

# Assignment #4

Instance #1 (Call_7_Vehicle_3)				
	Average Objective	Best Objective	Improvement (%)	Average Running time (seconds)
Random Search	3286422.0	3286422	0.00%	0,057 seconds
Local Search	1551640.0	1476444	55.07%	0,052 seconds
Simulated Annealing (old)	1494811.0	1476444	55.07%	0,090 seconds
Simulated Annealing (with new operators)	1476444.0	1476444	55.07%	0.312 seconds

Instance #2 (Call_18_Vehicle_5)				
	Average Objective	Best Objective	Improvement (%)	Average Running time (seconds)
Random Search	8761492.0	8761492	0.00%	0,094 seconds
Local Search	3391452.0	2968311	66.12%	0,062 seconds
Simulated Annealing (old)	3094205.0	2686290	69.34%	0,082 seconds
Simulated Annealing (with new operators)	2640187.0	2548493	70.91%	1.182 seconds

Instance #3 (Call_035_Vehicle_07)				
	Average Objective	Best Objective	Improvement (%)	Average Running time (seconds)
Random Search	1.8322178E7	18322178	0.00%	0,123 seconds
Local Search	9717135.0	8818566	51.9%	0,055 seconds
Simulated Annealing (old)	6731232.0	6053701	67.0%	0,131 seconds
Simulated Annealing (with new operators)	5988826.0	5508979	69.9%	0.944 seconds

Instance #4 (Call_080_Vehicle_20)				
	Average Objective	Best Objective	Improvement (%)	Average Running time (seconds)
Random Search	4.2211425E7	42211425	0.00%	0,210 seconds
Local Search	3.045567E7	28484007	32.5%	0,093 seconds
Simulated Annealing (old)	1.9355629E7	17736007	58.0%	0,292 seconds
Simulated Annealing (with new operators)	1.4595948E7	13725619	67.5%	7.547 seconds

Instance #5 (Call_130_Vehicle_40)				
	Average Objective	Best Objective	Improvement (%)	Average Running time (seconds)
Random Search	7.5446687E7	75446687	0.00%	0,295 seconds
Local Search	5.9988955E7	57646760	23.6%	0,125 seconds
Simulated Annealing (old)	3.7813836E7	35070442	53.5%	0,488 seconds
Simulated Annealing (with new operators)	2.1161632E7	20322456	73.1%	11.46 seconds

## Best Solutions

### Instance #1 (Call\_7\_Vehicle\_3)

[3, 3, 0, 7, 1, 7, 1, 0, 5, 5, 6, 6, 0, 2, 2, 4, 4]

### Instance #2 (Call\_18\_Vehicle\_5)

[16, 1, 16, 1, 0, 15, 15, 6, 17, 6, 17, 10, 10, 9, 9, 0, 4, 11, 11, 4, 3, 3, 0, 12, 14, 12, 14, 0, 18, 5, 5, 18, 8, 7, 7, 8, 2, 2, 0, 13, 13]

### Instance #3 (Call\_035\_Vehicle\_07)

[17, 17, 29, 35, 29, 35, 11, 11, 2, 2, 9, 9, 0, 23, 23, 22, 22, 33, 33, 0, 3, 3, 10, 10, 32, 32, 4, 4, 0, 19, 34, 19, 34, 16, 16, 14, 14, 15, 15, 0, 7, 5, 12, 13, 7, 13, 5, 20, 12, 27, 20, 27, 0, 25, 25, 30, 8, 24, 24, 30, 8, 31, 26, 26, 31, 0, 28, 28, 21, 21, 18, 18, 1, 1, 0, 6, 6]

#### Instance #4 (Call\_080\_Vehicle\_20)

[74, 74, 51, 51, 0, 33, 33, 22, 22, 42, 18, 42, 38, 8, 8, 38, 18, 0, 67, 53, 53, 67, 19, 1, 1, 19, 0, 61, 61, 11, 31, 11, 31, 0, 79, 29, 79, 29, 71, 71, 10, 10, 0, 62, 62, 14, 70, 14, 70, 58, 58, 0, 68, 68, 27, 27, 23, 23, 9, 9, 73, 73, 0, 80, 80, 30, 30, 64, 64, 0, 52, 52, 60, 24, 24, 65, 60, 65, 0, 50, 37, 50, 7, 13, 35, 37, 35, 7, 13, 43, 43, 0, 55, 28, 55, 40, 40, 28, 21, 21, 0, 4, 4, 54, 39, 54, 39, 17, 17, 0, 46, 46, 0, 34, 26, 26, 34, 12, 44, 12, 44, 0, 47, 57, 47, 36, 5, 36, 57, 5, 0, 3, 3, 45, 41, 41, 45, 0, 49, 49, 75, 75, 25, 25, 0, 63, 63, 78, 2, 2, 78, 0, 59, 72, 59, 72, 56, 56, 6, 76, 6, 76, 0, 69, 69, 16, 16, 15, 15, 0, 20, 20, 32, 32, 48, 48, 66, 66, 77, 77]

#### Instance #5 (Call\_130\_Vehicle\_40)

[74, 74, 106, 106, 10, 10, 0, 104, 104, 116, 60, 60, 116, 0, 37, 108, 102, 37, 102, 108, 127, 127, 4, 4, 0, 73, 73, 12, 12, 70, 70, 0, 43, 43, 68, 68, 22, 22, 0, 7, 122, 7, 122, 0, 33, 33, 51, 51, 0, 97, 97, 92, 27, 92, 40, 40, 27, 0, 94, 94, 59, 59, 13, 14, 13, 14, 0, 58, 58, 114, 28, 28, 66, 66, 114, 0, 34, 34, 55, 55, 19, 36, 36, 19, 0, 103, 103, 2, 2, 0, 21, 21, 62, 62, 98, 75, 98, 75, 0, 107, 107, 39, 39, 109, 109, 0, 52, 52, 128, 128, 1, 53, 53, 1, 0, 47, 47, 42, 8, 42, 8, 0, 64, 64, 0, 120, 120, 30, 30, 119, 119, 113, 113, 0, 65, 112, 65, 112, 100, 100, 0, 26, 26, 0, 32, 32, 23, 23, 46, 46, 0, 50, 50, 117, 41, 5, 117, 41, 5, 0, 83, 16, 16, 83, 110, 38, 110, 38, 0, 49, 31, 31, 49, 0, 123, 123, 24, 79, 24, 79, 0, 96, 93, 93, 96, 130, 11, 11, 130, 0, 121, 18, 18, 121, 105, 105, 15, 15, 0, 57, 90, 111, 90, 111, 57, 0, 89, 89, 87, 87, 45, 45, 0, 126, 80, 80, 126, 0, 82, 82, 78, 9, 9, 78, 0, 91, 35, 35, 91, 95, 95, 88, 88, 0, 69, 69, 56, 81, 56, 81, 99, 99, 0, 115, 115, 61, 6, 6, 61, 0, 25, 25, 44, 67, 44, 67, 3, 3, 0, 76, 76, 72, 20, 72, 20, 0, 77, 77, 63, 63, 86, 86, 0, 54, 54, 125, 125, 85, 85, 0, 84, 71, 71, 84, 29, 129, 124, 124, 129, 29, 0, 48, 48, 101, 101, 0, 17, 17, 118, 118]

## The new Operators

### 1-reinsert (indirectly improved)

It should be noted that all operators use a common method “moveCargo” that moves a cargo between two vessels. This method optimizes the layout of the vessels receiving and giving the cargo. This means that the 1-reinsert operator is also improved, albeit indirectly, as it gains an intensification component.

### Minimize not Transported

Minimize the number of cargoes we use freight to transport. Cost of not transporting is very high compared to even the worst route! If we minimize number of cargoes we do not transport the cost will (hopefully) go down. This operator helps with diversification as it moves to new vessels

### Minimize Wait Time

Minimize the cargo that is waiting the longest globally. This operators find the cargo which is currently waiting for port opening the longest and to and change the vessel cargo order in

such a way the the maximum wait time is lower. If we reduce the time we wait for a port to open/cargo to be available we reduce the cost of the vessel. This operator helps with intensification as it optimizes a vessels cargo route.

### Move Similar Cargo

Find cargoes that are similar (in origin and destination ports, and time frame) and move them into the same vessel. Having similar cargoes in a vessel makes it more likely that the vessels efficiency goes up as the vessel don't have to travel as far. This operator helps with diversification as it moves to new vessels.