 | 43200 |
| Inst6WS6 | 241364 (32.40%) | 10 | 1 | 7 | 0 | 5 | 0.15 | 0.12 | 0.12 | 1 | 0 | 0 | 9 | 43200 |
| Inst7WS1 | 248664 (2.31%) | 15 | 0 | 2 | 0 | 4 | 0.36 | 0.05 | 0.07 | 1 | 0 | 0 | 3 | 43200 |
| Inst7WS2 | 518296 (14.78%) | 15 | 1 | 5 | 0 | 7 | 1.30 | 0.09 | 0.11 | 2 | 0 | 0 | 7 | 43200 |
| Inst7WS3 | 795264 (3.33%) | 10 | 0 | 7 | 0 | 5 | 7.73 | 0.26 | 0.34 | 9 | 0 | 0 | 8 | 43200 |
| Inst7WS4 | 559387 (21.99%) | 11 | 2 | 6 | 0 | 7 | 1.69 | 0.33 | 0.26 | 3 | 0 | 0 | 9 | 43200 |
| Inst7WS5 | 469121 (10.95%) | 16 | 3 | 6 | 0 | 5 | 0.64 | 0.13 | 0.14 | 1 | 0 | 0 | 10 | 43200 |
| Inst7WS6 | 470114 (37.05%) | 11 | 8 | 2 | 1 | 4 | 0.64 | 0.25 | 0.26 | 2 | 0 | 0 | 12 | 43200 |
| VFRO | | | | | | | | | | | | | | |
| Inst3WS1 | 96157 (0%) | 3 | 0 | 1 | 0 | 5 | 0.16 | 0.04 | 0.03 | 1 | — | — | 2 | 284 |
| Inst3WS2 | 52923 (0%) | 5 | 0 | 1 | 0 | 3 | 0.01 | 0.07 | 0.03 | 1 | — | — | 2 | 454 |
| Inst3WS3 | 232141 (0%) | 7 | 0 | 2 | 0 | 5 | 0.29 | 0.04 | 0.04 | 1 | — | — | 3 | 2504 |
| Inst3WS4 | 180440 (0%) | 3 | 0 | 3 | 0 | 4 | 0.24 | 0.23 | 0.29 | 1 | — | — | 4 | 11337 |
| Inst3WS5 | 206237 (1.53%) | 6 | 1 | 1 | 0 | 8 | 0.14 | 0.06 | 0.05 | 1 | — | — | 3 | 43200 |
| Inst3WS6 | 87844 (4.86%) | 5 | 1 | 3 | 0 | 6 | 0.06 | 0.10 | 0.08 | 1 | — | — | 5 | 43200 |
| Inst4WS1 | 200788 (0%) | 4 | 0 | 2 | 0 | 6 | 0.56 | 0.06 | 0.09 | 1 | — | — | 3 | 4241 |
| Inst4WS2 | 117910 (2.81%) | 3 | 0 | 3 | 0 | 4 | 0.05 | 0.09 | 0.10 | 1 | — | — | 4 | 43200 |
| Inst4WS3 | 325866 (2.21%) | 9 | 0 | 4 | 0 | 5 | 0.19 | 0.15 | 0.21 | 1 | — | — | 5 | 43200 |
| Inst4WS4 | 151321 (6.48%) | 7 | 0 | 4 | 0 | 5 | 0.11 | 0.06 | 0.09 | 1 | — | — | 5 | 43200 |
| Inst4WS5 | 54798 (0%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.10 | 0.07 | 1 | — | — | 4 | 19538 |
| Inst4WS6 | 198543 (11.53%) | 8 | 0 | 5 | 0 | 5 | 0.15 | 0.12 | 0.13 | 1 | — | — | 6 | 43200 |
| Inst5WS1 | 297728 (2.96%) | 11 | 1 | 4 | 0 | 4 | 0.24 | 0.13 | 0.21 | 1 | — | — | 6 | 43200 |
| Inst5WS2 | 273730 (0%) | 6 | 0 | 3 | 0 | 7 | 1.41 | 0.07 | 0.11 | 2 | — | — | 4 | 19671 |
| Inst5WS3 | 393465 (8.74%) | 11 | 2 | 3 | 0 | 5 | 0.33 | 0.22 | 0.33 | 1 | — | — | 6 | 43200 |
| Inst5WS4 | 265176 (1.32%) | 10 | 0 | 2 | 0 | 4 | 0.44 | 0.07 | 0.08 | 1 | — | — | 3 | 43200 |
| Inst5WS5 | 365693 (1.55%) | 12 | 1 | 3 | 0 | 4 | 0.83 | 0.10 | 0.06 | 1 | — | — | 5 | 43200 |
| Inst5WS6 | 149015 (0%) | 3 | 0 | 5 | 0 | 2 | 0.08 | 0.11 | 0.12 | 1 | — | — | 6 | 23985 |
| Inst6WS1 | 205762 (0%) | 12 | 0 | 2 | 0 | 3 | 0.26 | 0.04 | 0.05 | 1 | — | — | 3 | 8227 |
| Inst6WS2 | 223968 (6.48%) | 9 | 3 | 2 | 0 | 4 | 0.29 | 0.07 | 0.08 | 1 | — | — | 6 | 43200 |
| Inst6WS3 | 267205 (2.53%) | 15 | 1 | 3 | 0 | 4 | 0.33 | 0.06 | 0.07 | 1 | — | — | 5 | 43200 |
| Inst6WS4 | 363180 (4.52%) | 15 | 2 | 3 | 0 | 5 | 0.95 | 0.06 | 0.05 | 2 | — | — | 6 | 43200 |
| Inst6WS5 | 288929 (21.58%) | 9 | 0 | 5 | 0 | 4 | 0.40 | 0.25 | 0.28 | 1 | — | — | 6 | 43200 |
| Inst6WS6 | 240311 (26.40%) | 10 | 1 | 7 | 0 | 5 | 0.13 | 0.11 | 0.12 | 1 | — | — | 9 | 43200 |

Continued on next page

Table continued from previous page

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-------------|-----------------|----|----|----|----|------|------|------|------|----|----|-----|-------|-------|
| Inst7WS1 | 245752 (2.81%) | 15 | 0 | 2 | 0 | 4 | 0.31 | 0.04 | 0.07 | 1 | — | — | 3 | 43200 |
| Inst7WS2 | 506403 (18.32%) | 16 | 2 | 4 | 0 | 6 | 1.07 | 0.07 | 0.11 | 2 | — | — | 7 | 43200 |
| Inst7WS3 | 728231 (4.62%) | 11 | 1 | 5 | 0 | 5 | 6.60 | 0.13 | 0.08 | 7 | — | — | 7 | 43200 |
| Inst7WS4 | 551085 (17.60%) | 16 | 1 | 5 | 0 | 4 | 1.80 | 0.12 | 0.28 | 3 | — | — | 7 | 43200 |
| Inst7WS5 | 469019 (22.60%) | 18 | 3 | 6 | 0 | 3 | 0.55 | 0.13 | 0.20 | 1 | — | — | 10 | 43200 |
| Inst7WS6 | 433845 (23.85%) | 13 | 4 | 4 | 2 | 3 | 0.49 | 0.24 | 0.26 | 1 | — | — | 10 | 43200 |
| VORO | | | | | | | | | | | | | | |
| Inst3WS1 | 96157 (0%) | 2 | 0 | 1 | 0 | 5 | 0.16 | 0.04 | 0.03 | 1 | 0 | 0 | 2 | 650 |
| Inst3WS2 | 52923 (0%) | 5 | 0 | 1 | 0 | 3 | 0.01 | 0.07 | 0.03 | 1 | 0 | 0 | 2 | 1597 |
| Inst3WS3 | 232141 (0%) | 7 | 0 | 2 | 0 | 5 | 0.29 | 0.04 | 0.04 | 1 | 0 | 0 | 3 | 6987 |
| Inst3WS4 | 176203 (0%) | 3 | 0 | 3 | 0 | 4 | 0.22 | 0.95 | 0.29 | 1 | 0 | 1 | 4 | 35383 |
| Inst3WS5 | 206237 (1.56%) | 6 | 1 | 1 | 0 | 8 | 0.14 | 0.06 | 0.05 | 1 | 0 | 0 | 3 | 43200 |
| Inst3WS6 | 87844 (7.45%) | 5 | 1 | 3 | 0 | 6 | 0.06 | 0.10 | 0.08 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS1 | 200459 (0%) | 4 | 0 | 2 | 0 | 6 | 0.51 | 0.13 | 0.22 | 1 | 0 | 1 | 3 | 23660 |
| Inst4WS2 | 117910 (3.71%) | 3 | 0 | 3 | 0 | 4 | 0.05 | 0.09 | 0.10 | 1 | 0 | 0 | 4 | 43200 |
| Inst4WS3 | 325866 (4.12%) | 9 | 0 | 4 | 0 | 5 | 0.19 | 0.15 | 0.21 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS4 | 151321 (7.04%) | 7 | 0 | 4 | 0 | 5 | 0.11 | 0.06 | 0.09 | 1 | 0 | 0 | 5 | 43200 |
| Inst4WS5 | 54798 (0%) | 3 | 0 | 3 | 0 | 4 | 0.01 | 0.10 | 0.07 | 1 | 0 | 0 | 4 | 19719 |
| Inst4WS6 | 198543 (25.76%) | 8 | 0 | 5 | 0 | 5 | 0.15 | 0.12 | 0.13 | 1 | 0 | 0 | 6 | 43200 |
| Inst5WS1 | 297728 (15.98%) | 11 | 1 | 4 | 0 | 4 | 0.24 | 0.13 | 0.21 | 1 | 0 | 0 | 6 | 43200 |
| Inst5WS2 | 270962 (2.32%) | 6 | 0 | 3 | 0 | 7 | 1.68 | 0.17 | 0.06 | 2 | 0 | 1 | 4 | 43200 |
| Inst5WS3 | 393465 (5.93%) | 11 | 2 | 3 | 0 | 5 | 0.33 | 0.22 | 0.33 | 1 | 0 | 0 | 6 | 43200 |
| Inst5WS4 | 265176 (5.39%) | 10 | 0 | 2 | 0 | 4 | 0.44 | 0.07 | 0.08 | 1 | 0 | 0 | 3 | 43200 |
| Inst5WS5 | 361058 (22.66%) | 12 | 1 | 3 | 0 | 4 | 2.05 | 0.14 | 0.06 | 1 | 0 | 2 | 5 | 43200 |
| Inst5WS6 | 149186 (17.68%) | 2 | 0 | 6 | 0 | 2 | 0.01 | 0.21 | 0.20 | 1 | 0 | 0 | 7 | 43200 |
| Inst6WS1 | 205762 (0.68%) | 12 | 0 | 2 | 0 | 3 | 0.26 | 0.04 | 0.05 | 1 | 0 | 0 | 3 | 43200 |
| Inst6WS2 | 223968 (7.87%) | 9 | 3 | 2 | 0 | 4 | 0.29 | 0.07 | 0.08 | 1 | 0 | 0 | 6 | 43200 |
| Inst6WS3 | 267205 (2.96%) | 15 | 1 | 3 | 0 | 4 | 0.33 | 0.06 | 0.07 | 1 | 0 | 0 | 5 | 43200 |
| Inst6WS4 | 363180 (12.58%) | 15 | 2 | 3 | 0 | 5 | 0.95 | 0.06 | 0.05 | 2 | 0 | 0 | 6 | 43200 |
| Inst6WS5 | 283977 (27.97%) | 9 | 0 | 5 | 0 | 4 | 0.15 | 1.18 | 0.31 | 1 | 0 | 1 | 6 | 43200 |
| Inst6WS6 | 242870 (36.14%) | 13 | 1 | 6 | 0 | 3 | 0.13 | 0.11 | 0.11 | 1 | 0 | 0 | 8 | 43200 |
| Inst7WS1 | 245752 (3.28%) | 15 | 0 | 2 | 0 | 4 | 0.31 | 0.04 | 0.07 | 1 | 0 | 0 | 3 | 43200 |
| Inst7WS2 | 506403 (20.02%) | 16 | 2 | 4 | 0 | 6 | 1.07 | 0.07 | 0.11 | 2 | 0 | 0 | 7 | 43200 |
| Inst7WS3 | 728231 (4.82%) | 11 | 1 | 5 | 0 | 5 | 6.60 | 0.13 | 0.08 | 7 | 0 | 0 | 7 | 43200 |
| Inst7WS4 | 544670 (26.21%) | 13 | 4 | 5 | 0 | 4 | 0.51 | 3.10 | 0.31 | 1 | 0 | 3 | 10 | 43200 |
| Inst7WS5 | 466426 (21.17%) | 17 | 2 | 6 | 0 | 5 | 0.60 | 0.08 | 0.16 | 1 | 0 | 0 | 9 | 43200 |
| Inst7WS6 | 433863 (28.35%) | 13 | 3 | 3 | 4 | 0.51 | 0.23 | 0.26 | 1 | 0 | 0 | 9 | 43200 | |

Table 2: Results overview large layout. Shown for each instance: total cost (MIP gap), number of part families assigned to LS, BS, SQ, SK, TK, fractional number of vehicles required for LS, RP and TR, the total integer number of tow trains, forklifts and AGVs to be acquired, number of cell constructed and the total runtime.

B Total cost results BS-only scenario

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|----------|----------------|------|----|----|----|----|-----|------|------|----|----|-----|-------|--------|
| | | VFRF | | | | | | | | | | | | |
| Inst3WS1 | 137881 (0%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.25 | 0.17 | 1 | — | — | 9 | 244 |
| Inst3WS2 | 93846 (0%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.06 | 0.01 | 1 | — | — | 9 | 455 |
| Inst3WS3 | 439329 (0%) | 0 | 14 | 0 | 0 | 0 | 0 | 0.51 | 0.10 | 1 | — | — | 14 | 8841 |
| Inst3WS4 | 338523 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.51 | 0.09 | 1 | — | — | 10 | 31316 |
| Inst3WS5 | 355468 (0.40%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.35 | 0.14 | 1 | — | — | 16 | 43200 |
| Inst3WS6 | 137740 (0%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.09 | 0.05 | 1 | — | — | 15 | 1679 |
| Inst4WS1 | 275819 (0%) | 0 | 12 | 0 | 0 | 0 | 0 | 0.42 | 0.12 | 1 | — | — | 12 | 1221 |
| Inst4WS2 | 243612 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.09 | 0.06 | 1 | — | — | 10 | 314 |
| Inst4WS3 | 498606 (0%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.20 | 0.14 | 1 | — | — | 18 | 3530 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 102202 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.07 | 0.03 | 1 | — | — | 10 | 959 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 121 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 152.01 |
| Inst5WS2 | 554115 (0.06%) | 0 | 16 | 0 | 0 | 0 | 0 | 3.82 | 0.17 | 4 | — | — | 16 | 43200 |
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 160 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 10061 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 982 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 45 |
| Inst6WS1 | 360159 (0%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.18 | 0.15 | 1 | — | — | 17 | 2891 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 173 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 318 |
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43201 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1723 |
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 247 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 152 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 544 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.12 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 325 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 550 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 488 |
| | | VORF | | | | | | | | | | | | |
| Inst3WS1 | 127044 (0%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.27 | 0.28 | 0 | 0 | 1 | 9 | 13346 |
| Inst3WS2 | 93845 (0.13%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.06 | 0.01 | 1 | 0 | 0 | 9 | 43200 |
| Inst3WS3 | 421842 (0.35%) | 0 | 14 | 0 | 0 | 0 | 0 | 0.47 | 0.27 | 0 | 0 | 1 | 14 | 43200 |
| Inst3WS4 | 323408 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.70 | 0.26 | 0 | 0 | 1 | 10 | 3423 |
| Inst3WS5 | 342427 (0.80%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.29 | 0.31 | 0 | 0 | 1 | 16 | 43200 |
| Inst3WS6 | 137740 (1.70%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.09 | 0.05 | 1 | 0 | 0 | 15 | 43200 |
| Inst4WS1 | 266461 (0.96%) | 0 | 12 | 0 | 0 | 0 | 0 | 0.71 | 0.32 | 1 | 0 | 1 | 12 | 43200 |
| Inst4WS2 | 243612 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.09 | 0.06 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS3 | 495923 (0.29%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.52 | 0.44 | 0 | 0 | 1 | 18 | 43200 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 102202 (0.05%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.07 | 0.03 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS2 | 397624 (0.81%) | 0 | 16 | 0 | 0 | 0 | 0 | 2.01 | 0.17 | 1 | 0 | 2 | 16 | 43200 |
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 6184 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43201 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 495 |
| Inst6WS1 | 357416 (0.30%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.39 | 0.53 | 0 | 0 | 1 | 17 | 43200 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 2352 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 2015 |

Continued on next page

Table continued from previous page

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-----------------|--------------------|-----------|-----------|-----------|-----------|-----------|------------|------------|------------|-----------|-----------|------------|--------------|-----------|
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1363 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1631 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.07 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 576 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 814 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| VFRO | | | | | | | | | | | | | | |
| Inst3WS1 | 137079 (0.55%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.24 | 0.17 | 1 | — | — | 9 | 43200 |
| Inst3WS2 | 93665 (0%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.05 | 0.01 | 1 | — | — | 9 | 43200 |
| Inst3WS3 | 438052 (1.22%) | 0 | 14 | 0 | 0 | 0 | 0 | 0.48 | 0.10 | 1 | — | — | 14 | 43200 |
| Inst3WS4 | 337479 (0.34%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.49 | 0.09 | 1 | — | — | 10 | 43200 |
| Inst3WS5 | 354661 (1.44%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.33 | 0.14 | 1 | — | — | 16 | 43200 |
| Inst3WS6 | 137457 (1.86%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.09 | 0.05 | 1 | — | — | 15 | 43200 |
| Inst4WS1 | 274576 (0.97%) | 0 | 12 | 0 | 0 | 0 | 0 | 0.40 | 0.12 | 1 | — | — | 12 | 43200 |
| Inst4WS2 | 243347 (0.01%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.09 | 0.06 | 1 | — | — | 10 | 43200 |
| Inst4WS3 | 497999 (0.66%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.19 | 0.14 | 1 | — | — | 18 | 43200 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 102202 (0.15%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.07 | 0.03 | 1 | — | — | 10 | 43200 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS2 | 542309 (2.01%) | 0 | 16 | 0 | 0 | 0 | 0 | 3.57 | 0.17 | 4 | — | — | 16 | 43200 |
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 2688 |
| Inst6WS1 | 359765 (0.82%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.18 | 0.14 | 1 | — | — | 17 | 43200 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 7156 |
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1700 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1429 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43214 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.05 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1169 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 2453 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 2036 |
| VORO | | | | | | | | | | | | | | |
| Inst3WS1 | 126449 (0.69%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.21 | 0.28 | 0 | 0 | 1 | 9 | 43200 |
| Inst3WS2 | 93665 (0.12%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.05 | 0.01 | 1 | 0 | 0 | 9 | 43200 |
| Inst3WS3 | 420786 (1.21%) | 0 | 14 | 0 | 0 | 0 | 0 | 0.39 | 0.24 | 0 | 0 | 1 | 14 | 43200 |
| Inst3WS4 | 321833 (0.07%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.57 | 0.23 | 0 | 0 | 1 | 10 | 43200 |
| Inst3WS5 | 341734 (1.60%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.27 | 0.26 | 0 | 0 | 1 | 16 | 43200 |
| Inst3WS6 | 137457 (2.17%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.09 | 0.05 | 1 | 0 | 0 | 15 | 43200 |
| Inst4WS1 | 262789 (1.46%) | 0 | 12 | 0 | 0 | 0 | 0 | 0.58 | 0.34 | 0 | 0 | 1 | 12 | 43200 |
| Inst4WS2 | 243347 (0.11%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.09 | 0.06 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS3 | 494749 (0.82%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.45 | 0.39 | 0 | 0 | 1 | 18 | 43200 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 102202 (0.26%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.07 | 0.03 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS2 | 390587 (2.27%) | 0 | 16 | 0 | 0 | 0 | 0 | 1.58 | 0.45 | 1 | 0 | 2 | 16 | 43200 |

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Table continued from previous page

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|----------|----------------|----|----|----|----|----|-----|------|------|----|----|-----|-------|-------|
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 27703 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 37792 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 4276 |
| Inst6WS1 | 356526 (1.05%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.35 | 0.48 | 0 | 0 | 1 | 17 | 43200 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 39766 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 13403 |
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 15823 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.11 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 15116 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |

Table 3: Results overview small layout BS-only case. Shown for each instance: total cost (MIP gap), number of part families assigned to LS, BS, SQ, SK, TK, fractional number of vehicles required for LS, RP and TR, the total integer number of tow trains, forklifts and AGVs to be acquired, number of cell constructed and the total runtime.

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|----------|-----------------|----|----|----|----|----|-----|-------|------|----|----|-----|-------|-------|
| VFRF | | | | | | | | | | | | | | |
| Inst3WS1 | 153436 (0%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.44 | 0.32 | 1 | — | — | 9 | 255 |
| Inst3WS2 | 96339 (0%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.10 | 0.02 | 1 | — | — | 9 | 514 |
| Inst3WS3 | 462039 (0.22%) | 0 | 14 | 0 | 0 | 0 | 0 | 0.87 | 0.17 | 2 | — | — | 14 | 43200 |
| Inst3WS4 | 361085 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.87 | 0.17 | 2 | — | — | 10 | 2165 |
| Inst3WS5 | 372777 (0%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.59 | 0.25 | 1 | — | — | 16 | 4350 |
| Inst3WS6 | 142960 (0.71%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.16 | 0.10 | 1 | — | — | 15 | 43200 |
| Inst4WS1 | 295860 (0%) | 0 | 12 | 0 | 0 | 0 | 0 | 0.73 | 0.24 | 1 | — | — | 12 | 2622 |
| Inst4WS2 | 249307 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.15 | 0.11 | 1 | — | — | 10 | 384 |
| Inst4WS3 | 511739 (0%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.34 | 0.28 | 1 | — | — | 18 | 2762 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 105850 (0%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.12 | 0.05 | 1 | — | — | 10 | 1151 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 121 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 160 |
| Inst5WS2 | 1826277 (0.04%) | 0 | 16 | 0 | 0 | 0 | 0 | 29.27 | 0.34 | 30 | — | — | 16 | 43200 |
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 220 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 8079 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 57 |
| Inst6WS1 | 374566 (0%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.31 | 0.32 | 1 | — | — | 17 | 2063 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 184 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 235 |
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 357 |
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 217 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 224 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 432 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.02 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 297 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 846 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 380 |

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Table continued from previous page

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-------------|----------------|----|----|----|----|----|-----|------|------|----|----|-----|-------|-------|
| VORF | | | | | | | | | | | | | | |
| Inst3WS1 | 146686 (0.40%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.94 | 1.03 | 0 | 0 | 2 | 9 | 43200 |
| Inst3WS2 | 96339 (0.20%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.10 | 0.02 | 1 | 0 | 0 | 9 | 43200 |
| Inst3WS3 | 445904 (1.06%) | 0 | 14 | 0 | 0 | 0 | 0 | 1.23 | 0.17 | 1 | 0 | 2 | 14 | 43200 |
| Inst3WS4 | 346143 (0.36%) | 0 | 10 | 0 | 0 | 0 | 0 | 1.10 | 0.17 | 1 | 0 | 1 | 10 | 43200 |
| Inst3WS5 | 359843 (2.03%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.77 | 0.25 | 1 | 0 | 1 | 16 | 43200 |
| Inst3WS6 | 142959 (1.90%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.16 | 0.10 | 1 | 0 | 0 | 15 | 43200 |
| Inst4WS1 | 295860 (1.08%) | 0 | 12 | 0 | 0 | 0 | 0 | 0.73 | 0.24 | 1 | 0 | 0 | 12 | 43200 |
| Inst4WS2 | 249307 (0.01%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.15 | 0.11 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS3 | 511739 (0.62%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.34 | 0.28 | 1 | 0 | 0 | 18 | 43200 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 105850 (0.34%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.12 | 0.05 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS2 | 487574 (0.67%) | 0 | 16 | 0 | 0 | 0 | 0 | 7.08 | 0.34 | 1 | 0 | 7 | 16 | 43200 |
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 3934 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 626 |
| Inst6WS1 | 374566 (0.68%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.31 | 0.32 | 1 | 0 | 0 | 17 | 43200 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1254 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 9013 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.06 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 736 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| VFRO | | | | | | | | | | | | | | |
| Inst3WS1 | 149426 (0.34%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.35 | 0.32 | 1 | — | — | 9 | 43200 |
| Inst3WS2 | 95438 (0.57%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.08 | 0.02 | 1 | — | — | 9 | 43200 |
| Inst3WS3 | 453053 (1.51%) | 0 | 14 | 0 | 0 | 0 | 0 | 0.72 | 0.17 | 1 | — | — | 14 | 43200 |
| Inst3WS4 | 352516 (1.03%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.73 | 0.17 | 1 | — | — | 10 | 43200 |
| Inst3WS5 | 367819 (2.14%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.49 | 0.25 | 1 | — | — | 16 | 43200 |
| Inst3WS6 | 141548 (1.92%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.13 | 0.09 | 1 | — | — | 15 | 43200 |
| Inst4WS1 | 289330 (0.52%) | 0 | 12 | 0 | 0 | 0 | 0 | 0.59 | 0.24 | 1 | — | — | 12 | 43200 |
| Inst4WS2 | 247983 (0.03%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.14 | 0.10 | 1 | — | — | 10 | 43200 |
| Inst4WS3 | 508700 (0.88%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.28 | 0.27 | 1 | — | — | 18 | 43200 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 105104 (0.07%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.11 | 0.05 | 1 | — | — | 10 | 43200 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS2 | 638117 (0.58%) | 0 | 16 | 0 | 0 | 0 | 0 | 5.33 | 0.34 | 6 | — | — | 16 | 43200 |
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43201 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 3274 |
| Inst6WS1 | 372597 (1.10%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.31 | 0.28 | 1 | — | — | 17 | 43200 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |

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Table continued from previous page

| Instance | Cost (Gap%) | LS | BS | SQ | SK | TK | VLS | VRP | VTR | TT | FL | AGV | Cells | RT |
|-------------|----------------|----|----|----|----|----|-----|------|------|----|----|-----|-------|-------|
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 29934 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.04 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 910 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1377 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1852 |
| VORO | | | | | | | | | | | | | | |
| Inst3WS1 | 143711 (0.30%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.63 | 1.03 | 0 | 0 | 2 | 9 | 43200 |
| Inst3WS2 | 95438 (0.80%) | 0 | 9 | 0 | 0 | 0 | 0 | 0.08 | 0.02 | 1 | 0 | 0 | 9 | 43200 |
| Inst3WS3 | 435270 (1.80%) | 0 | 14 | 0 | 0 | 0 | 0 | 0.98 | 0.21 | 1 | 0 | 1 | 14 | 43200 |
| Inst3WS4 | 340377 (0.44%) | 0 | 10 | 0 | 0 | 0 | 0 | 1.08 | 0.23 | 1 | 0 | 1 | 10 | 43200 |
| Inst3WS5 | 356988 (2.53%) | 0 | 16 | 0 | 0 | 0 | 0 | 0.65 | 0.25 | 1 | 0 | 1 | 16 | 43200 |
| Inst3WS6 | 141548 (3.15%) | 0 | 15 | 0 | 0 | 0 | 0 | 0.13 | 0.09 | 1 | 0 | 0 | 15 | 43200 |
| Inst4WS1 | 288900 (2.33%) | 0 | 12 | 0 | 0 | 0 | 0 | 1.65 | 0.25 | 1 | 0 | 2 | 12 | 43200 |
| Inst4WS2 | 247983 (0.29%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.14 | 0.10 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS3 | 508700 (2.10%) | 0 | 18 | 0 | 0 | 0 | 0 | 0.28 | 0.27 | 1 | 0 | 0 | 18 | 43200 |
| Inst4WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst4WS5 | 105104 (0.18%) | 0 | 10 | 0 | 0 | 0 | 0 | 0.11 | 0.05 | 1 | 0 | 0 | 10 | 43200 |
| Inst4WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS2 | 448929 (2.98%) | 0 | 16 | 0 | 0 | 0 | 0 | 4.25 | 0.34 | 1 | 0 | 4 | 16 | 43200 |
| Inst5WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst5WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 4637 |
| Inst6WS1 | 372597 (2.91%) | 0 | 17 | 0 | 0 | 0 | 0 | 0.31 | 0.28 | 1 | 0 | 0 | 17 | 43200 |
| Inst6WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst6WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 12150 |
| Inst7WS1 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS2 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS3 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 0.11 |
| Inst7WS4 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 1726 |
| Inst7WS5 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |
| Inst7WS6 | — | — | — | — | — | — | — | — | — | — | — | — | 0 | 43200 |

Table 4: Results overview large layout BS-only case. Shown for each instance: total cost (MIP gap), number of part families assigned to LS, BS, SQ, SK, TK, fractional number of vehicles required for LS, RP and TR, the total integer number of tow trains, forklifts and AGVs to be acquired, number of cell constructed and the total runtime.