

# Supplementary Material for Towards Low-cost Task Allocation in Smart Warehouses with Multi-delivery Stations and Heterogeneous Robots

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## 1 Datasets

Robots are selected based on the Box-Muller Algorithm for randomization in Normal Distribution with a mean of 17 and standard deviation of 578. The

## 2 *Supplementary Material*

mean refers to the smallest load capacity among all robots, and the standard deviation was chosen to generate random values that vary between the robots' capacities. The selection of robots by instance takes place as follows:

1. Generates a random value by Box-Muller Algorithm with mean 17 and standard deviation 578.
2. Ignores values less than zero and greater than 1500 (largest capacity).
3. Select a robot from the Table 1 based on the following rules:
  - (a) If the random value is less than or equal to 17, then select one of the two robots with a capacity less than or equal to 18;a
  - (b) If the random value is between 17 and 55, then select one of the four robots with a capacity less than or equal to 55;
  - (c) If the random value is between 55 and 80, then select one of the eight robots with a capacity less than or equal to 80;
  - (d) If the random value is between 80 and 100, then select one of the eleven robots with a capacity less than or equal to 100;
  - (e) If the random value is between 100 and 200, then select one of the eighteen robots with a capacity less than or equal to 300;
  - (f) If the random value is between 200 and 500, then select one of twenty robots with a capacity less than or equal to 500;
  - (g) If the random value is between 500 and 750, then select one of the twenty-two robots with a capacity less than or equal to 1000;
  - (h) If selected value is greater than 750, then select one among all robots;

## 2 Evaluation

**Table 1** List of robots that make up RMT and SMT instances. Each robot belongs to the group defined by its load capacity.

Robot Name	Load Capacity (kg)	Group	Traffic Speed (m/s)
Adept Pioneer 3-DX	17	Group A	1.2
InVia Picker Robot	18	Group A	2.2
Locus Bot	45	Group B	1.1
CajaRobotics Cart Robot	55	Group B	2
Omron LD-60	60	Group C	1.8
Matthews AMR	70	Group C	1.8
FetchRobotics HMIShelf	78	Group C	1.5
FetchRobotics RollerTop	80	Group C	1.5
Omron LD-90	90	Group D	1.35
Otto-100	100	Group D	2
Pollux MiR100	100	Group D	1.5
Pollux MiR200	200	Group E	1.1
Magazino TORU	235	Group E	1.5
Conveyco Stacker-Bot	250	Group E	1.33
Omron LD-250	250	Group E	1.2
Pollux MiR250	250	Group E	2
CajaRobotics Lift Robot	300	Group E	1.5
IAMRobotics Bolt	300	Group E	2
FetchRobotics Freight500	500	Group F	1.5
Otto-750	750	Group F	2
Pollux MiR500	500	Group G	2
Pollux MiR1000	1000	Group G	1.2
FetchRobotics Freight1500	1500	Group H	1.5
Omron HD-1500	1500	Group H	1.8
Otto-1500	1500	Group H	2

**Table 2:** All test results for SMT instances (HFMDVPR-DV) by DoNe-CPTA and a-nCAR

Instance Name	a-nCAR		DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR			
	#	Cost	Exec.	#	Cost	Exec.	#	Cost	Exec.
	Robot		Time (s)	Robot		Time (s)	Robot		Time (s)
SMT-t101-r25-d4	25	24673,9	0,6	24	16399,0	0,1	4%	34%	90%
SMT-t106-r14-d4	14	11868,5	0,4	9	7827,6	0,1	36%	34%	81%
SMT-t110-r13-d4	13	14892,2	0,5	13	10398,9	0,1	0%	30%	87%
SMT-t115-r10-d4	10	16770,3	0,9	10	11702,3	0,1	0%	30%	91%
SMT-t120-r6-d4	6	11568,3	0,6	6	8814,9	0,1	0%	24%	88%
SMT-t125-r30-d4	30	26452,5	1,4	27	16145,8	0,1	10%	39%	93%
SMT-t129-r18-d4	18	19638,6	1,0	18	14271,0	0,1	0%	27%	92%
SMT-t134-r13-d4	13	11474,7	1,2	11	7464,0	0,1	15%	35%	92%

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4 *Supplementary Material*Table 2 – *Continued from the previous page*

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
SMT-t139-r10-d4	10	14559,0	0,9	10	10640,2	0,1	0%	27%	90%
SMT-t143-r7-d4	7	13309,1	1,1	7	9648,6	0,1	0%	28%	92%
SMT-t148-r46-d4	46	28302,0	2,8	42	19944,1	0,1	9%	30%	95%
SMT-t153-r22-d4	22	24049,0	2,4	18	17042,5	0,1	18%	29%	95%
SMT-t157-r13-d4	13	12251,3	1,2	13	9734,0	0,2	0%	21%	87%
SMT-t162-r11-d4	11	15178,6	1,4	11	11299,5	0,1	0%	26%	92%
SMT-t167-r10-d4	10	15638,6	1,5	10	12033,5	0,1	0%	23%	93%
SMT-t172-r51-d4	51	40631,5	4,9	48	26222,5	0,2	6%	35%	97%
SMT-t176-r26-d4	26	30400,8	3,9	26	18630,2	0,1	0%	39%	97%
SMT-t181-r23-d4	23	16889,6	2,6	21	13199,7	0,2	9%	22%	91%
SMT-t186-r15-d4	15	18551,0	2,3	15	13476,5	0,1	0%	27%	94%
SMT-t190-r8-d4	8	10866,0	2,3	7	7365,0	0,1	13%	32%	93%
SMT-t195-r51-d4	51	42151,3	6,1	47	25441,4	0,2	8%	40%	97%
SMT-t200-r36-d4	36	29724,8	5,1	29	18073,1	0,2	19%	39%	95%
SMT-t204-r19-d4	19	20231,2	3,3	19	14259,6	0,2	0%	30%	95%
SMT-t209-r16-d4	16	19831,2	3,4	16	14654,3	0,2	0%	26%	95%
SMT-t214-r11-d4	11	11555,4	3,8	9	9307,4	0,2	18%	19%	95%
SMT-t219-r73-d4	73	45775,4	11,7	58	33916,5	0,7	21%	26%	94%
SMT-t223-r34-d4	34	31975,3	7,4	33	21542,4	0,2	3%	33%	97%
SMT-t228-r23-d4	23	26485,1	8,5	22	17590,0	0,2	4%	34%	98%
SMT-t233-r16-d4	16	20249,9	7,8	16	14020,9	0,2	0%	31%	98%
SMT-t237-r14-d4	14	20513,4	4,2	14	14187,1	0,2	0%	31%	95%
SMT-t242-r48-d4	48	35441,7	11,9	47	24751,8	0,2	2%	30%	98%
SMT-t247-r50-d5	48	39766,2	13,8	32	27937,2	0,5	33%	30%	96%
SMT-t251-r28-d5	28	24852,2	7,6	27	17453,0	0,3	4%	30%	96%
SMT-t256-r16-d5	16	18466,2	6,4	16	13539,9	0,2	0%	27%	96%
SMT-t261-r13-d5	13	21312,2	6,7	13	14020,4	0,2	0%	34%	97%
SMT-t266-r58-d5	58	35308,1	17,4	53	24857,1	0,6	9%	30%	97%
SMT-t270-r35-d5	35	29655,7	12,2	35	20399,4	0,4	0%	31%	97%
SMT-t275-r28-d5	28	19626,9	10,0	25	12580,9	0,5	11%	36%	95%
SMT-t280-r17-d5	17	27233,8	14,9	17	17748,8	0,2	0%	35%	99%
SMT-t284-r15-d5	15	18153,0	8,4	14	11795,9	0,2	7%	35%	97%
SMT-t289-r60-d5	60	53215,7	25,7	58	29931,7	0,4	3%	44%	99%
SMT-t294-r50-d5	50	45573,0	21,0	49	27473,5	0,3	2%	40%	99%
SMT-t298-r31-d5	31	34367,1	15,7	31	21074,5	0,2	0%	39%	99%
SMT-t303-r21-d5	21	23249,0	13,1	20	15416,4	0,3	5%	34%	98%
SMT-t308-r13-d5	13	22910,0	18,8	13	16773,7	0,2	0%	27%	99%
SMT-t313-r71-d5	71	60234,1	36,0	66	33902,8	0,5	7%	44%	99%
SMT-t317-r53-d5	53	34556,7	24,8	42	24285,0	2,4	21%	30%	90%
SMT-t322-r28-d5	28	27488,9	15,9	28	20499,6	0,4	0%	25%	98%
SMT-t327-r20-d5	20	24246,7	13,2	20	16049,2	0,4	0%	34%	97%
SMT-t331-r15-d5	14	22756,7	12,1	15	16803,4	0,4	-7%	26%	97%
SMT-t336-r84-d5	84	70965,3	53,6	83	40818,1	0,5	1%	42%	99%
SMT-t344-r43-d5	43	35003,9	28,9	43	24992,9	0,6	0%	29%	98%
SMT-t351-r40-d5	40	26776,1	29,9	33	16622,9	0,4	18%	38%	99%
SMT-t359-r29-d5	29	34253,4	24,7	29	21783,2	0,3	0%	36%	99%
SMT-t367-r17-d5	17	20784,2	31,6	17	14895,8	0,3	0%	28%	99%

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Table 2 – Continued from the previous page

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
SMT-t376-r94-d5	94	52036,3	71,9	85	37279,6	3,5	10%	28%	95%
SMT-t384-r52-d5	52	41317,6	45,9	52	29309,9	0,8	0%	29%	98%
SMT-t393-r38-d5	38	34873,9	36,6	38	24360,2	1,0	0%	30%	97%
SMT-t401-r29-d5	29	29362,5	48,8	26	18507,0	0,5	10%	37%	99%
SMT-t411-r19-d5	18	23563,2	43,7	17	15293,5	0,4	6%	35%	99%
SMT-t420-r130-d5	130	68204,5	134,1	118	52609,8	1,7	9%	23%	99%
SMT-t429-r61-d5	61	42514,3	68,2	61	31127,7	1,2	0%	27%	98%
SMT-t439-r37-d5	37	34222,8	44,8	37	24418,0	1,4	0%	29%	97%
SMT-t449-r29-d5	29	33216,1	49,9	29	22095,4	0,4	0%	33%	99%
SMT-t459-r26-d5	26	26616,2	56,2	22	16231,1	0,5	15%	39%	99%
SMT-t469-r138-d5	138	70869,9	192,0	120	54350,2	4,6	13%	23%	98%
SMT-t480-r70-d5	70	45508,1	109,8	65	33379,8	2,5	7%	27%	98%
SMT-t491-r59-d5	59	45669,4	108,5	58	27918,6	0,8	2%	39%	99%
SMT-t502-r39-d5	38	29622,8	68,9	32	19616,2	4,4	16%	34%	94%
SMT-t513-r21-d5	21	31372,4	55,9	21	20824,3	0,5	0%	34%	99%
SMT-t524-r153-d5	145	98605,7	260,5	149	54760,3	4,9	-3%	44%	98%
SMT-t536-r96-d5	96	79117,1	213,7	74	43232,3	2,9	23%	45%	99%
SMT-t548-r50-d5	49	41971,4	120,3	50	29805,7	2,8	-2%	29%	98%
SMT-t561-r42-d5	42	45893,0	123,1	42	27971,4	0,7	0%	39%	99%
SMT-t573-r30-d5	30	26334,3	154,0	21	15131,0	1,1	30%	43%	99%
SMT-t586-r159-d5	159	87240,3	437,5	135	64171,4	10,3	15%	26%	98%
SMT-t599-r92-d5	92	60440,4	279,0	92	44821,5	4,4	0%	26%	98%
SMT-t613-r62-d5	62	52023,9	218,2	62	31638,6	0,9	0%	39%	100%
SMT-t627-r43-d5	43	35814,6	155,1	37	22896,3	3,2	14%	36%	98%
SMT-t641-r35-d5	35	39808,3	150,6	35	29143,7	1,8	0%	27%	99%
SMT-t655-r131-d5	131	96681,5	488,6	78	67155,2	58,3	40%	31%	88%
SMT-t670-r130-d6	127	96249,4	610,1	129	56058,0	5,9	-2%	42%	99%
SMT-t685-r75-d6	75	57475,4	473,3	75	34597,9	1,5	0%	40%	100%
SMT-t701-r44-d6	44	49339,6	243,5	44	28723,5	1,0	0%	42%	100%
SMT-t716-r35-d6	35	33162,0	211,5	25	19476,4	1,5	29%	41%	99%
SMT-t733-r159-d6	159	84389,2	907,4	156	59149,3	5,6	2%	30%	99%
SMT-t749-r98-d6	98	70790,0	570,3	86	40762,8	2,4	12%	42%	100%
SMT-t766-r71-d6	71	66447,5	769,8	71	39044,3	2,0	0%	41%	100%
SMT-t783-r48-d6	48	48023,6	481,2	48	28121,5	1,2	0%	41%	100%
SMT-t801-r40-d6	39	42796,4	296,9	40	29043,6	4,2	-3%	32%	99%
SMT-t819-r171-d6	171	87770,9	1252,0	138	63853,3	43,0	19%	27%	97%
SMT-t837-r142-d6	142	80316,9	1149,4	139	59493,5	22,4	2%	26%	98%
SMT-t856-r95-d6	95	64859,7	789,7	94	48186,3	23,6	1%	26%	97%
SMT-t876-r59-d6	59	48584,8	589,6	52	29122,8	2,7	12%	40%	100%
SMT-t895-r37-d6	37	50521,6	411,3	37	31661,2	1,7	0%	37%	100%
SMT-t916-r207-d6	207	102852,5	2169,0	182	74273,1	50,9	12%	28%	98%
SMT-t936-r151-d6	151	112818,6	1921,2	151	62975,2	13,0	0%	44%	99%
SMT-t957-r87-d6	86	60315,5	1035,4	85	39994,5	26,3	1%	34%	97%
SMT-t979-r58-d6	58	49671,0	1014,7	50	29041,6	5,8	14%	42%	99%
SMT-t1001-r43-d6	43	55124,7	710,9	43	34354,2	1,5	0%	38%	100%
AVERAGE:							6%	33%	96%

6 *Supplementary Material***Table 3:** All test results for WMT instances (MDVRP-DV) by DoNe-CPTA and a-nCAR

Instance Name	a-nCAR		DoNe-CPTA		Performance DoNe-CPTA vs a-nCAR				
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
WMT-t101-r25-d4	25	34372,4	0,5	25	25573,9	0,1	0%	26%	89%
WMT-t106-r14-d4	14	19314,5	0,4	10	13715,1	0,1	29%	29%	82%
WMT-t110-r13-d4	13	22687,7	0,5	13	17396,4	0,1	0%	23%	86%
WMT-t115-r10-d4	10	23049,8	0,8	10	17697,7	0,1	0%	23%	92%
WMT-t120-r6-d4	6	19678,1	0,5	6	14235,3	0,1	0%	28%	87%
WMT-t125-r30-d4	30	36829,5	1,2	27	25953,2	0,1	10%	30%	92%
WMT-t129-r18-d4	18	28714,3	0,9	18	20651,2	0,1	0%	28%	91%
WMT-t134-r13-d4	13	16501,1	1,2	11	11462,5	0,1	15%	31%	92%
WMT-t139-r10-d4	10	24195,2	0,8	10	18118,6	0,1	0%	25%	90%
WMT-t143-r7-d4	7	22804,2	1,1	7	16193	0,1	0%	29%	92%
WMT-t148-r46-d4	46	47967,5	2,5	45	34536,4	0,1	2%	28%	95%
WMT-t153-r22-d4	22	37083,4	2,0	20	27436,6	0,1	9%	26%	94%
WMT-t157-r13-d4	13	20359,1	1,2	13	15595,3	0,1	0%	23%	88%
WMT-t162-r11-d4	11	25807,6	1,3	11	18378,5	0,1	0%	29%	92%
WMT-t167-r10-d4	10	25985,5	1,4	10	20149,3	0,1	0%	22%	93%
WMT-t172-r51-d4	51	62184,8	4,5	50	43326	0,2	2%	30%	96%
WMT-t176-r26-d4	26	47667	3,2	26	28874,9	0,1	0%	39%	96%
WMT-t181-r23-d4	23	27392	2,3	22	20652,4	0,2	4%	25%	92%
WMT-t186-r15-d4	15	30255,5	2,2	15	21292,4	0,1	0%	30%	95%
WMT-t190-r8-d4	8	15302	2,2	7	12230,7	0,1	13%	20%	93%
WMT-t195-r51-d4	51	61369,4	5,8	49	41403,2	0,2	4%	33%	97%
WMT-t200-r36-d4	36	40987,4	5,1	32	30064,9	0,2	11%	27%	96%
WMT-t204-r19-d4	19	31279,2	3,2	19	23214,1	0,2	0%	26%	95%
WMT-t209-r16-d4	16	32711,9	3,3	16	23555,1	0,1	0%	28%	96%
WMT-t214-r11-d4	11	18998,5	3,4	9	16032,4	0,2	18%	16%	95%
WMT-t219-r73-d4	73	66770,8	10,1	73	56446,1	0,6	0%	15%	94%
WMT-t223-r34-d4	34	46929,2	7,0	34	33042,7	0,2	0%	30%	97%
WMT-t228-r23-d4	23	40064,2	6,8	22	27016	0,2	4%	33%	97%
WMT-t233-r16-d4	16	34996,8	7,3	16	23456,8	0,2	0%	33%	98%
WMT-t237-r14-d4	14	32848,4	4,0	14	23886,7	0,2	0%	27%	96%
WMT-t242-r48-d4	48	58302,7	11,0	48	41397,2	0,2	0%	29%	98%
WMT-t247-r50-d5	50	61516,8	11,0	38	51101,5	0,5	24%	17%	95%
WMT-t251-r28-d5	28	40471	7,6	27	27665,7	0,3	4%	32%	96%
WMT-t256-r16-d5	16	31035	5,8	16	21180,9	0,2	0%	32%	96%
WMT-t261-r13-d5	13	31539,3	6,4	13	22647,7	0,2	0%	28%	97%
WMT-t266-r58-d5	58	56425,1	16,6	57	42293,5	0,5	2%	25%	97%
WMT-t270-r35-d5	35	44753,7	11,4	35	34283,8	0,3	0%	23%	97%
WMT-t275-r28-d5	28	31472	9,1	25	20299,4	0,4	11%	36%	96%
WMT-t280-r17-d5	17	38219	14,9	17	27961,7	0,2	0%	27%	99%
WMT-t284-r15-d5	15	26023,8	8,1	14	18983,5	0,2	7%	27%	97%
WMT-t289-r60-d5	60	79345,3	23,3	59	46712,7	0,4	2%	41%	98%
WMT-t294-r50-d5	50	62659,1	19,2	50	42122,5	0,3	0%	33%	98%
WMT-t298-r31-d5	31	48125,6	15,0	31	31409,2	0,2	0%	35%	98%
WMT-t303-r21-d5	21	37572,9	12,9	20	25528,2	0,3	5%	32%	98%
WMT-t308-r13-d5	13	33829,8	17,3	13	25233,1	0,2	0%	25%	99%
WMT-t313-r71-d5	71	92680	32,5	68	53264,6	0,5	4%	43%	98%
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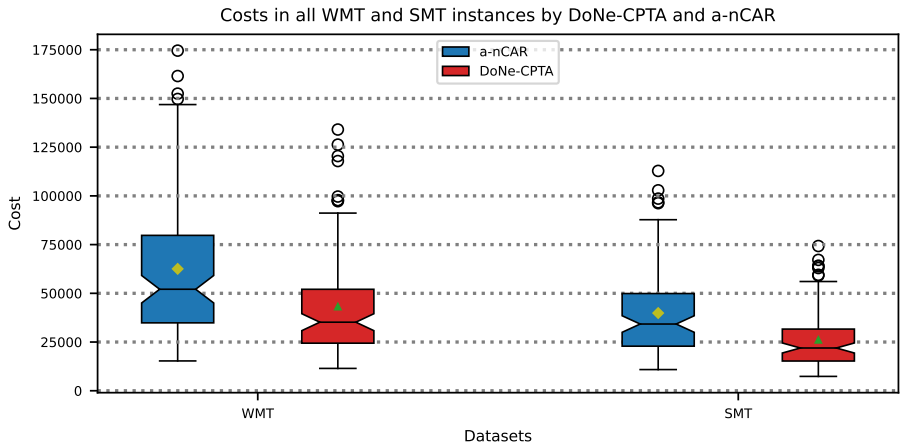
Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
WMT-t317-r53-d5	53	52626,2	22,9	47	42973,8	1,7	11%	18%	93%
WMT-t322-r28-d5	28	45640,2	16,1	28	31930,4	0,3	0%	30%	98%
WMT-t327-r20-d5	20	40031,3	13,3	20	25912,7	0,3	0%	35%	98%
WMT-t331-r15-d5	15	36556,1	11,2	15	28074,6	0,3	0%	23%	98%
WMT-t336-r84-d5	84	106412,2	48,5	84	63736,6	0,6	0%	40%	99%
WMT-t344-r43-d5	43	55271,6	27,8	43	40641,9	0,6	0%	26%	98%
WMT-t351-r40-d5	40	45092,5	28,4	33	28842,9	0,5	18%	36%	98%
WMT-t359-r29-d5	29	48131,6	23,3	29	32597,2	0,3	0%	32%	99%
WMT-t367-r17-d5	17	30778,8	30,0	16	22794,6	0,3	6%	26%	99%
WMT-t376-r94-d5	94	75799	62,3	94	59619	2,3	0%	21%	96%
WMT-t384-r52-d5	52	64150,6	45,2	52	47279,4	0,8	0%	26%	98%
WMT-t393-r38-d5	38	57081,5	36,8	38	40015,4	0,8	0%	30%	98%
WMT-t401-r29-d5	29	51686,3	46,6	25	31824,2	0,5	14%	38%	99%
WMT-t411-r19-d5	19	35004,7	41,0	17	23626,6	0,5	11%	33%	99%
WMT-t420-r130-d5	130	113672,6	129,9	124	91169,5	2,0	5%	20%	98%
WMT-t429-r61-d5	61	68559,4	70,6	61	50444,9	1,1	0%	26%	98%
WMT-t439-r37-d5	37	52484,2	45,2	37	37607,5	1,1	0%	28%	98%
WMT-t449-r29-d5	29	55634,5	46,9	29	35832,6	0,4	0%	36%	99%
WMT-t459-r26-d5	26	42889,9	55,3	24	27639,2	0,6	8%	36%	99%
WMT-t469-r138-d5	138	116195,1	196,3	138	97277,7	6,0	0%	16%	97%
WMT-t480-r70-d5	70	71993	109,3	65	53188	2,3	7%	26%	98%
WMT-t491-r59-d5	59	78020,2	101,7	58	48980,3	0,9	2%	37%	99%
WMT-t502-r39-d5	39	48319,9	69,8	33	32835,9	3,7	15%	32%	95%
WMT-t513-r21-d5	21	45063,4	55,0	21	32019,4	0,6	0%	29%	99%
WMT-t524-r153-d5	153	149729	207,2	153	86722,9	7,2	0%	42%	97%
WMT-t536-r96-d5	96	126626,3	204,5	81	73544	3,0	16%	42%	99%
WMT-t548-r50-d5	50	66505,8	111,2	50	47422,9	1,7	0%	29%	98%
WMT-t561-r42-d5	42	68372,6	119,0	42	43338,7	0,9	0%	37%	99%
WMT-t573-r30-d5	30	38460,2	149,0	21	24588,6	1,2	30%	36%	99%
WMT-t586-r159-d5	159	141094,2	441,7	155	117871,8	11,5	3%	16%	97%
WMT-t599-r92-d5	92	95682,8	276,8	92	72847,9	3,9	0%	24%	99%
WMT-t613-r62-d5	62	90961,3	209,7	62	53244,7	1,1	0%	41%	99%
WMT-t627-r43-d5	43	58079,2	160,3	38	37522,3	3,3	12%	35%	98%
WMT-t641-r35-d5	35	64717,6	143,4	35	45557,1	1,8	0%	30%	99%
WMT-t655-r131-d5	131	152475,9	445,3	96	126311,5	28,0	27%	17%	94%
WMT-t670-r130-d6	130	146860,4	491,7	130	90042,4	9,5	0%	39%	98%
WMT-t685-r75-d6	75	105932	448,6	75	60182,6	1,9	0%	43%	100%
WMT-t701-r44-d6	44	69829,7	234,4	44	43165,1	1,5	0%	38%	99%
WMT-t716-r35-d6	35	51693,4	210,5	26	32445,7	1,8	26%	37%	99%
WMT-t733-r159-d6	159	134867,6	861,4	158	97686,8	5,5	1%	28%	99%
WMT-t749-r98-d6	98	103809,2	545,7	89	64320,4	3,3	9%	38%	99%
WMT-t766-r71-d6	71	103366,3	633,1	71	59020,7	4,1	0%	43%	99%
WMT-t783-r48-d6	48	83573,9	465,3	48	47718,5	1,6	0%	43%	100%
WMT-t801-r40-d6	40	69974,7	292,3	40	47216,9	2,8	0%	33%	99%
WMT-t819-r171-d6	171	145575,6	1270,0	156	120426,4	26,8	9%	17%	98%
WMT-t837-r142-d6	142	126337,2	1125,9	141	97807,2	17,1	1%	23%	98%
WMT-t856-r95-d6	95	98809,4	742,2	95	74156,5	18,4	0%	25%	98%

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8 *Supplementary Material*

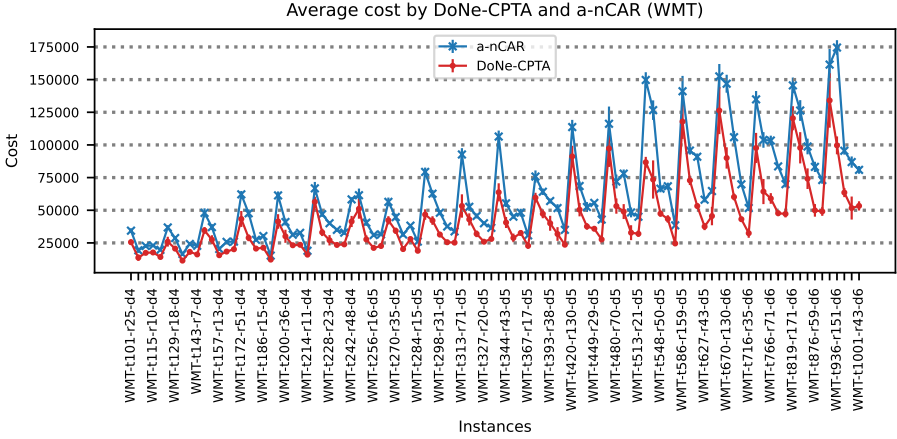
Table 3 – Continued from the previous page

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
WMT-t876-r59-d6	59	83199,2	595,5	52	49909,3	3,3	12%	40%	99%
WMT-t895-r37-d6	37	73152	409,0	37	49077,2	2,5	0%	33%	99%
WMT-t916-r207-d6	207	161498,4	2102,2	205	134047,2	35,8	1%	17%	98%
WMT-t936-r151-d6	151	174542,3	1517,0	151	99661,4	20,8	0%	43%	99%
WMT-t957-r87-d6	87	95534,1	956,3	87	63549,5	20,6	0%	33%	98%
WMT-t979-r58-d6	58	86885,5	996,9	50	51689,6	6,1	14%	41%	99%
WMT-t1001-r43-d6	43	80901,7	695,7	43	53338,6	2,4	0%	34%	100%
AVERAGE:							4%	30%	96%

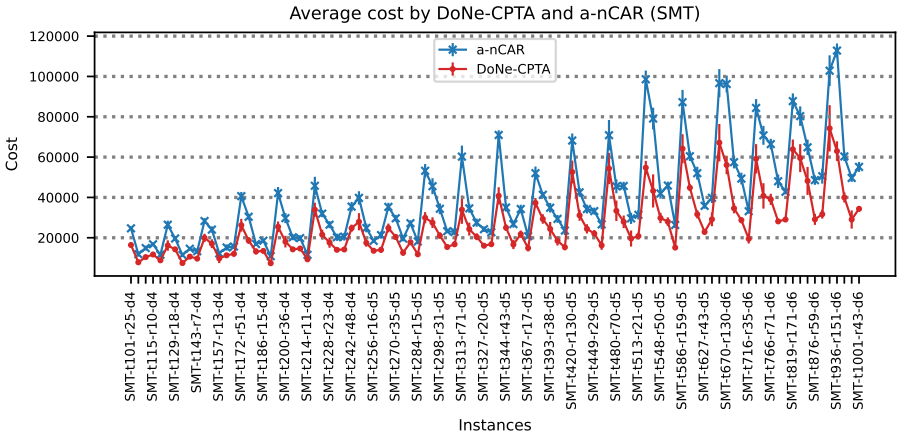
**Figure 1** Overview of the cost of routes computed by DoNe-CPTA and a-nCAR when running SMT and WMT instances.**Table 4** Mann-Whitney U test results for route costs by DoNe-CPTA and a-nCAR on SMT and WMT datasets. Skewed right data by Shapiro Wilk

Dataset	Significance Level	p-value	Result	Common-Language Effect Size
WMT	0.05	$2.83 \times 10^{-5}$	Reject $H_0$	33%
SMT	0.05	$3.42 \times 10^{-6}$	Reject $H_0$	31%





**Figure 2** Cost of routes computed by DoNe-CPTA and a-nCAR with WMT.



**Figure 3** Cost of routes computed by DoNe-CPTA and a-nCAR with SMT.

**Table 5** Mann-Whitney U test results for execution time by DoNe-CPTA and a-nCAR on SMT and WMT datasets. Skewed right data by Shapiro Wilk

Dataset	Significance Level	p-value	Result	Common-Language Effect Size
WMT	0.05	$1.11 \times 10^{-15}$	Reject $H_0$	9.5%
SMT	0.05	0	Reject $H_0$	9%

**Table 7:** All test results for RMT instances (HFVRP) by DoNe-CPTA and a-nCAR

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	#	Cost	Exec. Time	#	Cost	Exec. Time	#	Cost	Exec. Time
	Robot		(s)	Robot		(s)	Robot		(s)
RMT-t101-r25-d1	25	28223,7	0,6	22	29760,6	0,1	12%	-5%	86%

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10 *Supplementary Material*Table 7 – *Continued from the previous page*

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
RMT-t106-r14-d1	14	21670,1	0,4	11	21355,9	0,1	21%	1%	73%
RMT-t110-r13-d1	13	14634,4	0,5	12	15287,5	0,1	8%	-4%	81%
RMT-t115-r10-d1	10	15782,0	0,9	10	14662,8	0,1	0%	7%	91%
RMT-t120-r6-d1	6	13433,5	0,6	6	13884,0	0,1	0%	-3%	82%
RMT-t125-r30-d1	30	52932,4	1,4	25	54150,8	0,1	17%	-2%	90%
RMT-t129-r18-d1	18	30224,7	1,0	14	30675,7	0,1	22%	-1%	87%
RMT-t134-r13-d1	13	11673,5	1,2	10	11622,5	0,1	23%	0%	90%
RMT-t139-r10-d1	10	14295,3	0,9	10	14286,1	0,1	0%	0%	88%
RMT-t143-r7-d1	7	15598,4	1,2	7	16408,3	0,1	0%	-5%	90%
RMT-t148-r46-d1	46	34262,0	2,9	39	40005,6	0,2	15%	-17%	92%
RMT-t153-r22-d1	22	23161,9	2,4	18	21570,0	0,2	18%	7%	93%
RMT-t157-r13-d1	13	13810,0	1,2	11	13483,3	0,2	15%	2%	82%
RMT-t162-r11-d1	11	14785,5	1,4	10	13901,7	0,1	9%	6%	90%
RMT-t167-r10-d1	10	20330,4	1,5	9	19661,4	0,2	10%	3%	88%
RMT-t172-r51-d1	51	47199,6	4,9	41	49933,3	0,3	20%	-6%	94%
RMT-t176-r26-d1	26	48595,0	4,0	20	49105,0	0,2	23%	-1%	95%
RMT-t181-r23-d1	23	22633,1	2,6	20	22626,4	0,5	13%	0%	79%
RMT-t186-r15-d1	15	21951,0	2,3	12	22113,5	0,2	20%	-1%	89%
RMT-t190-r8-d1	8	18672,9	2,3	7	18090,5	0,3	13%	3%	89%
RMT-t195-r51-d1	51	46509,6	6,2	41	47375,1	0,3	20%	-2%	95%
RMT-t200-r36-d1	36	50468,8	5,1	31	50210,5	0,4	14%	1%	92%
RMT-t204-r19-d1	19	19286,4	3,4	17	18933,5	0,3	11%	2%	92%
RMT-t209-r16-d1	16	27420,9	3,5	13	27583,9	0,4	19%	-1%	89%
RMT-t214-r11-d1	11	10773,9	3,7	11	10885,0	0,2	0%	-1%	94%
RMT-t219-r73-d1	73	105645,8	11,9	55	99911,0	2,4	25%	5%	80%
RMT-t223-r34-d1	34	39325,6	7,2	25	39172,1	0,4	26%	0%	95%
RMT-t228-r23-d1	23	28191,9	8,6	19	27596,5	0,3	17%	2%	97%
RMT-t233-r16-d1	16	19927,7	7,8	16	20161,3	0,2	0%	-1%	97%
RMT-t237-r14-d1	14	25241,1	4,3	12	23322,0	0,5	14%	8%	88%
RMT-t242-r48-d1	48	66493,2	11,7	39	71756,9	0,7	19%	-8%	94%
RMT-t247-r50-d1	48	36755,0	13,7	38	35262,7	0,7	21%	4%	95%
RMT-t251-r28-d1	28	33088,6	7,4	22	32633,0	0,8	21%	1%	89%
RMT-t256-r16-d1	16	18761,1	6,3	15	17979,8	0,4	6%	4%	94%
RMT-t261-r13-d1	13	27209,4	6,7	12	27639,5	0,3	8%	-2%	95%
RMT-t266-r58-d1	58	60448,2	17,2	44	60571,2	2,7	24%	0%	84%
RMT-t270-r35-d1	35	30831,6	12,2	28	31322,4	0,9	20%	-2%	93%
RMT-t275-r28-d1	28	19145,3	9,9	24	20602,1	1,2	14%	-8%	88%
RMT-t280-r17-d1	17	37494,9	15,3	13	35594,0	0,4	24%	5%	97%
RMT-t284-r15-d1	15	22509,9	8,4	11	19765,6	0,5	27%	12%	94%
RMT-t289-r60-d1	60	96849,8	25,8	38	86275,8	1,0	37%	11%	96%
RMT-t294-r50-d1	50	49107,0	21,2	41	50605,6	0,6	18%	-3%	97%
RMT-t298-r31-d1	31	36996,7	15,6	24	36561,9	0,5	23%	1%	97%
RMT-t303-r21-d1	21	22165,0	13,1	21	22211,2	0,4	0%	0%	97%
RMT-t308-r13-d1	13	29862,3	18,2	10	27864,1	0,4	23%	7%	98%
RMT-t313-r71-d1	71	90365,8	35,2	61	98361,2	1,2	14%	-9%	97%
RMT-t317-r53-d1	53	62082,2	25,2	40	65665,8	7,4	25%	-6%	71%
RMT-t322-r28-d1	28	28093,5	16,0	24	27927,2	0,9	14%	1%	94%

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Table 7 – Continued from the previous page

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
RMT-t327-r20-d1	20	26529,8	13,3	16	25346,4	1,1	20%	4%	92%
RMT-t331-r15-d1	14	30067,7	12,2	12	26828,2	1,2	14%	11%	90%
RMT-t336-r84-d1	84	141812,6	52,5	61	138999,9	1,6	27%	2%	97%
RMT-t344-r43-d1	43	36567,3	29,0	35	37833,6	1,8	19%	-3%	94%
RMT-t351-r40-d1	40	24057,4	30,3	35	25580,9	0,8	13%	-6%	97%
RMT-t359-r29-d1	29	53581,5	24,5	21	47519,2	1,0	28%	11%	96%
RMT-t367-r17-d1	17	24876,2	31,7	15	25093,8	0,6	12%	-1%	98%
RMT-t376-r94-d1	94	128927,7	72,8	70	119085,5	19,0	26%	8%	74%
RMT-t384-r52-d1	52	53367,5	46,5	41	54197,2	4,0	21%	-2%	91%
RMT-t393-r38-d1	38	35623,5	37,1	31	34914,1	2,3	18%	2%	94%
RMT-t401-r29-d1	29	58443,1	48,8	25	56119,5	1,5	14%	4%	97%
RMT-t411-r19-d1	18	22766,4	43,9	14	20414,7	0,7	22%	10%	98%
RMT-t420-r130-d1	130	85776,0	135,6	106	92257,9	4,9	18%	-8%	96%
RMT-t429-r61-d1	61	53331,3	69,1	47	54184,3	5,7	23%	-2%	92%
RMT-t439-r37-d1	37	33867,0	44,5	32	33415,2	4,5	14%	1%	90%
RMT-t449-r29-d1	29	50043,9	49,8	27	56858,2	1,4	7%	-14%	97%
RMT-t459-r26-d1	26	25615,4	57,0	20	21303,5	1,0	23%	17%	98%
RMT-t469-r138-d1	138	188342,6	195,2	99	163858,2	23,1	28%	13%	88%
RMT-t480-r70-d1	70	73423,6	110,3	57	72885,3	11,9	19%	1%	89%
RMT-t491-r59-d1	59	55588,9	106,4	51	63282,5	2,3	14%	-14%	98%
RMT-t502-r39-d1	38	54374,4	69,7	33	51550,4	8,4	13%	5%	88%
RMT-t513-r21-d1	21	29598,1	57,0	18	26913,4	1,2	14%	9%	98%
RMT-t524-r153-d1	145	144856,3	257,7	89	124664,1	14,3	39%	14%	94%
RMT-t536-r96-d1	96	99078,7	216,4	80	100542,2	4,9	17%	-1%	98%
RMT-t548-r50-d1	49	69919,0	121,9	40	66045,4	18,1	18%	6%	85%
RMT-t561-r42-d1	42	45833,5	123,9	31	41946,1	2,1	26%	8%	98%
RMT-t573-r30-d1	30	49853,6	157,5	24	44627,3	4,6	20%	10%	97%
RMT-t586-r159-d1	159	150814,9	436,2	108	138592,0	49,3	32%	8%	89%
RMT-t599-r92-d1	92	83780,2	284,4	70	87340,7	27,7	24%	-4%	90%
RMT-t613-r62-d1	62	55596,8	220,9	56	60744,3	2,9	10%	-9%	99%
RMT-t627-r43-d1	43	52060,6	157,7	32	51301,9	12,6	26%	1%	92%
RMT-t641-r35-d1	35	55923,3	152,9	28	51893,6	8,7	20%	7%	94%
RMT-t655-r131-d1	131	91159,6	490,3	94	78162,2	115,1	28%	14%	77%
RMT-t670-r130-d1	128	137813,5	595,3	93	144815,3	13,3	27%	-5%	98%
RMT-t685-r75-d1	75	59722,7	465,3	65	66926,4	4,3	13%	-12%	99%
RMT-t701-r44-d1	44	84470,8	243,2	31	72911,5	7,6	30%	14%	97%
RMT-t716-r35-d1	35	42451,3	208,7	27	41081,6	4,8	23%	3%	98%
RMT-t733-r159-d1	159	109587,0	916,1	129	122238,8	23,9	19%	-12%	97%
RMT-t749-r98-d1	98	76000,4	578,3	74	78640,9	7,5	24%	-3%	99%
RMT-t766-r71-d1	71	114468,5	769,1	48	105440,5	10,2	32%	8%	99%
RMT-t783-r48-d1	48	65450,7	479,1	41	72547,3	6,1	15%	-11%	99%
RMT-t801-r40-d1	39	62336,6	298,3	31	55219,0	36,1	21%	11%	88%
RMT-t819-r171-d1	171	126030,6	1256,3	140	123098,0	178,9	18%	2%	86%
RMT-t837-r142-d1	142	149837,7	1158,6	110	146629,5	148,8	23%	2%	87%
RMT-t856-r95-d1	95	73199,8	787,8	78	69219,4	101,9	18%	5%	87%
RMT-t876-r59-d1	59	81216,8	593,6	51	83687,2	11,4	14%	-3%	98%
RMT-t895-r37-d1	37	58986,5	412,6	27	49897,3	15,1	27%	15%	96%

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12 *Supplementary Material*

Table 7 – Continued from the previous page

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
RMT-t916-r207-d1	207	268454,5	2136,8	154	233696,0	312,1	26%	13%	85%
RMT-t936-r151-d1	151	129950,5	1921,7	116	137290,8	26,1	23%	-6%	99%
RMT-t957-r87-d1	86	69644,8	1043,4	71	65479,2	142,5	17%	6%	86%
RMT-t979-r58-d1	58	99221,1	1020,2	52	106715,2	19,4	10%	-8%	98%
RMT-t1001-r43-d1	43	74882,4	716,7	30	64540,8	15,1	30%	14%	98%
AVERAGE:							18%	1%	92%

**Table 8:** All test results for XMT instances (CVRP) by DoNe-CPTA and a-nCAR

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
XMT-t101-r25-d1	25	42276,0	0,5	25	47422,0	0,1	0%	-12%	80%
XMT-t106-r14-d1	14	36992,0	0,4	14	40600,0	0,1	0%	-10%	66%
XMT-t110-r13-d1	13	23324,0	0,5	13	25216,0	0,1	0%	-8%	79%
XMT-t115-r10-d1	10	21074,0	0,8	10	21888,0	0,1	0%	-4%	90%
XMT-t120-r6-d1	6	22228,0	0,5	6	22766,0	0,1	0%	-2%	80%
XMT-t125-r30-d1	30	79640,0	1,3	30	86386,0	0,2	0%	-8%	87%
XMT-t129-r18-d1	18	42200,0	0,9	18	49066,0	0,1	0%	-16%	85%
XMT-t134-r13-d1	13	16346,0	1,2	13	20924,0	0,1	0%	-28%	89%
XMT-t139-r10-d1	10	22294,0	0,9	10	24552,0	0,1	0%	-10%	87%
XMT-t143-r7-d1	7	26904,0	1,1	7	30194,0	0,1	0%	-12%	90%
XMT-t148-r46-d1	46	61926,0	2,6	46	70482,0	0,3	0%	-14%	90%
XMT-t153-r22-d1	22	35478,0	2,1	22	33912,0	0,2	0%	4%	92%
XMT-t157-r13-d1	13	23180,0	1,2	13	23834,0	0,3	0%	-3%	75%
XMT-t162-r11-d1	11	23388,0	1,3	11	23058,0	0,1	0%	1%	89%
XMT-t167-r10-d1	10	33428,0	1,5	10	31462,0	0,2	0%	6%	87%
XMT-t172-r51-d1	51	70760,0	4,6	51	78980,0	0,4	0%	-12%	92%
XMT-t176-r26-d1	26	75486,0	3,2	26	80342,0	0,3	0%	-6%	92%
XMT-t181-r23-d1	23	35352,0	2,4	23	43980,0	0,7	0%	-24%	72%
XMT-t186-r15-d1	15	37256,0	2,2	15	39132,0	0,3	0%	-5%	88%
XMT-t190-r8-d1	8	26082,0	2,3	8	26134,0	0,3	0%	0%	88%
XMT-t195-r51-d1	51	67658,0	6,1	51	72502,0	0,4	0%	-7%	94%
XMT-t200-r36-d1	36	72978,0	5,2	36	80310,0	0,5	0%	-10%	90%
XMT-t204-r19-d1	19	29114,0	3,2	19	32818,0	0,3	0%	-13%	91%
XMT-t209-r16-d1	16	46968,0	3,3	16	48940,0	0,4	0%	-4%	88%
XMT-t214-r11-d1	11	18030,0	3,6	11	17280,0	0,2	0%	4%	93%
XMT-t219-r73-d1	73	156792,0	10,5	73	185068,0	3,7	0%	-18%	65%
XMT-t223-r34-d1	34	58322,0	7,0	34	62964,0	0,4	0%	-8%	94%
XMT-t228-r23-d1	23	39722,0	6,9	23	44168,0	0,3	0%	-11%	95%
XMT-t233-r16-d1	16	32910,0	7,5	16	35590,0	0,2	0%	-8%	97%
XMT-t237-r14-d1	14	41476,0	4,0	14	41182,0	0,7	0%	1%	84%
XMT-t242-r48-d1	48	115122,0	11,1	48	133782,0	0,8	0%	-16%	93%

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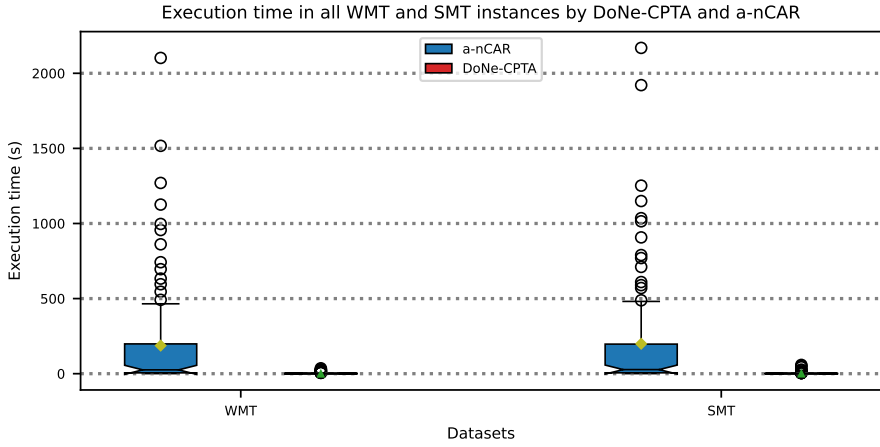
Table 8 – Continued from the previous page

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
XMT-t247-r50-d1	50	58948,0	10,9	50	57998,0	1,1	0%	2%	90%
XMT-t251-r28-d1	28	57730,0	7,6	28	59640,0	1,0	0%	-3%	87%
XMT-t256-r16-d1	16	32226,0	5,7	16	28864,0	0,4	0%	10%	93%
XMT-t261-r13-d1	13	42634,0	6,5	13	46084,0	0,3	0%	-8%	95%
XMT-t266-r58-d1	58	107892,0	16,6	58	115976,0	2,4	0%	-7%	85%
XMT-t270-r35-d1	35	52114,0	11,5	35	56110,0	1,2	0%	-8%	90%
XMT-t275-r28-d1	28	31940,0	9,1	28	37732,0	1,5	0%	-18%	83%
XMT-t280-r17-d1	17	52336,0	15,2	17	58196,0	0,4	0%	-11%	97%
XMT-t284-r15-d1	15	32794,0	8,0	15	33198,0	0,5	0%	-1%	93%
XMT-t289-r60-d1	60	144886,0	23,0	60	162094,0	1,2	0%	-12%	95%
XMT-t294-r50-d1	50	70148,0	18,8	50	80984,0	0,7	0%	-15%	96%
XMT-t298-r31-d1	31	52918,0	15,0	31	59624,0	0,6	0%	-13%	96%
XMT-t303-r21-d1	21	35742,0	12,9	21	37464,0	0,5	0%	-5%	96%
XMT-t308-r13-d1	13	44306,0	17,1	13	46104,0	0,4	0%	-4%	97%
XMT-t313-r71-d1	71	134030,0	32,6	71	150512,0	1,7	0%	-12%	95%
XMT-t317-r53-d1	53	107044,0	23,3	53	164592,0	8,8	0%	-54%	62%
XMT-t322-r28-d1	28	44830,0	16,6	28	47374,0	1,1	0%	-6%	93%
XMT-t327-r20-d1	20	44158,0	13,3	20	46108,0	1,1	0%	-4%	92%
XMT-t331-r15-d1	15	51478,0	11,3	15	47730,0	1,7	0%	7%	85%
XMT-t336-r84-d1	84	207832,0	47,2	84	235332,0	2,2	0%	-13%	95%
XMT-t344-r43-d1	43	61694,0	27,3	43	66592,0	2,2	0%	-8%	92%
XMT-t351-r40-d1	40	40510,0	28,3	40	43172,0	0,9	0%	-7%	97%
XMT-t359-r29-d1	29	75062,0	23,3	29	81110,0	1,1	0%	-8%	95%
XMT-t367-r17-d1	17	35616,0	29,2	17	37262,0	0,6	0%	-5%	98%
XMT-t376-r94-d1	94	195072,0	62,2	94	238458,0	18,7	0%	-22%	70%
XMT-t384-r52-d1	52	93558,0	45,2	52	102214,0	4,0	0%	-9%	91%
XMT-t393-r38-d1	38	58228,0	36,3	38	59888,0	2,7	0%	-3%	93%
XMT-t401-r29-d1	29	98256,0	45,4	29	101804,0	1,6	0%	-4%	96%
XMT-t411-r19-d1	19	34056,0	40,6	19	33608,0	0,7	0%	1%	98%
XMT-t420-r130-d1	130	147482,0	128,3	130	168696,0	4,9	0%	-14%	96%
XMT-t429-r61-d1	61	94964,0	70,6	61	100148,0	6,1	0%	-5%	91%
XMT-t439-r37-d1	37	52444,0	44,4	37	55854,0	5,5	0%	-7%	88%
XMT-t449-r29-d1	29	85420,0	47,4	29	97980,0	1,5	0%	-15%	97%
XMT-t459-r26-d1	26	40168,0	54,8	26	38128,0	1,1	0%	5%	98%
XMT-t469-r138-d1	138	312568,0	192,9	138	344908,0	22,8	0%	-10%	88%
XMT-t480-r70-d1	70	126646,0	107,0	70	134594,0	11,3	0%	-6%	89%
XMT-t491-r59-d1	59	95912,0	99,4	59	117394,0	2,6	0%	-22%	97%
XMT-t502-r39-d1	39	89688,0	68,8	39	106942,0	16,2	0%	-19%	76%
XMT-t513-r21-d1	21	43266,0	54,6	21	42308,0	1,3	0%	2%	98%
XMT-t524-r153-d1	153	228128,0	203,3	153	227738,0	26,7	0%	0%	87%
XMT-t536-r96-d1	96	149420,0	199,9	96	159002,0	6,5	0%	-6%	97%
XMT-t548-r50-d1	50	122182,0	109,6	50	165644,0	23,2	0%	-36%	79%
XMT-t561-r42-d1	42	71284,0	117,0	42	72672,0	2,5	0%	-2%	98%
XMT-t573-r30-d1	30	72170,0	143,3	30	73424,0	4,9	0%	-2%	97%
XMT-t586-r159-d1	159	257450,0	421,2	159	287602,0	53,1	0%	-12%	87%
XMT-t599-r92-d1	92	151936,0	268,5	92	163578,0	26,1	0%	-8%	90%
XMT-t613-r62-d1	62	96100,0	207,7	62	103696,0	3,2	0%	-8%	98%

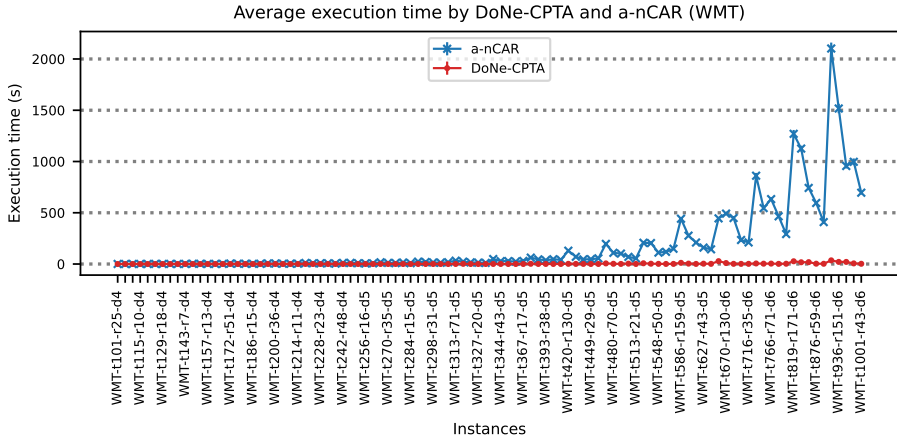
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14 *Supplementary Material*Table 8 – *Continued from the previous page*

Instance Name	a-nCAR			DoNe-CPTA			Performance DoNe-CPTA vs a-nCAR		
	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)	# Robot	Cost	Exec. Time (s)
XMT-t627-r43-d1	43	90504,0	156,1	43	93370,0	15,4	0%	-3%	90%
XMT-t641-r35-d1	35	95112,0	140,1	35	93712,0	14,3	0%	1%	90%
XMT-t655-r131-d1	131	145276,0	437,0	131	169146,0	134,4	0%	-16%	69%
XMT-t670-r130-d1	130	221120,0	484,4	130	220298,0	24,6	0%	0%	95%
XMT-t685-r75-d1	75	108918,0	432,2	75	115248,0	4,8	0%	-6%	99%
XMT-t701-r44-d1	44	120248,0	228,3	44	127508,0	8,6	0%	-6%	96%
XMT-t716-r35-d1	35	68402,0	205,1	35	78898,0	5,0	0%	-15%	98%
XMT-t733-r159-d1	159	191404,0	840,2	159	225060,0	17,7	0%	-18%	98%
XMT-t749-r98-d1	98	112188,0	533,4	98	131096,0	9,0	0%	-17%	98%
XMT-t766-r71-d1	71	169206,0	608,0	71	187602,0	7,4	0%	-11%	99%
XMT-t783-r48-d1	48	118380,0	454,7	48	126504,0	7,4	0%	-7%	98%
XMT-t801-r40-d1	40	107850,0	287,0	40	152880,0	55,9	0%	-42%	81%
XMT-t819-r171-d1	171	222340,0	1247,0	171	240552,0	108,7	0%	-8%	91%
XMT-t837-r142-d1	142	269386,0	1083,7	142	285564,0	156,1	0%	-6%	86%
XMT-t856-r95-d1	95	121156,0	721,9	95	146078,0	132,0	0%	-21%	82%
XMT-t876-r59-d1	59	139160,0	576,2	59	146648,0	12,6	0%	-5%	98%
XMT-t895-r37-d1	37	84696,0	400,7	37	84720,0	30,5	0%	0%	92%
XMT-t916-r207-d1	207	449230,0	2032,7	207	491004,0	265,0	0%	-9%	87%
XMT-t936-r151-d1	151	203234,0	1481,4	151	210178,0	54,6	0%	-3%	96%
XMT-t957-r87-d1	87	121740,0	932,3	87	151904,0	189,1	0%	-25%	80%
XMT-t979-r58-d1	58	176458,0	957,9	58	188926,0	19,1	0%	-7%	98%
XMT-t1001-r43-d1	43	110920,0	680,5	43	110146,0	18,4	0%	1%	97%
AVERAGE:							0%	-9%	90%



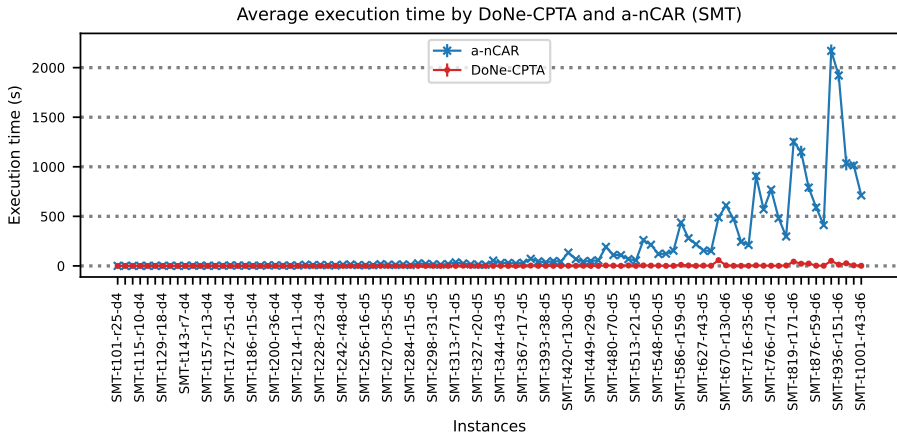
**Figure 4** Overview of the execution time of DoNe-CPTA and a-nCAR when running SMT and WMT.



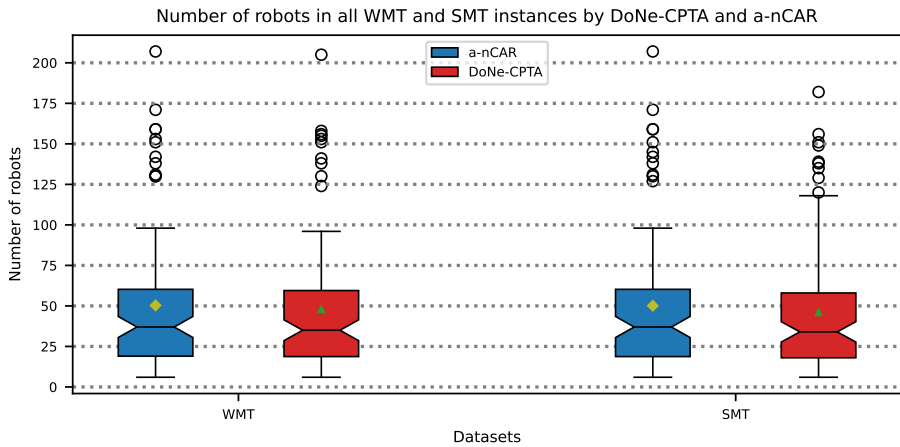
**Figure 5** Execution times of a-nCAR and DoNe CPTA when performing WMT.

**Table 6** Mann-Whitney U test results for number of robots by DoNe-CPTA and a-nCAR on SMT and WMT datasets. Skewed right data by Shapiro Wilk

Dataset	Significance Level	p-value	Result	Common-Language Effect Size
WMT	0.05	0.6653	Do not reject $H_0$	48%
SMT	0.05	0.5583	Do not reject $H_0$	48%



**Figure 6** Execution times of a-nCAR and DoNe CPTA when performing SMT.

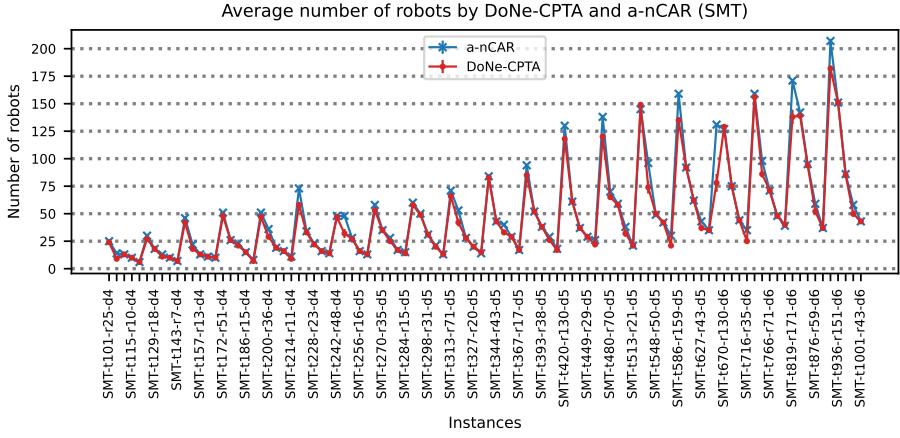


**Figure 7** Overview of the number of robots by DoNe-CPTA and a-nCAR when running SMT and WMT.

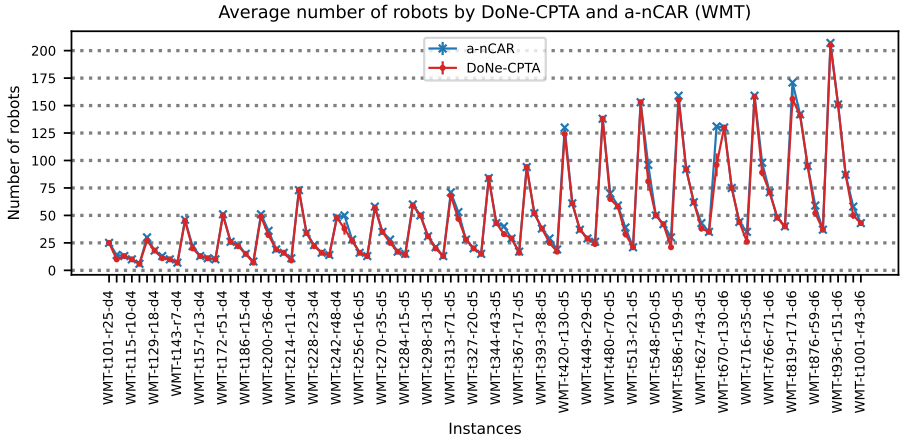
**Table 9** Mann-Whitney U test results for route costs by DoNe-CPTA and a-nCAR on RMT and XMT datasets. Skewed right data by Shapiro Wilk

Dataset	Significance Level	p-value	Result	Common-Language Effect Size
XMT	0.05	0.4278	Reject $H_0$	53%
RMT	0.05	0.8536	Reject $H_0$	49%





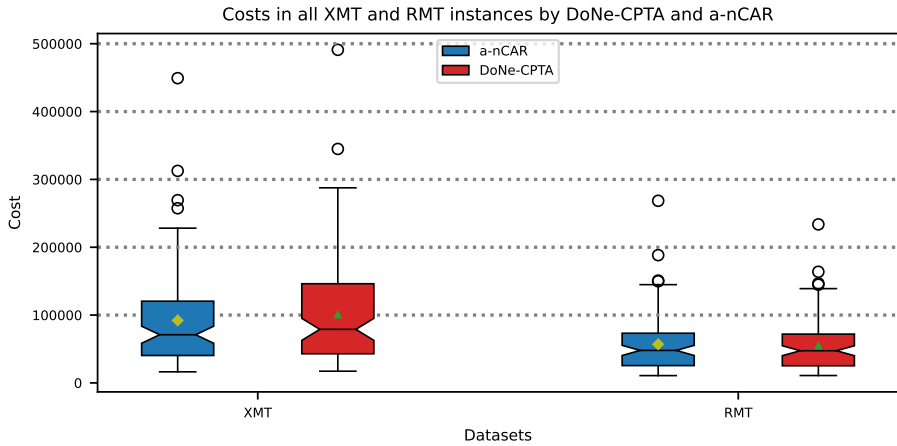
**Figure 8** Number of robots by a-nCAR and DoNe CPTA when performing SMT.



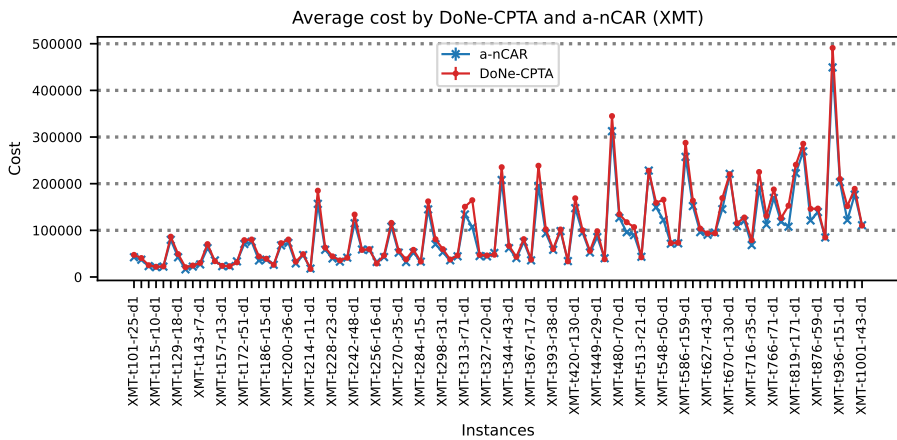
**Figure 9** Number of robots by a-nCAR and DoNe CPTA when performing WMT.

**Table 10** Mann-Whitney U test results for execution time by DoNe-CPTA and a-nCAR on RMT and XMT datasets. Skewed right data by Shapiro Wilk

Dataset	Significance Level	p-value	Result	Common-Language Effect Size
XMT	0.05	$1.63 \times 10^{-13}$	Reject $H_0$	20%
RMT	0.05	$3.89 \times 10^{-15}$	Reject $H_0$	18%



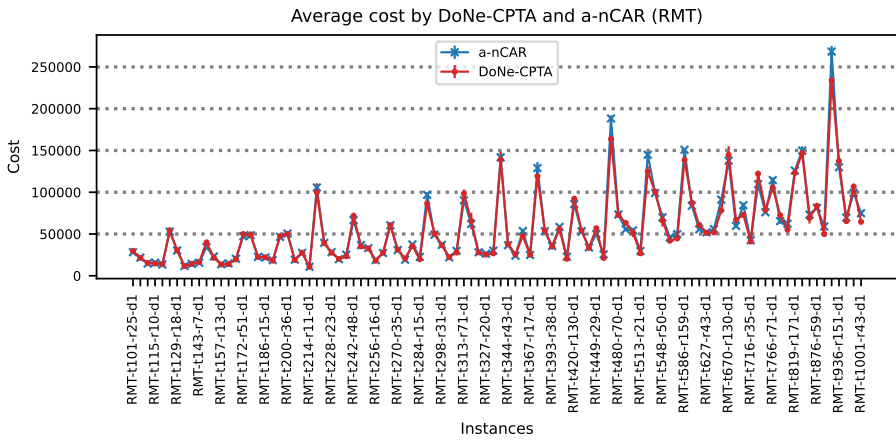
**Figure 10** Overview of the cost of routes computed by DoNe-CPTA and a-nCAR when running RMT and XMT instances.



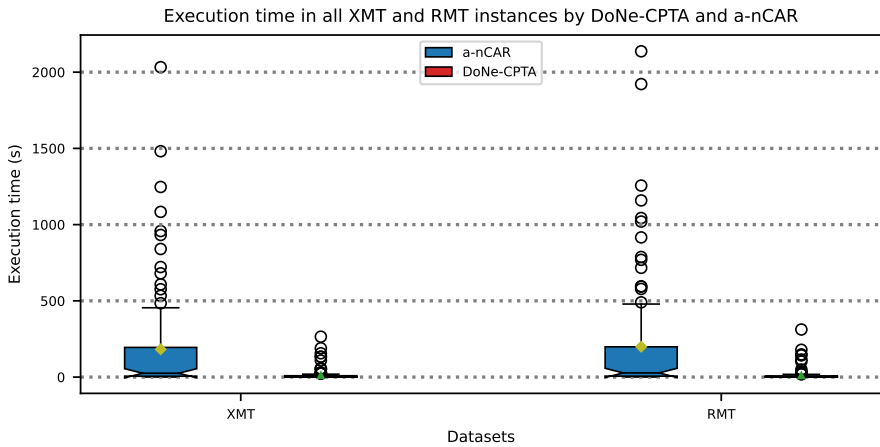
**Figure 11** Cost of routes computed by DoNe-CPTA and a-nCAR with XMT.

**Table 11** Mann-Whitney U test results for number of robots by DoNe-CPTA and a-nCAR on RMT and XMT datasets. Skewed right data by Shapiro Wilk

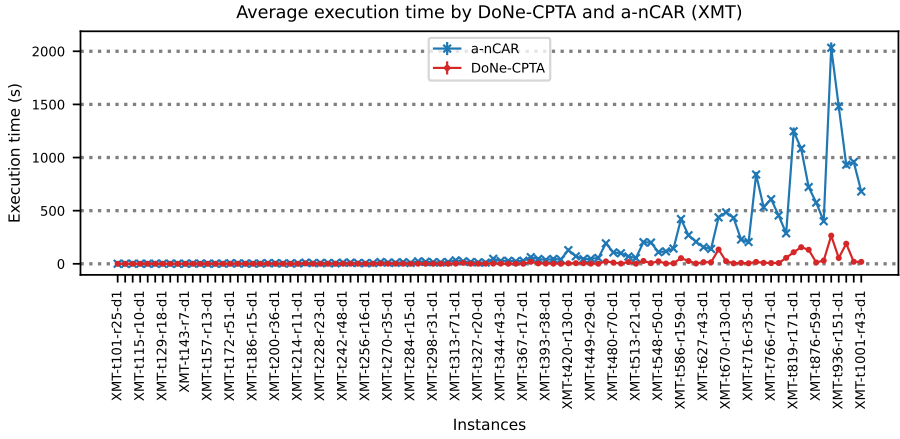
Dataset	Significance Level	p-value	Result	Common-Language Effect Size
XMT	0.05	0.999	Do not reject $H_0$	50%
RMT	0.05	0.07623	Do not reject $H_0$	43%



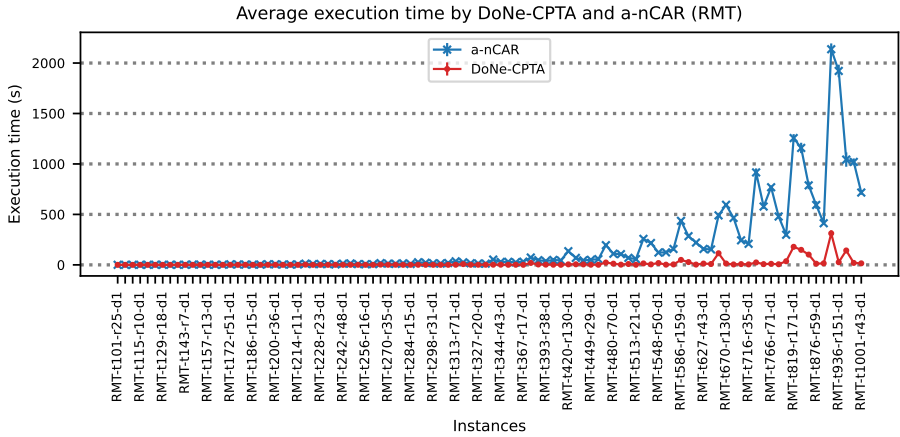
**Figure 12** Cost of routes computed by DoNe-CPTA and a-nCAR with RMT.



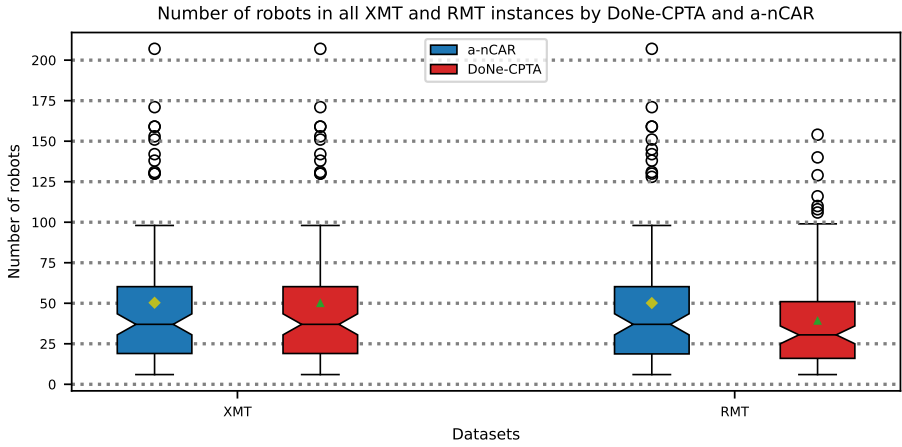
**Figure 13** Overview of the execution time of DoNe-CPTA and a-nCAR when running RMT and XMT.



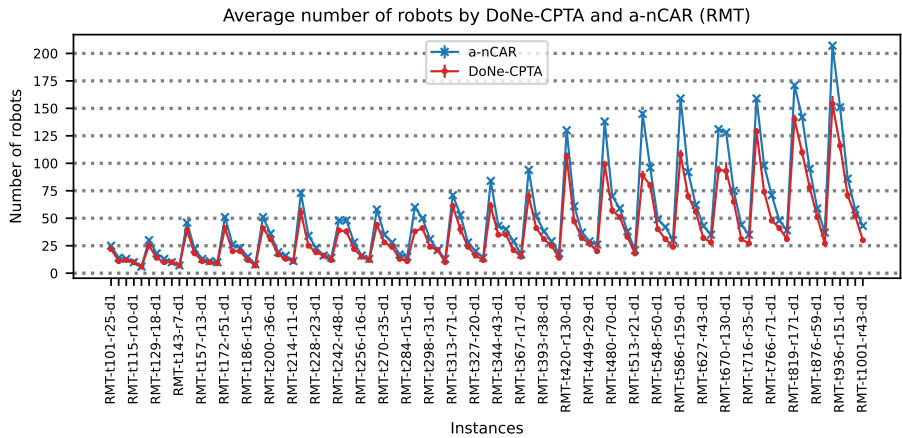
**Figure 14** Execution times of a-nCAR and DoNe CPTA when performing XMT.



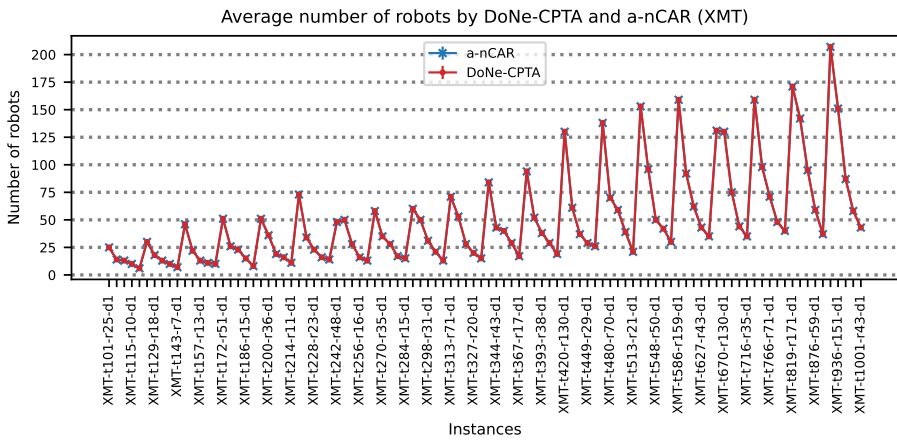
**Figure 15** Execution times of a-nCAR and DoNe CPTA when performing RMT.



**Figure 16** Overview of the number of robots by DoNe-CPTA and a-nCAR when running RMT and XMT.



**Figure 17** Number of robots by a-nCAR and DoNe CPTA when performing RMT.



**Figure 18** Number of robots by a-nCAR and DoNe CPTA when performing XMT.