



APPENDICES

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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APPENDIX A

Based Table

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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Table A-1 Customer list, code, coordinate and monthly demand and distance between point to point

Customers List			Code	Coordinate	Demand
C M	Chiang Mai				8,077,546.63
	PN	Phung Noi Bakery Company		CM PN	18.811585, 98.988144
	B	Branch			
		1	Central Airport Plaza, Chiang Mai	CM B 1	18.769144, 98.975884
		2	Big-C Supercenter, Hang Dong	CM B 2	18.740922, 98.959286
		3	Big-C Supercenter, Chiang Mai	CM B 3	18.769256, 99.032419
		4	Big-C X-tra, Chiang Mai	CM B 4	18.798174, 99.022028
		5	Tesco Lotus, Kam Thieng	CM B 5	18.808412, 98.996944
		6	Central Kad Suan Kheaw	CM B 6	18.796077, 98.976082
		7	Som Prech Market, Chiang Mai	CM B 7	18.791885, 98.993294
	C	Customer			
		1	Behind CMU	CM C 1	18.791994, 98.957307
		2	Boar Sang, Chiang Mai	CM C 2	18.765683, 99.082362
		3	Big-C X-tra North Chiang Mai U.	CM C 3	18.680571, 98.918468
		4	Tesco Lotus, Fang	CM C 4	19.910455, 99.204247
		5	K. Rungthip, Fang	Out source	Red cab 26,130.13
L A	Lamphun				3,965,171.25
	PN B	Beverage		LA PNB	18.589913, 98.977316
	B	Branch			
		1	Wholesale, Lamphun	LA B 1	18.577582, 99.006954
		2	Jam Fah Plaza, Lamphun	LA B 2	18.576047, 99.006305
		3	Big-C Supercenter, Lamphun	LA B 3	18.591087, 99.04119
	C	Customer			
		4	Suan Bunyo Phatum School	LA C 1	18.572955, 99.001019
C R	Chiang Rai				8,670,012.74
	B	Branch			
		1	Big-C Supercenter, Chiang Rai	CR B 1	19.888625, 99.837753

Customers List			Code	Coordinate	Demand
	2	Central Plaza, Chiang Rai	CR B 2	19.886897, 99.835076	1,096,027.00
	3	Tesco Lotus, Mae Chan	CR B 3	20.145793, 99.857555	843,779.00
	4	Tesco Lotus, Mae Sai	CR B 4	20.407486, 99.884251	1,195,828.00
C	Customer				
	1	Bangchak Gas Staion, Doi Sa Ked	CR C 1	18.875532, 99.135494	11,766.50
	2	Kru Tuu, Transportation Station Mae Kha Chan	CR C 2	19.195625, 99.515241	17,475.10
	3	K.Phung, Mae Kha Chan	CR C 3	19.198393, 99.516526	29,404.95
	4	Group of Mae Kha Chan's Customers	CR C 4	19.198016, 99.516196	46,326.50
	5	Kru Noom, Mae Kha Chan	CR C 5	19.201045, 99.5061	24,396.00
	6	K.Larh, Vieng Pa Pao Hospital	CR C 6	19.338773, 99.509944	159,015.00
	7	K.Sasitorn, Vieng Pa Pao	CR C 7	19.358887, 99.504375	65,502.00
	8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	CR C 8		52,728.00
	9	Moo Hao Chalearn	CR C 9	19.535019, 99.486823	7,652.75
	10	K. Nang, Therng	CR B 2		420,187.38
	11	K. Jaifer, Chiang Rai	CR B 2		142,652.35
	12	K.Rung, Chiang Rai	CR C 10	19.910307, 99.841331	263,962.50
	13	K.Oa, Chiang Rai	CR C 11	19.905966, 99.835843	140,565.00
	14	K.Sripun, Chiang Rai	CR C 12	19.899152, 99.832152	421,649.40
	15	K.Oranuch , San Khong Chiang Rai	CR C 13	19.901056, 99.820002	743,765.18
	16	K.Srila Yanisa, Chiang Sand			440,483.70
	17	Lalid, Chaing Khong			224,188.83
	18	K. Pam Janjira, Mae Chan	CR C 14	20.145305, 99.85755	232,750.94
	19	K. Reynu			5,650.00
	20	K. Pornthip			97,423.15
	21	K. Ton Veerayut	CR B 4		175,572.15
	22	K. Pisit	CR B 4		3,153.38
PY	Phayao				3,724,725.94
	D	Distribution Center			

Customers List			Code	Coordinate	Demand
	1	Distribution Center, Phayao	PY D 1	19.151518, 99.913192	
B	Branch				
	1	Charoen Pun Department Store, Phayao	PY B 1	19.171351, 99.899164	716,241.00
	2	Tesco Lotus, Phayao	PY B 2	19.182766, 99.896289	867,846.00
C	Customer				
	1	K.Nay, Wangnuea	PY C 1	19.146032, 99.613796	75,022.00
	2	K.Tadsanee, Wangnuea	PY C 2	19.145842, 99.619753	50,250.00
	3	K.Wilaiwan, Wangnuea	PY C 3	19.145690, 99.616250	3,277.75
	4	K. Thung, Chiang Come	PY D 1		55,244.08
	5	K. Duan, Lotus Chiang Come	PY D 1		615,449.58
	6	K. Wat, June	PY D 1		27,284.95
	7	Srisomphod, Dok Come Tai	PY D 1		371,268.03
	8	Arunee, Lotus Parn	PY D 1		158,851.75
	9	Mae Tum, Phayao	PY C 4	19.142429, 99.911114	286,320.80
	10	K.No, Phayao University	PY C 5	19.029764, 99.926121	172,124.75
	11	Tom mart, Phayao University	PY C 6	19.029419, 99.893449	193,834.42
	12	K. Pimol	PY B 1		34,502.25
	13	K. Padung, Chiang Muan	PY D 1		40,225.38
	14	K. Ratee, Phong	PY D 1		56,983.23
LP	Lampang				4,398,270.08
B	Branch				
	1	Big-C Supercenter, Lampang	LP B 1	18.275691, 99.481244	2,344,488.00
	2	Tesco Lotus, Lampang	LP B 2	18.280662, 99.493228	550,363.00
C	Customer				
	1	K.Berm, Lampang	LP C 1	18.280968, 99.479291	297,094.83
	2	K.Nittaya, Lampang	LP C 2	18.287305, 99.488164	576,529.35
	3	K Channarong, Kad Make	LP B 1		94,182.53
	4	K.Narong, Pang Ma-O Lampang	LP C 3	18.29116, 99.51048	260,338.30
	5	K.Sunan, Nam Tong Market, Lampang	LP C 4	18.308823,	

Customers List				Code	Coordinate	Demand
					99.467382	275,274.08
PH	Phrae					3,559,830.53
	B	Branch				
		1	Big-C Supercenter, Phrae	PH B 1	18.128213, 100.146051	1,260,019.00
	C	Customer				
		1	Mark Four Plaza, Phrae	PH C 1	18.13378, 100.1489	477,197.03
		2	K.Ja-ded, Phrae	PH C 2	18.122521, 100.153569	505,856.90
		3	Baan Thung, Sai Petch	PH C 1		157,340.50
		4	K. Subin	PH C 1		21,370.18
		5	K. Chai (Maintenace), Rong Khwang	PH C 1		162,255.55
		6	Den Chai	PH C 1		94,341.65
		7	K. Pramote, Shung Menn	PH C 1		243,260.78
		8	K. Kiat	PH C 1		109,580.63
		9	K. Wilailuck, Vieng Nak	PH C 1		153,531.50
		10	K. Khanittha, Song	PH C 1		43,685.50
		11	K. Eak Sirinipa	PH C 1		37,202.18
		12	K. Dang, Vieng Sa, Nan	PH C 1		60,349.50
		13	K.Kanlaya, Phrae			85,796.18
		14	Sim store, Long	PH C 3	18.101874, 99.860098	30,085.65
		15	Sim Heng Huad			9,488.03
		16	K.Suweena,, Phrae Hospital	PH C 4	18.089473, 99.844056	11,515.00
		17	K. Ratchanee, Vieng Sa	PH B 1		96,954.80
U D	Uttaradi t					1,705,013.33
	B	Branch				
		1	Friday Department Store, Uttaradit	UD B 1	17.614625, 100.092546	1,066,102.00
	C	Customer				
		1	Tesco Lotus Uttaradit	UD B 1		390,383.20
		2	K. Nam Phung	UD B 1		248,528.13
PL	Phitsanulok					8,311,842.54

Customers List			Code	Coordinate	Demand
D	Distribution Center				
	1	Distribution Center, Phitsanulok	PL D 1	16.82104, 100.272297	3,579,487.00
B	Branch				
	1	Big-C Supercenter, Phitsanulok	PL B 1	16.818062, 100.290008	656,223.00
	2	Topland Plaza, Phitsanulok	PL B 2	16.821641, 100.264503	335,836.00
	3	Train Station, Phitsanulok	PL B 3	16.815186, 100.265383	368,107.00
C	Customer				
	1	Tesco Lotus Loei	PL D 1		352,459.29
	2	Tesco Lotus Chum Pare, Khon Kaen	PL D 1		154,306.58
	3	Happy store, Pichit	PL D 1		237,392.90
	4	Taparnhin, Pichit	PL D 1		254,618.30
	5	Big-C Supercenter, Kamphaengphet	PL D 1		549,727.10
	6	Ta ma kham, Kamphaengphet	PL D 1		185,323.55
	7	Larn Kra Buaa, Kamphaengphet	PL D 1		161,047.48
	8	Prankrat, Kamphaengphet	PL D 1		123,094.55
	9	K. Noi, Kamphaengphet	PL D 1		289,467.50
	10	Big -C Suothai	PL D 1		378,053.35
	11	Top mart, Phitsanulok	PL D 1		196,823.70
	12	Naraysuen ray	PL D 1		58,885.65
	13	Big-C Superstore, Phitsanulok	PL D 1		152,938.48
	15	Zeer, Rhung Sit			127,017.45
	16	Tesco Lotus, Nawanakorn	Out source	Nim See Seng	90,856.43
	17	Carrefour, 4th Praram			60,177.25

To		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
From		CM PN	CM B 1	CM B 2	CM B 3	CM B 4	CM B 5	CM B 6	CM B 7	CM C 1	CM C 2	CM C 3	CM C 4	LA B 1	LA B 2	LA B 3
1	CM PN		7.6	13.1	8.8	5.4	2.7	4.1	3.9	4.7	13.2	21.1	146	32. 6	32. 8	28. 9
2	CM B 1	7.1		5.2	8.5	8.8	6.3	3.2	5	4.4	14.7	13.3	152	33. 6	33. 8	28. 4
3	CM B 2	12.8	5.7		12.6	18.1	12	8.8	9.5	10.1	19.2	8.1	159	28. 4	28. 6	30. 4
4	CM B 3	8	7.3	10.9		5.7	7.6	10.4	6.7	11.6	7.7	18.9	178	24. 5	24. 7	20. 8
5	CM B 4	5.5	10.4	14	3.8		5.1	7.9	5.5	10.1	8.3	22.1	173	27. 7	27. 8	24
6	CM B 5	1.1	6.1	9.6	7.7	5		4.7	2.4	5.8	12.2	17.7	148	31. 6	31. 7	27. 9
7	CM B 6	5	5.9	11.5	8.6	6.7	4.2		3.2	4	13	19.6	149	39. 9	40. 1	28. 7
8	CM B 7	3.2	4.2	7.7	6.2	4.7	2.4	2.8		5.2	10.6	15.8	149	30	30. 2	26. 3
9	CM C 1	6.6	7.1	8.7	13.4	9.8	6.9	3.8	5.2		19.6	16.7	150	37. 1	37. 2	35. 8
10	CM C 2	13.1	13.3	15.9	8.4	9.1	12.7	16.5	11.1	17.7		22.3	179	26. 8	27	23. 1
11	CM C 3	18.9	11.8	10.2	18.8	24.2	18.1	15	15.7	16.2	22.3		165	20. 4	20. 6	26
12	CM C 4	174	181	184	175	171	176	177	177	177	178	192		201	202	198
13	LA B 1	31.7	31.8	30.1	24.6	29.3	31.3	34.9	30.3	36.2	27.3	20	202		0.1 8	6.1
14	LA B 2	31.8	31.9	30.3	24.8	29.5	31.4	35.1	30.5	36.4	27.4	20.2	202	0.1 8		6.3
15	LA B 3	27.8	25.4	26.9	20.7	25.4	27.4	28.6	26.4	29.8	23.4	32	198	9	9.2	
16	LA C 1	32.8	32.1	30.4	25.8	30.5	32.4	35.2	35.9	36.5	28.4	20.3	203	1.2	1	7.3
17	CR B 1	196	205	208	202	193	195	198	196	200	193	214	115	213	213	207
18	CR B 2	196	206	208	203	194	196	199	196	201	194	215	115	214	214	208
19	CR B 3	225	235	238	232	223	225	228	225	230	223	244	86.9	243	243	237
20	CR B 4	257	267	270	264	255	257	260	257	262	255	276	119	275	275	269
21	CR C 1	21.1	28.6	32.1	22	18.6	20.7	23.5	21.1	25.8	22.2	40.2	184	45. 7	45. 9	42
22	CR C 2	92.8	103	105	99.4	90.3	92.4	95.2	92.8	97.5	90.7	112	117	110	111	105
23	CR C 3	93.2	103	106	99.8	90.7	92.8	95.6	93.1	97.8	91	112	116	111	111	105
24	CR C 4	93.2	103	106	99.8	90.7	92.8	95.6	93.1	97.8	91	112	116	111	111	105
25	CR C 5	94.2	104	107	101	91.7	93.8	96.6	94.2	98.9	92.1	113	118	112	112	106
26	CR C 6	109	119	121	116	106	109	111	109	114	107	128	101	127	127	121
27	CR C 7	111	121	124	118	109	111	114	111	116	109	130	98.4	129	129	123
28	CR C 8	111	121	124	118	109	111	114	111	116	109	130	98.4	129	129	123
29	CR C 9	132	142	144	139	130	132	134	132	137	130	151	77.6	150	150	144
30	CR C 10	198	208	210	204	195	197	200	198	202	196	217	117	215	216	210
31	CR C 11	198	207	210	204	195	197	200	198	202	195	216	117	215	215	209
32	CR C 12	197	207	210	204	195	197	200	197	202	195	216	117	215	215	209

To		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
From		CM PN	CM B 1	CM B 2	CM B 3	CM B 4	CM B 5	CM B 6	CM B 7	CM C 1	CM C 2	CM C 3	CM C 4	LA B 1	LA B 2	LA B 3
3 3	CR C 13	199	208	211	205	196	198	201	199	203	196	217	118	216	216	210
3 4	CR C 14	225	235	238	232	223	225	228	225	230	223	244	86.9	243	243	237
3 5	PY D 1	162	171	174	168	159	161	165	162	167	159	180	168	180	179	173
3 6	PY B 1	166	176	178	172	163	165	168	166	170	164	185	165	183	183	178
3 7	PY B 2	166	176	178	172	163	165	168	166	170	164	185	165	183	184	178
3 8	PY C 1	110	119	122	116	107	109	112	110	114	107	128	130	127	127	121
3 9	PY C 2	110	120	122	117	107	110	112	110	115	108	129	130	128	128	122
4 0	PY C 3	109	119	122	116	107	109	112	109	114	107	128	130	127	127	121
4 1	PY C 4	161	171	174	168	159	161	163	161	166	159	180	168	179	179	173
4 2	PY C 5	164	174	176	171	162	164	167	164	169	162	183	185	182	182	176
4 3	PY C 6	158	168	171	165	156	158	161	158	163	156	177	179	176	176	170
4 4	LP B 1	100	97.8	99.2	93.1	97.8	99.7	101	98.8	102	95.7	93.4	241	73. 4	73. 2	72. 4
4 5	LP B 2	101	98.6	100	93.8	98.6	100	102	99.6	103	96.5	94.2	241	74. 2	74	73. 1
4 6	LP C 1	99.4	97	98.5	92.3	97	99	100	98.1	101	95	92.7	242	72. 7	72. 5	71. 6
4 7	LP C 2	101	98.2	99.6	93.5	98.2	100	101	99.2	103	96.1	93.8	241	73. 8	73. 6	72. 8
4 8	LP C 3	104	101	103	96.8	101	103	105	103	106	99.4	97.1	238	77. 1	76. 9	76. 1
4 9	LP C 4	99.6	97.3	97.8	92.6	97.3	99.2	100	98.3	102	95.2	92.9	240	72. 9	72. 7	71. 9
5 0	PH B 1	203	200	202	196	200	202	204	201	205	198	196	308	176	176	175
5 1	PH C 1	202	200	201	195	200	202	203	201	204	198	195	306	175	175	174
5 2	PH C 2	203	201	202	196	201	203	204	202	205	199	196	307	176	176	175
5 3	PH C 3	164	162	163	157	162	164	165	163	166	160	157	300	137	137	136
5 4	PH C 4	162	160	161	155	160	162	163	161	164	158	155	298	135	135	134
5 5	UD B 1	241	238	240	234	238	240	241	239	243	236	234	377	214	214	213
5 6	PL D 1	361	359	360	354	359	361	362	360	363	357	355	498	335	334	334
5 7	PL B 1	363	361	362	356	361	363	364	362	365	359	357	499	337	336	335
5 8	PL B 2	361	358	360	354	358	360	362	359	363	356	353	497	334	334	333
5 9	PL B 3	361	359	360	354	359	361	362	360	363	357	355	497	335	334	334

To		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
From		LA C 1	CR B 1	CR B 2	CR B 3	CR B 4	CR C 1	CR C 2	CR C 3	CR C 4	CR C 5	CR C 6	CR C 7	CR C 8	CR C 9	CR C 10
1	CM PN	33.8	197	196	226	256	19.1	93.7	94	94	95.1	110	112	112	133	199
2	CM B 1	34.1	207	206	237	267	22.5	104	104	104	105	120	122	122	143	209
3	CM B 2	28.9	212	211	241	271	31.3	109	109	109	110	125	127	127	148	213
4	CM B 3	25.7	200	199	230	260	19.4	97	97.4	97.4	98.4	113	115	115	136	202
5	CM B 4	28.8	194	193	223	253	15.9	90.5	90.8	90.8	91.9	107	109	109	130	195
6	CM B 5	32.8	196	195	226	256	18.7	93.3	93.6	93.6	94.7	109	112	112	132	198
7	CM B 6	40.4	198	197	228	258	20.4	94.9	95.3	95.3	96.3	111	113	113	134	200
8	CM B 7	31.2	196	195	226	256	18.5	93	93.4	93.4	94.4	109	111	111	132	198
9	CM C 1	37.6	201	200	231	261	23.6	98.1	98.5	98.5	99.5	114	117	117	137	203
10	CM C 2	28	193	192	222	252	14.8	89.5	89.8	89.8	90.9	106	108	108	129	194
11	CM C 3	20.9	215	214	244	274	37.5	112	112	112	113	128	130	130	151	217
12	CM C 4	203	114	113	90.1	120	180	116	115	115	117	99.7	97.4	97.4	76.6	116
13	LA B 1	1.2	214	213	244	274	43.4	111	112	112	113	127	130	130	150	216
14	LA B 2	1	214	213	244	274	43.6	111	111	111	112	127	129	129	150	216
15	LA B 3	10.2	209	208	239	269	39.5	106	106	106	107	122	124	124	145	211
16	LA C 1		215	214	244	274	44.6	112	112	112	113	128	130	130	151	217
17	CR B 1	214		1.4	31.9	62	178	103	102	103	104	86.7	84.4	84.4	63.6	4.1
18	CR B 2	215	1		30.5	60.6	179	103	103	103	104	87.2	84.8	84.8	64.1	2.8
19	CR B 3	244	30.3	31		31	208	132	132	132	133	116	114	114	93.3	27.7
20	CR B 4	276	62.2	62.9	31.9		240	164	164	164	165	148	146	146	125	59.6
21	CR C 1	46.9	178	177	207	237		74.7	75	75	76.1	90.8	93.1	93.1	114	180
22	CR C 2	112	103	102	133	163	75.7		0.35	0.35	1.4	16.1	18.4	18.4	39.2	105
23	CR C 3	112	103	102	132	162	76	0.35		0.05 5	1.1	15.8	18.1	18.1	38.8	105
24	CR C 4	112	103	102	132	162	76	0.35	0.05 5		1.1	15.8	18.1	18.1	38.9	105
25	CR C 5	113	104	103	133	164	77.1	1.4	1.1	1.1		16.9	19.2	19.2	40	106
26	CR C 6	128	81.7	86	117	147	91.8	16.1	15.8	15.8	16.9		2.3	2.3	23.1	88.8
27	CR C 7	130	84.8	83.7	114	144	94.1	18.4	18.1	18.1	19.2	2.3			20.8	86.5
28	CR C 8	130	84.8	83.7	114	144	94.1	18.4	18.1	18.1	19.2	2.3			20.8	86.5
29	CR C 9	151	64	62.9	93.5	124	115	39.2	38.9	38.9	40	23.1	20.8	20.8		65.7
30	CR C 10	217	2.7	3.5	27.9	58	181	105	105	105	106	88.8	86.5	86.5	65.7	
31	CR C 11	216	2.6	3.4	28.9	59	180	105	104	105	106	88.7	86.4	86.4	65.6	1.1
32	CR C 12	216	2.4	2.3	30.3	60.4	180	105	104	104	105	88.5	86.2	86.2	65.4	2.6

To		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
From		LA C 1	CR B 1	CR B 2	CR B 3	CR B 4	CR C 1	CR C 2	CR C 3	CR C 4	CR C 5	CR C 6	CR C 7	CR C 8	CR C 9	CR C 10
3 1	CR C 11	216	2.6	3.4	28.9	59	180	105	104	105	106	88.7	86.4	86.4	65.6	1.1
3 2	CR C 12	216	2.4	2.3	30.3	60.4	180	105	104	104	105	88.5	86.2	86.2	65.4	2.6
3 3	CR C 13	217	3.5	3.7	31.4	61.5	181	106	105	105	107	89.6	87.3	87.3	66.5	3.7
3 4	CR C 14	244	30.2	31	0.85	30.9	208	132	132	132	133	116	114	114	93.2	27.6
3 5	PY D 1	180	95.5	94.5	125	155	144	68.8	68.5	68.5	69.6	82.1	83.7	83.7	104	97.3
3 6	PY B 1	184	92	90.9	121	152	149	72.9	72.5	72.6	73.7	85.4	87.8	87.8	109	93.7
3 7	PY B 2	185	92.1	91.1	122	152	149	73	72.6	72.7	73.8	85.5	87.9	87.9	109	93.9
3 8	PY C 1	128	116	115	146	176	92.4	16.8	16.4	16.5	17.6	29.3	31.7	31.7	52.4	118
3 9	PY C 2	129	117	116	146	176	92.8	17.1	16.8	16.8	17.9	29.7	32	32	52.7	118
4 0	PY C 3	128	116	115	146	176	92.3	16.6	16.3	16.3	17.4	29.2	31.5	31.5	52.3	118
4 1	PY C 4	180	95.5	94.4	125	155	144	68.3	68	68	69.1	80.9	83.2	83.2	104	97.2
4 2	PY C 5	183	110	109	139	170	147	71.3	70.9	71	72.1	83.8	86.2	86.2	107	112
4 3	PY C 6	177	112	111	142	172	141	65.5	65.2	65.3	66.3	78.1	80.4	80.4	101	114
4 4	LP B 1	73.9	228	227	258	288	112	128	128	128	129	141	143	143	164	230
4 5	LP B 2	74.7	228	227	257	288	113	128	127	127	128	140	143	143	163	230
4 6	LP C 1	73.2	229	228	258	289	111	129	128	128	129	141	144	144	164	231
4 7	LP C 2	74.3	228	227	258	288	112	128	128	128	129	141	143	143	164	230
4 8	LP C 3	77.6	225	223	254	284	116	124	124	124	125	137	139	139	160	226
4 9	LP C 4	73.4	227	226	256	286	111	127	127	127	128	140	142	142	163	228
5 0	PH B 1	177	234	233	263	293	214	195	195	195	196	208	210	210	231	236
5 1	PH C 1	176	232	231	261	291	214	193	193	193	194	206	208	208	229	234
5 2	PH C 2	177	233	232	262	292	215	194	194	194	195	207	209	209	230	234
5 3	PH C 3	138	268	267	298	328	176	187	187	187	188	200	202	202	223	270
5 4	PH C 4	136	270	269	300	330	174	185	185	185	186	198	200	200	221	272
5 5	UD B 1	214	305	304	335	365	252	264	263	263	264	276	278	278	299	307
5 6	PL D 1	335	411	410	440	470	373	384	384	384	385	397	399	399	420	413
5 7	PL B 1	337	413	412	442	473	375	386	386	386	387	399	401	401	422	415
5 8	PL B 2	335	410	409	440	470	373	384	383	383	384	396	399	399	419	412
5 9	PL B 3	335	411	410	441	471	373	384	384	384	385	397	399	399	420	413

To		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
From		CR C 11	CR C 12	CR C 13	CR C 14	PY D 1	PY B 1	PY B 2	PY C 1	PY C 2	PY C 3	PY C 4	PY C 5	PY C 6	LP B 1	LP B 2
1	CM PN	198	198	199	226	163	166	167	110	111	110	161	164	159	101	103
2	CM B 1	209	209	210	237	174	176	177	120	121	121	172	175	170	100	102
3	CM B 2	213	213	214	241	178	181	182	125	126	125	176	179	174	102	103
4	CM B 3	202	202	203	230	167	169	170	113	114	114	165	168	163	92. 6	94. 5
5	CM B 4	195	195	196	223	160	163	164	107	108	107	158	161	156	95. 8	97. 6
6	CM B 5	198	198	199	226	163	165	166	110	110	110	161	164	159	99. 7	102
7	CM B 6	200	200	201	228	165	167	168	111	111	112	163	166	161	101	102
8	CM B 7	198	198	199	226	163	165	166	109	110	110	161	164	159	98. 2	100
9	CM C 1	203	203	204	231	168	170	171	115	115	115	166	169	164	108	109
10	CM C 2	194	194	195	222	159	162	162	106	107	106	157	160	155	94. 9	96. 8
11	CM C 3	216	216	217	244	181	184	185	128	129	128	179	182	177	93. 5	95. 4
12	CM C 4	116	116	117	90.2	166	164	162	129	129	129	169	183	178	242	240
13	LA B 1	216	216	217	244	181	183	184	128	128	128	179	182	177	73. 2	75
14	LA B 2	216	216	217	244	181	183	184	127	128	128	179	182	177	73	74. 8
15	LA B 3	211	211	212	239	176	178	179	122	123	123	174	177	172	74. 3	76. 2
16	LA C 1	216	216	217	244	181	184	185	128	129	128	180	182	177	73. 7	75. 5
17	CR B 1	3.9	3.8	4.9	32	94	91.6	89.9	116	116	116	96.9	109	112	229	227
18	CR B 2	2.5	2.4	3.5	30.6	94.5	92.1	90.3	116	117	116	97.4	109	112	229	227
19	CR B 3	29.2	30.1	31.2	0.05 4	124	121	120	145	146	146	127	138	141	258	256
20	CR B 4	61.1	62	63.1	32	156	153	151	177	178	177	158	170	173	290	288
21	CR C 1	179	179	180	207	144	147	148	91.1	91.8	91.3	142	145	140	114	116
22	CR C 2	105	105	106	133	69.8	72.1	73	16.4	17.1	16.7	67.8	70.7	65.6	130	128
23	CR C 3	104	104	105	132	69.4	71.8	72.7	16.1	16.8	16.3	67.5	70.3	65.2	130	128
24	CR C 4	104	104	105	132	69.5	71.8	72.7	16.1	16.8	16.4	67.5	70.4	65.3	130	128
25	CR C 5	105	105	106	134	70.5	72.9	73.8	17.2	17.9	17.4	68.6	71.5	66.3	131	129
26	CR C 6	88.5	88.5	89.6	117	82.3	84.6	85.6	28.9	29.7	29.2	80.3	83.2	78.1	143	141
27	CR C 7	86.2	86.2	87.3	114	84.6	86.9	87.9	31.2	32	31.5	82.6	85.5	80.4	145	143
28	CR C 8	86.2	86.2	87.3	114	84.6	86.9	87.9	31.2	32	31.5	82.6	85.5	80.4	145	143
29	CR C 9	65.5	65.4	66.5	93.5	105	108	109	52	52.7	52.3	103	106	101	166	164
30	CR C 10	1.7	2.6	3.7	28	96.2	93.7	92	118	118	118	99	111	114	231	229
31	CR C 11		1.3	2.4	28.9	96	93.6	91.9	118	118	118	98.9	111	114	231	229
32	CR C 12	1		1.5	30.4	95.8	93.4	91.7	117	118	118	98.7	111	114	230	228

To		31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
From		CR C 11	CR C 12	CR C 13	CR C 14	PY D 1	PY B 1	PY B 2	PY C 1	PY C 2	PY C 3	PY C 4	PY C 5	PY C 6	LP B 1	LP B 2
3 3	CR C 13	2.2	1.5		31.5	97	94.5	92.8	119	119	119	99.8	112	115	231	230
3 4	CR C 14	29.2	30	31.2		124	121	119	145	146	146	127	138	141	258	256
3 5	PY D 1	97	96.9	98.1	125		4.4	5.3	54.1	51.9	52.2	2.9	14.8	17.8	135	133
3 6	PY B 1	93.5	93.4	94.5	122	4.1		1.7	58.1	56	56.3	6.9	18.8	21.8	139	137
3 7	PY B 2	93.6	93.5	94.6	122	4.2	1.7		58.2	56.1	56.4	7	18.9	21.9	139	137
3 8	PY C 1	118	118	119	146	53.4	55.7	56.6		0.75	0.26	51.4	54.3	49.2	114	112
3 9	PY C 2	118	118	119	146	52.8	55.2	56.1	2.5		0.5	50.9	53.8	48.6	114	113
4 0	PY C 3	118	118	119	146	53.1	55.5	56.4	1.9	0.5		51.2	54.1	48.9	114	112
4 1	PY C 4	96.9	96.9	98	125	2	4.2	5.2	53.6	51.4	51.7		14.3	17.3	134	132
4 2	PY C 5	111	111	112	139	16.4	18.8	19.7	56.5	54.4	54.7	14.5		7.3	120	118
4 3	PY C 6	114	114	115	142	18.7	21	21.9	50.8	48.6	48.9	16.7	8.3		121	120
4 4	LP B 1	230	230	231	258	135	137	138	113	112	112	133	120	121		2.3
4 5	LP B 2	229	229	230	258	134	137	138	113	112	112	132	120	120	2.1	
4 6	LP C 1	226	230	231	258	135	138	139	114	113	113	133	121	121	0.9	2.5
4 7	LP C 2	230	230	231	258	135	137	138	113	112	112	133	120	121	1.9	2.1
4 8	LP C 3	226	226	227	254	131	133	134	110	109	108	129	116	117	5	3.1
4 9	LP C 4	228	228	229	256	136	138	139	112	111	111	134	121	122	6.4	6.9
5 0	PH B 1	235	235	236	263	140	143	144	180	178	179	138	126	126	108	104
5 1	PH C 1	233	233	234	261	138	141	142	178	176	177	136	124	124	107	103
5 2	PH C 2	234	234	235	262	139	142	142	179	177	177	137	124	125	108	104
5 3	PH C 3	270	269	271	298	175	177	178	172	171	171	173	160	161	69	65
5 4	PH C 4	272	272	273	300	177	179	180	170	169	169	175	162	163	66.9	62.9
5 5	UD B 1	307	307	308	335	212	214	215	249	248	247	210	197	198	145	141
5 6	PL D 1	412	412	413	440	317	320	321	370	369	368	315	303	303	266	262
5 7	PL B 1	414	414	415	442	319	322	323	371	371	370	317	305	305	268	264
5 8	PL B 2	412	412	413	440	317	319	320	369	368	368	315	302	303	266	262
5 9	PL B 3	412	412	414	441	318	320	321	369	369	368	316	303	304	266	262

To		46	47	48	49	50	51	52	53	54	55	56	57	58	59
From		LP C 1	LP C 2	LP C 3	LP C 4	PH B 1	PH C 1	PH C 2	PH C 3	PH C 4	UD B 1	PL D 1	PL B 1	PL B 2	PL B 3
1	CM PN	100	102	105	98.7	203	203	204	165	163	240	365	367	364	365
2	CM B 1	99.7	102	104	98.2	203	202	204	165	162	240	365	367	363	364
3	CM B 2	101	103	105	99.5	204	204	205	166	164	241	366	368	365	366
4	CM B 3	92	94.1	96.5	90.6	195	195	196	157	155	232	357	359	356	357
5	CM B 4	95.2	97.3	99.7	93.8	198	198	199	160	158	235	360	362	359	360
6	CM B 5	99.1	101	104	99.7	202	202	203	164	162	239	364	366	363	364
7	CM B 6	100	102	104	98.5	203	203	204	165	163	240	365	367	364	365
8	CM B 7	97.6	99.6	102	96.2	201	200	201	163	160	238	363	365	361	362
9	CM C 1	107	109	112	106	210	210	211	172	170	247	372	374	371	372
10	CM C 2	94.4	96.4	98.8	92.9	197	197	198	159	157	235	359	362	358	359
11	CM C 3	93	95	97.4	91.5	196	196	197	158	156	233	358	360	357	358
12	CM C 4	242	242	236	238	309	308	307	301	299	376	501	503	500	501
13	LA B 1	72.6	74.6	77	71.2	176	175	176	138	135	213	338	340	336	337
14	LA B 2	72.4	74.4	76.9	71	175	175	176	137	135	213	337	340	336	337
15	LA B 3	73.8	75.8	78.2	72.3	177	176	178	139	137	214	339	341	338	339
16	LA C 1	73.1	75.2	77.6	71.7	176	176	177	138	136	213	338	340	337	338
17	CR B 1	229	228	224	225	234	234	233	269	273	305	404	405	451	452
18	CR B 2	229	229	225	226	235	235	234	269	273	305	404	405	451	452
19	CR B 3	258	258	254	255	264	264	263	298	303	334	433	434	481	482
20	CR B 4	290	290	286	287	296	296	295	330	334	366	465	466	512	514
21	CR C 1	113	115	118	112	216	216	217	187	176	253	378	381	377	378
22	CR C 2	130	130	124	126	196	196	195	189	186	264	389	391	387	388
23	CR C 3	130	129	123	126	196	196	195	188	186	263	388	390	387	388
24	CR C 4	130	129	124	126	196	196	195	188	186	263	388	391	387	388
25	CR C 5	131	130	125	127	197	197	196	189	187	264	389	392	388	389
26	CR C 6	143	142	136	139	209	209	208	201	199	276	401	403	400	401
27	CR C 7	145	145	139	141	211	211	210	203	201	279	403	406	402	403
28	CR C 8	145	145	139	141	211	211	210	203	201	279	403	406	402	403
29	CR C 9	166	165	159	162	232	232	231	224	222	299	424	426	423	424
30	CR C 10	231	230	226	228	237	236	235	271	275	307	406	407	453	454
31	CR C 11	231	230	226	227	236	236	235	271	275	307	406	407	453	454
32	CR C 12	230	230	226	227	236	236	235	271	275	306	405	406	453	454

To		46	47	48	49	50	51	52	53	54	55	56	57	58	59
From		LP C 1	LP C 2	LP C 3	LP C 4	PH B 1	PH C 1	PH C 2	PH C 3	PH C 4	UD B 1	PL D 1	PL B 1	PL B 2	PL B 3
3 3	CR C 13	232	231	227	228	237	237	236	272	276	307	406	408	454	455
3 4	CR C 14	258	258	254	255	264	264	263	298	303	334	433	434	481	482
3 5	PY D 1	135	134	130	135	140	140	139	175	175	211	310	311	357	358
3 6	PY B 1	139	138	134	139	144	144	143	179	183	215	314	315	361	362
3 7	PY B 2	139	138	134	139	145	144	143	179	183	215	314	315	361	362
3 8	PY C 1	114	113	107	110	180	180	179	172	170	247	372	374	371	372
3 9	PY C 2	114	114	108	110	179	179	178	173	171	249	373	375	372	373
4 0	PY C 3	114	113	108	110	180	179	179	172	170	248	372	375	371	372
4 1	PY C 4	134	134	130	134	140	140	139	174	178	210	309	310	356	357
4 2	PY C 5	120	119	115	120	126	125	125	160	164	196	295	296	342	343
4 3	PY C 6	122	121	117	122	127	127	126	162	166	197	296	298	344	345
4 4	LP B 1	1.2	1.9	4.3	6.5	107	107	108	69.2	67	144	269	272	268	269
4 5	LP B 2	2.1	1.6	4	6.2	108	108	109	70	67.8	145	270	272	269	270
4 6	LP C 1		1.3	3.7	4.2	107	107	108	69.2	67	144	269	272	268	269
4 7	LP C 2	1.3		2.7	4.7	109	108	109	70.5	68.3	146	271	273	269	270
4 8	LP C 3	3.8	2.9		5.5	102	101	102	63.4	61.2	139	263	266	262	263
4 9	LP C 4	4.9	4.6	5.4		107	107	108	68.8	66.6	144	269	271	268	269
5 0	PH B 1	108	109	102	107		1.6	1.1	38.6	42.7	72.1	171	172	218	219
5 1	PH C 1	108	108	101	107	1.5		1.7	37.8	42	72.8	172	173	219	220
5 2	PH C 2	109	109	102	108	1.1	1.7		38.9	43.1	72.5	172	173	219	220
5 3	PH C 3	69.8	70.5	63.4	68.9	38.1	37.8	38.9		4.2	93.1	218	220	217	218
5 4	PH C 4	67.7	68.4	61.3	66.8	40.3	40	41.1	2.2		91.1	216	218	215	216
5 5	UD B 1	146	147	140	145	74	74.1	73.7	94.8	92.6		104	105	104	105
5 6	PL D 1	267	268	261	266	179	180	179	216	213	104		2.8	2.5	2.5
5 7	PL B 1	269	270	262	268	182	182	181	217	215	107	1.9		4.3	3.4
5 8	PL B 2	266	267	260	266	179	179	179	215	213	104	1.2	3.5		1.9
5 9	PL B 3	267	268	260	266	180	180	179	215	213	105	1.5	4.2	0.8	

Table A-2 Current fleet information

No.	License Plate	Wheels	Baskets	Capacity (Baht)	Fuel Consumption (km/l)
1	4339	4	87	46,400	8.39
2	4846	4	87	46,400	8.39
3	6062	4	87	46,400	8.39
4	6945	4	87	46,400	8.39
5	6964	4	87	46,400	8.39
6	7726	4	87	46,400	8.39
7	9749	4	156	83,200	8.39
8	7904	6	273	145,600	5.3
9	3498	6	273	145,600	5.3
10	6428	6	280	149,333	5.3
11	4572	6	351	187,200	5.3
12	8331	6	378	201,600	5.3
13	8967	6	378	201,600	5.3
14	4956	6	378	201,600	5.3
15	6862	6	378	201,600	5.3
16	5643	6	600	320,000	4.75
17	9302	6	752	401,067	4.37

Table A-5 Average capacity and fuel consumption for calculation

Vehicle Type	Capacity	Fuel Consumption
4 Wheels truck (Pick-up)	46,400	8.39
6 Wheels truck (Medium)	83,200	5.3
6 Wheels truck (Large)	215,520	4.56



APPENDIX B

Calculation Results Table

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Table B-1: The results of the GA parameter experimental.

Mutation rate	0.05								
Crossover rate	0.6			0.7			0.8		
Population	180	270	360	180	270	360	180	270	360
Minimum	427,975	418,818	428,457	433,282	428,349	429,891	430,842	428,461	427,671
1	475,475	458,556	468,886	435,259	465,919	469,996	489,553	478,240	493,002
2	438,691	423,419	431,584	473,646	434,196	468,714	437,586	467,917	548,303
3	478,964	420,454	431,187	475,422	433,953	468,714	467,399	471,913	506,001
4	474,020	420,352	428,459	471,760	465,080	504,705	438,853	471,980	505,569
5	479,041	424,203	469,754	438,050	429,407	467,825	468,381	439,681	506,075
6	510,543	459,748	428,727	474,319	431,867	468,953	468,997	485,199	475,397
7	474,098	426,808	432,211	472,806	472,749	506,702	468,306	468,774	507,368
8	436,659	456,215	467,810	472,516	469,468	469,745	472,232	470,346	427,671
9	427,975	462,993	479,112	436,598	431,574	507,132	468,825	435,105	507,651
10	473,877	459,809	478,544	438,140	467,777	508,076	433,593	469,582	468,318
11	439,247	458,365	470,094	474,937	467,335	511,626	468,393	469,079	507,604
12	437,744	418,818	430,395	469,607	428,349	511,412	467,440	468,756	466,556
13	494,402	424,494	430,587	438,567	482,210	507,934	476,452	431,873	467,183
14	440,877	501,079	482,632	436,706	436,403	471,314	437,046	473,173	506,537
15	493,804	457,979	437,177	476,044	468,297	471,665	475,292	437,853	468,574
16	440,233	457,767	432,250	484,505	470,088	510,768	430,842	467,888	467,509
17	512,316	458,837	428,457	436,703	436,425	469,330	466,952	504,891	468,805
18	475,532	456,046	431,942	435,951	470,321	471,193	469,181	467,117	503,862
19	475,439	427,239	468,135	433,282	468,764	507,806	469,623	470,919	528,697

Mutation rate	0.05								
Crossover rate	0.6			0.7			0.8		
Population	180	270	360	180	270	360	180	270	360
20	445,405	471,033	428,670	470,102	434,886	507,323	435,244	469,432	466,227
21	475,603	457,606	469,189	437,475	439,074	467,606	481,226	441,060	510,551
22	473,290	425,613	467,320	436,068	464,216	468,335	466,509	433,937	469,106
23	436,608	422,692	467,959	435,830	475,914	429,891	466,614	439,254	469,343
24	494,328	458,588	464,882	469,389	432,260	473,765	472,057	474,459	510,626
25	470,421	422,441	431,187	436,202	433,723	471,204	473,161	432,974	506,985
26	474,558	471,934	469,024	436,715	469,526	470,153	433,094	434,303	465,028
27	441,146	425,518	467,952	473,066	466,619	511,431	438,636	469,890	465,608
28	438,316	422,695	434,895	473,924	432,013	521,132	432,043	428,461	504,941
29	477,121	457,517	433,966	472,618	430,431	508,318	468,309	468,148	471,847
30	472,303	457,747	466,283	471,877	433,915	507,077	466,171	469,962	505,131

Table B-2 Calculation table of current route

No.	Ci	Place	Demand	Out Depot	Ci	In Depot	Cut	Group	Cum.
				Distance	Distance	Distance	Demand		Distance
1	1	CM PN							
2	6	CM B 5	47433.93	2.7	2.7	1.1	47433.93	1	5.10
3	8	CM B 7	2980.63	3.9	2.4	3.2	50414.57	1	7.90
4	7	CM B 6	25145.43	4.1	2.8	5	75560.00	1	11.90
5	9	CM C 1	8013.87	4.7	4.0	6.6	83573.87	1	19.00
6	2	CM B 1	50874.07	7.6	7.1	7.1	134447.94	1	24.20
7	3	CM B 2	46783.57	13.1	5.2	12.8	181231.51	1	58.10
8	11	CM C 3	12254.94	21.1	8.1	18.9	12254.94	2	82.30
9	5	CM B 4	16037.70	5.4	24.2	5.5	28292.64	2	96.60
10	4	CM B 3	32450.03	8.8	3.8	8	32450.03	3	104.30
11	10	CM C 2	4912.41	13.2	7.7	13.1	37362.44	3	194.10
12	24	CR C 4	1544.22	94.0	89.8	93.2	38906.66	3	382.40
13	25	CR C 5	813.20	95.1	1.1	94.2	813.20	4	383.50
14	23	CR C 3	980.17	94.0	1.1	93.2	1793.37	4	383.85
15	22	CR C 2	582.50	93.7	0.4	92.8	2375.87	4	399.95
16	26	CR C 6	5300.50	110.0	16.1	109	7676.37	4	620.95
17	28	CR C 8	1757.60	112.0	2.3	111	1757.60	5	620.95
18	27	CR C 7	2183.40	112.0	0.0	111	3941.00	5	641.75
19	29	CR C 9	255.09	133.0	20.8	132	4196.09	5	969.75
20	18	CR B 2	55295.56	196.0	62.9	196	55295.56	6	1362.75
21	17	CR B 1	60270.27	197.0	1.0	196	60270.27	7	1757.75
22	30	CR C 10	8798.75	199.0	4.1	198	8798.75	8	1759.45
23	31	CR C 11	4685.50	198.0	1.7	198	13484.25	8	1760.75
24	32	CR C 12	14054.98	198.0	1.3	197	27539.23	8	2156.75
25	33	CR C 13	24792.17	199.0	1.5	199	24792.17	9	2188.25
26	34	CR C 14	33349.89	226.0	31.5	225	58142.06	9	2396.25

No.	Ci	Place	Demand	Out Depot	Ci	In Depot	Cut	Group	Cum.
				Distance	Distance	Distance	Demand		Distance
27	21	CR C 1	392.22	19.1	208.0	21.1	58534.28	9	2643.35
28	19	CR B 3	28125.97	226.0	207.0	225	28125.97	10	2674.35
29	20	CR B 4	45818.45	256.0	31.0	257	73944.42	10	2793.35
30	12	CM C 4	21493.96	146.0	119.0	174	95438.38	10	2922.35
31	38	PY C 1	2500.73	110.0	129.0	110	97939.11	10	2923.10
32	39	PY C 2	1675.00	111.0	0.8	110	99614.11	10	2923.60
33	40	PY C 3	109.26	110.0	0.5	109	99723.37	10	2974.80
34	41	PY C 4	9544.03	161.0	51.2	161	109267.40	10	3298.80
35	35	PY D 1	44176.90	163.0	2.0	162	44176.90	11	3303.20
36	36	PY B 1	25024.78	166.0	4.4	166	69201.67	11	3304.90
37	37	PY B 2	28928.20	167.0	1.7	166	98129.87	11	3323.80
38	42	PY C 5	5737.49	164.0	18.9	164	103867.37	11	3331.10
39	43	PY C 6	6461.15	159.0	7.3	158	110328.51	11	3518.00
40	15	LA B 3	40220.27	28.9	170.0	27.8	40220.27	12	3527.00
41	13	LA B 1	76021.73	32.6	9.0	31.7	116242.00	12	3527.18
42	14	LA B 2	15391.37	32.8	0.2	31.8	131633.37	12	3528.18
43	16	LA C 1	539.01	33.8	1.0	32.8	132172.38	12	3659.68
44	49	LPC 4	9175.80	98.7	71.7	99.6	9175.80	13	3664.28
45	47	LPC 2	19217.65	102.0	4.6	101	28393.45	13	3665.58
46	46	LPC 1	9903.16	100.0	1.3	99.4	38296.61	13	3666.48
47	44	LP B 1	81289.02	101.0	0.9	100	119585.63	13	3668.78
48	45	LP B 2	18345.43	103.0	2.3	101	137931.06	13	3672.78
49	48	LPC 3	8677.94	105.0	4.0	104	146609.00	13	3941.78
50	53	PH C 3	4179.00	165.0	63.4	164	4179.00	14	3945.98
51	54	PH C 4	383.83	163.0	4.2	162	4562.83	14	3985.98
52	51	PH C 1	52003.83	203.0	40.0	202	56566.66	14	3987.48
53	50	PH B 1	45232.46	203.0	1.5	203	101799.12	14	3988.58
54	52	PH C 2	16861.90	204.0	1.1	203	118661.02	14	4431.58

No.	Ci	Place	Demand	Out Depot	Ci	In Depot	Cut	Group	Cum.
				Distance	Distance	Distance	Demand		Distance
55	55	UD B 1	56833.78	240.0	72.5	241	56833.78	15	4535.58
56	58	PL B 2	11194.53	364.0	104.0	361	68028.31	15	5261.58
57	59	PL B 3	12270.23	365.0	1.9	361	12270.23	16	5987.58
58	56	PL D 1	222454.18	365.0	1.5	361	222454.18	17	5990.38
59	57	PL B 1	21874.10	367.0	2.8	363	244328.28	17	6353.38

Table B-3: Calculation table of VRP without crossdocking system.

C i	Place	Place Name	Demand	Cut					Cut					Cut				
				V1	Demand	V1	V1	Distance	V2	Demand	V2	V2	Distance	V3	Demand	V3	V3	Distance
1	CM PN	Distribution Center, Chiang Mai			51657					179267					360533			
5	CM B 4	Big-C X-tra, Chiang Mai	16038	0	0	1	0	0.0	1	163229	1	1	16.4	0	0	1	0	0.0
8	CM B 7	Som Prech Market, Chiang Mai	2981	0	0	1	0	0.0	1	160248	1	1	20.6	0	0	1	0	0.0
2	CM B 1	Central Airport Plaza, Chiang Mai	50874	0	0	1	0	0.0	1	109374	1	1	33.9	0	0	1	0	0.0
1 1	CM C 3	Big-C X-tra North Chiang Mai U.	12255	0	0	1	0	0.0	1	97119	1	1	50.1	0	0	1	0	0.0
9	CM C 1	Behind CMU	8014	0	0	1	0	0.0	1	89105	1	1	53.9	0	0	1	0	0.0
7	CM B 6	Central Kad Suan Kheaw	25145	0	0	1	0	0.0	1	63960	1	1	250.9	0	0	1	0	0.0
1 8	CR B 2	Central Plaza, Chiang Rai	55296	0	0	2	0	0.0	1	8664	1	1	446.9	0	0	1	0	0.0
4 1	PY C 4	Mae Tum, Phayao	9544	1	42113	1	1	165.2	0	0	1	1	446.9	0	0	1	0	0.0
3 6	PY B 1	Charoen Pun Department Store, Phayao	25025	1	17088	1	1	238.9	0	0	1	1	446.9	0	0	1	0	0.0
2 5	CR C 5	Kru Noom, Mae Kha Chan	813	1	16275	1	1	255.8	0	0	1	1	446.9	0	0	1	0	0.0
2 6	CR C 6	K.Larh, Vieng Pa Pao Hospital	5301	1	10975	1	1	271.6	0	0	1	1	446.9	0	0	1	0	0.0
2 4	CR C 4	Group of Mae Kha Chan's Customers	1544	1	9430	1	1	271.7	0	0	1	1	446.9	0	0	1	0	0.0
2 3	CR C 3	K.Phung, Mae Kha Chan	980	1	8450	1	1	310.5	0	0	1	1	446.9	0	0	1	0	0.0
2 9	CR C 9	Moo Hao Chalearn	255	1	8195	1	1	331.3	0	0	1	1	446.9	0	0	1	0	0.0
2 7	CR C 7	K.Sasitorn, Vieng Pa Pao	2183	1	6012	1	1	331.3	0	0	1	1	446.9	0	0	1	0	0.0
2 8	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	1758	1	4254	1	1	442.3	0	0	1	1	446.9	0	0	1	0	0.0
6	CM	Tesco Lotus, Kam	47434	1	4223	1	1	452.2	0	0	1	1	446.9	0	0	1	0	0.0

C i	Place	Place Name	Demand	Cut					Trip					Group					Cum.				
				V1	Demand	V1	V1	Distance	V2	Demand	V2	V2	Distance	V3	Demand	V3	V3	Distance					
	B 5	Thieng																					
4	CM B 3	Big-C Supercenter, Chiang Mai	32450	1	19207	1	2	459.9	0	0	1	1	446.9	0	0	1	0	0.0					
1 0	CM C 2	Boar Sang, Chiang Mai	4912	1	14295	1	2	474.7	0	0	1	1	446.9	0	0	1	0	0.0					
2 1	CR C 1	Bangchak Gas Staion, Doi Sa Ked	392	1	13902	1	2	506.8	0	0	1	1	446.9	0	0	1	0	0.0					
3	CM B 2	Big-C Supercenter, Hang Dong	46784	1	4874	1	2	519.6	0	0	1	1	446.9	0	0	1	0	0.0					
3 1	CR C 11	K.Oa, Chiang Rai	4686	0	0	1	2	519.6	1	174581	1	2	646.2	0	0	1	0	0.0					
3 2	CR C 12	K.Sripun, Chiang Rai	14055	0	0	1	2	519.6	1	160526	1	2	647.7	0	0	1	0	0.0					
3 3	CR C 13	K.Oranuch , San Khong Chiang Rai	24792	0	0	1	2	519.6	1	135734	1	2	651.4	0	0	1	0	0.0					
3 0	CR C 10	K.Rung, Chiang Rai	8799	0	0	1	2	519.6	1	126935	1	2	679.3	0	0	1	0	0.0					
1 9	CR B 3	Tesco Lotus, Mae Chan	28126	0	0	1	2	519.6	1	98809	1	2	679.4	0	0	1	0	0.0					
3 4	CR C 14	K.Srila Yanisa, Chiang Sand	33350	0	0	1	2	519.6	1	65459	1	2	710.3	0	0	1	0	0.0					
2 0	CR B 4	Tesco Lotus, Mae Sai	45818	0	0	1	2	519.6	1	19641	1	2	1113.3	0	0	1	0	0.0					
1 2	CM C 4	Tesco Lotus, Fang	21494	0	0	1	2	519.6	1	157773	1	3	1242.3	0	0	1	0	0.0					
3 9	PY C 2	K.Tadsanee, Wangnuea	1675	0	0	1	2	519.6	1	156098	1	3	1242.8	0	0	1	0	0.0					
4 0	PY C 3	K.Wilaiwan, Wangnuea	109	0	0	1	2	519.6	1	155988	1	3	1259.4	0	0	1	0	0.0					
2 2	CR C 2	Kru Tuu, Transportation Station Mae Kha Chan	583	0	0	1	2	519.6	1	155406	1	3	1362.4	0	0	1	0	0.0					
1 7	CR B 1	Big-C Supercenter, Chiang Rai	60270	0	0	2	2	519.6	1	95136	1	3	1456.4	0	0	1	0	0.0					
3 5	PY D 1	Distribution Center, Phayao	44177	0	0	1	2	519.6	1	50959	1	3	1461.7	0	0	1	0	0.0					
3 7	PY B 2	Tesco Lotus, Phayao	28928	0	0	1	2	519.6	1	22031	1	3	1519.9	0	0	1	0	0.0					
3 8	PY C 1	K.Nay, Wangnuea	2501	0	0	1	2	519.6	1	19530	1	3	1574.2	0	0	1	0	0.0					

C i	Place	Place Name	Demand	Cut					Trip					Group					Cum.				
				V1	Demand	V1	V1	Distance	V2	Demand	V2	V2	Distance	V3	Demand	V3	V3	Distance					
4 2	PY C 5	K.Noï, Phayao University	5737	0	0	1	2	519.6	1	13792	1	3	1581.5	0	0	1	0	0.0					
4 3	PY C 6	Tom mart, Phayao University	6461	0	0	1	2	519.6	1	7331	1	3	1768.4	0	0	1	0	0.0					
1 5	LA B 3	Big-C Supercenter, Lamphun	40220	0	0	1	2	519.6	1	139046	1	4	1842.7	0	0	1	0	0.0					
4 4	LP B 1	Big-C Supercenter, Lampang	81289	0	0	2	2	519.6	1	57757	1	4	1915.9	0	0	1	0	0.0					
1 4	LA B 2	Jam Fah Plaza, Lamphun	15391	0	0	1	2	519.6	1	42366	1	4	1916.9	0	0	1	0	0.0					
1 6	LA C 1	Suan Bunyo Phatum School	539	0	0	1	2	519.6	1	41827	1	4	1982.3	0	0	1	0	0.0					
1 3	LA B 1	Wholesale, Lamphun	76022	0	0	2	2	519.6	1	103245	1	5	2056.9	0	0	1	0	0.0					
4 7	LP C 2	K.Nittaya, Lampang	19218	0	0	1	2	519.6	1	84027	1	5	2058.2	0	0	1	0	0.0					
4 6	LP C 1	K.Berm, Lampang	9903	0	0	1	2	519.6	1	74124	1	5	2062.4	0	0	1	0	0.0					
4 9	LP C 4	K.Sunan, Nam Tong Market, Lampang	9176	0	0	1	2	519.6	1	64948	1	5	2069.3	0	0	1	0	0.0					
4 5	LP B 2	Tesco Lotus, Lampang	18345	0	0	1	2	519.6	1	46603	1	5	2073.3	0	0	1	0	0.0					
4 8	LP C 3	K.Narong, Pang Ma-O Lampang	8678	0	0	1	2	519.6	1	37925	1	5	2136.7	0	0	1	0	0.0					
5 3	PH C 3	K.Kanlaya, Phrae	4179	0	0	1	2	519.6	1	33746	1	5	2140.9	0	0	1	0	0.0					
5 4	PH C 4	K.Suweena., Phrae Hospital	384	0	0	1	2	519.6	1	33362	1	5	2505.9	0	0	1	0	0.0					
5 1	PH C 1	Mark Four Plaza, Phrae	52004	0	0	2	2	519.6	1	127263	1	6	2507.4	0	0	1	0	0.0					
5 0	PH B 1	Big-C Supercenter, Phrae	45232	0	0	1	2	519.6	1	82030	1	6	2508.5	0	0	1	0	0.0					
5 2	PH C 2	K.Ja-ded, Phrae	16862	0	0	1	2	519.6	1	65168	1	6	2711.5	0	0	1	0	0.0					
5 5	UD B 1	Friday Department Store, Uttaradit	56834	0	0	2	2	519.6	0	0	1	6	2711.5	1	303700	1	1	344.0					
5 8	PL B 2	Topland Plaza, Phitsanulok	11195	0	0	1	2	519.6	0	0	1	6	2711.5	1	292505	1	1	345.9					
5 5	PL B	Train Station,	12270	0	0	1	2	519.6	0	0	1	6	2711.5	1	280235	1	1	347.4					

C i	Place	Place Name	Demand	Cut				Trip				Group				Cum.			
				V1	Demand	V1	V1	Distance	V2	Demand	V2	V2	Distance	V3	Demand	V3	V3	Distance	
9	3	Phitsanulok																	
5 6	PL D 1	Distribution Center, Phitsanulok	222454	0	0	5	2	519.6	0	0	2	6	2711.5	1	57781	1	1	350.2	
5 7	PL B 1	Big-C Supercenter, Phitsanulok	21874	0	0	1	2	519.6	0	0	1	6	2711.5	1	35907	1	1	713.2	

Table B-4: Crossdock candidates

Rank	Code	Location Name
1	LA PNB	Beverage Factory, Lamphun
2	LA B 1	Wholesale, Lamphun
3	PY D 1	Distribution Center, Phayao
4	CM PN	Distribution Center, Chiang Mai
5	LP B 1	Big-C Supercenter, Lampang
6	PL D 1	Distribution Center, Phitsanulok
7	CM B 5	Tesco Lotus, Kam Thieng
8	CM B 2	Big-C Supercenter, Hang Dong
9	LA B 3	Big-C Supercenter, Lamphun
10	CM B 3	Big-C Supercenter, Chiang Mai
11	CR B 1	Big-C Supercenter, Chiang Rai
12	CM B 4	Big-C X-tra, Chiang Mai
13	PY B 2	Tesco Lotus, Phayao
14	LP B 2	Tesco Lotus, Lampang
15	CM B 1	Central Airport Plaza, Chiang Mai
16	LA B 2	Jam Fah Plaza, Lamphun
17	PH B 1	Big-C Supercenter, Phrae
18	PY B 1	Charoen Pun Department Store, Phayao
19	CM B 6	Central Kad Suan Kheaw
20	CR B 3	Tesco Lotus, Mae Chan
21	CR B 4	Tesco Lotus, Mae Sai
22	CR B 2	Central Plaza, Chiang Rai
23	CM B 7	Som Prech Market, Chiang Mai
24	UD B 1	Friday Department Store, Uttaradit
25	PL B 1	Big-C Supercenter, Phitsanulok
26	CR C 1	Bangchak Gas Station, Doi Sa Ked
27	CR C 4	Group of Mae Kha Chan's Customers
28	CR C 2	Kru Tuu, Transportation Station Mae Kha Chan
29	PL B 2	Topland Plaza, Phitsanulok
30	CM C 2	Boar Sang, Chiang Mai
31	CR C 3	K.Phung, Mae Kha Chan
32	CR C 5	Kru Noom, Mae Kha Chan
33	PY C 1	K.Nay, Wangnuea
34	PY C 2	K.Tadsanee, Wangnuea
35	LPC 2	K.Nittaya, Lampang
36	PY C 3	K.Wilaiwan, Wangnuea
37	CR C 6	K.Larh, Vieng Pa Pao Hospital
38	PL B 3	Train Station, Phitsanulok
39	CR C 7	K.Sasitorn, Vieng Pa Pao
40	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao
41	LPC 3	K.Narong, Pang Ma-O Lampang
42	LPC 1	K.Berm, Lampang

Rank	Code	Location Name
43	PY C 4	Mae Tum, Phayao
44	LP C 4	K.Sunan, Nam Tong Market, Lampang
45	LA C 1	Suan Bunyo Phatum School
46	CR C 9	Moo Hao Chalearn
47	CR C 13	K.Oranuch , San Khong Chiang Rai
48	CM C 1	Behind CMU
49	CR C 12	K.Sripun, Chiang Rai
50	PH C 2	K.Ja-ded, Phrae
51	PY C 6	Tom mart, Phayao University
52	CR C 10	K.Rung, Chiang Rai
53	CR C 11	K.Oa, Chiang Rai
54	PH C 3	K.Kanlaya, Phrae
55	CR C 14	K.Srila Yanisa, Chiang Sand
56	PH C 4	K.Suweena,, Phrae Hospital
57	CM C 3	Big-C X-tra North Chiang Mai U.
58	PH C 1	Mark Four Plaza, Phrae
59	PY C 5	K.Noi, Phayao University
60	CM C 4	Tesco Lotus, Fang

Table B-5: SAW of crossdock location selection

No.	CODE	C1	score	C2	score	C3	standardize	max 7	score	C4	standardize	max 7	score	C5	score	C6	score	Total Score	Rank
1	CM PN	7	0.81	7	0.27	1,423,018	0.40	2.78	0.54	7794	0.89	6.26	1.68	7	0.81	7	1.88	5.99	3
2	CM B 1	3	0.35	7	0.27	1,526,222	0.43	2.98	0.57	8058	0.86	6.05	1.63	3	0.35	7	1.88	5.05	14
3	CM B 2	5	0.58	7	0.27	1,403,507	0.39	2.74	0.53	8241	0.85	5.92	1.59	5	0.58	7	1.88	5.43	7
4	CM B 3	5	0.58	7	0.27	973,501	0.27	1.90	0.37	7757	0.90	6.28	1.69	5	0.58	7	1.88	5.37	9
5	CM B 4	5	0.58	7	0.27	481,131	0.13	0.94	0.18	7637	0.91	6.38	1.72	5	0.58	7	1.88	5.21	11
6	CM B 5	5	0.58	7	0.27	1,423,018	0.40	2.78	0.54	7753	0.90	6.29	1.69	5	0.58	7	1.88	5.54	6
7	CM B 6	3	0.35	7	0.27	754,363	0.21	1.48	0.28	7850	0.89	6.21	1.67	3	0.35	7	1.88	4.80	18
8	CM B 7	5	0.58	5	0.19	89,419	0.02	0.17	0.03	7704	0.90	6.33	1.70	1	0.12	7	1.88	4.51	22
9	CM C 1	5	0.58	5	0.19	240,416	0.07	0.47	0.09	8065	0.86	6.04	1.63	1	0.12	3	0.81	3.41	47
10	CM C 2	5	0.58	3	0.12	147,372	0.04	0.29	0.06	7650	0.91	6.37	1.72	1	0.12	5	1.35	3.93	29
11	CM C 3	5	0.58	7	0.27	367,648	0.10	0.72	0.14	8229	0.85	5.92	1.60	3	0.35	1	0.27	3.19	56
12	CM C 4	5	0.58	5	0.19	644,819	0.18	1.26	0.24	11820	0.59	4.12	1.11	3	0.35	1	0.27	2.74	59
13	LA B 1	7	0.81	7	0.27	2,280,652	0.64	4.46	0.86	8006	0.87	6.09	1.64	7	0.81	7	1.88	6.27	1
14	LA B 2	5	0.58	5	0.19	461,741	0.13	0.90	0.17	7998	0.87	6.10	1.64	5	0.58	7	1.88	5.05	15
15	LA B 3	5	0.58	7	0.27	1,206,608	0.34	2.36	0.45	7875	0.88	6.19	1.67	5	0.58	7	1.88	5.43	8
16	LA C 1	5	0.58	5	0.19	16,170	0.00	0.03	0.01	8042	0.87	6.06	1.63	3	0.35	3	0.81	3.56	44
17	CR B 1	5	0.58	7	0.27	1,808,108	0.51	3.54	0.68	10093	0.69	4.83	1.30	5	0.58	7	1.88	5.29	10
18	CR B 2	3	0.35	7	0.27	1,096,027	0.31	2.14	0.41	10107	0.69	4.82	1.30	3	0.35	7	1.88	4.56	21
19	CR B 3	5	0.58	5	0.19	843,779	0.24	1.65	0.32	11644	0.60	4.19	1.13	5	0.58	7	1.88	4.68	19
20	CR B 4	5	0.58	5	0.19	1,195,828	0.33	2.34	0.45	13526	0.51	3.60	0.97	5	0.58	7	1.88	4.65	20
21	CR C 1	5	0.58	3	0.12	11,767	0.00	0.02	0.00	7775	0.90	6.27	1.69	3	0.35	5	1.35	4.08	25
22	CR C 2	5	0.58	3	0.12	17,475	0.00	0.03	0.01	6977	1.00	6.99	1.88	1	0.12	5	1.35	4.04	27
23	CR C 3	3	0.35	3	0.12	29,405	0.01	0.06	0.01	6965	1.00	7.00	1.88	1	0.12	5	1.35	3.82	30
24	CR C 4	3	0.35	3	0.12	46,327	0.01	0.09	0.02	6969	1.00	7.00	1.88	3	0.35	5	1.35	4.05	26
25	CR C 5	3	0.35	3	0.12	24,396	0.01	0.05	0.01	7032	0.99	6.93	1.87	1	0.12	5	1.35	3.80	31
26	CR C 6	3	0.35	3	0.12	159,015	0.04	0.31	0.06	7414	0.94	6.58	1.77	1	0.12	5	1.35	3.75	36
27	CR C 7	3	0.35	3	0.12	65,502	0.02	0.13	0.02	7495	0.93	6.50	1.75	1	0.12	5	1.35	3.70	38
28	CR C 8	3	0.35	3	0.12	52,728	0.01	0.10	0.02	7495	0.93	6.50	1.75	1	0.12	5	1.35	3.69	39
29	CR C 9	3	0.35	3	0.12	7,653	0.00	0.01	0.00	8308	0.84	5.87	1.58	1	0.12	5	1.35	3.51	45

No.	CODE	C1	score	C2	score	C3	standardize	max 7	score	C4	standardize	max 7	score	C5	score	C6	score	Total Score	Rank
30	CR C 10	3	0.35	3	0.12	263,963	0.07	0.52	0.10	10192	0.68	4.78	1.29	1	0.12	5	1.35	3.31	51
31	CR C 11	3	0.35	3	0.12	140,565	0.04	0.27	0.05	10179	0.68	4.79	1.29	1	0.12	5	1.35	3.27	52
32	CR C 12	3	0.35	3	0.12	421,649	0.12	0.82	0.16	10170	0.68	4.79	1.29	1	0.12	5	1.35	3.37	48
33	CR C 13	3	0.35	3	0.12	743,765	0.21	1.45	0.28	10239	0.68	4.76	1.28	1	0.12	5	1.35	3.48	46
34	CR C 14	3	0.35	3	0.12	440,484	0.12	0.86	0.17	11642	0.60	4.19	1.13	1	0.12	5	1.35	3.22	54
35	PY D 1	7	0.81	7	0.27	2,236,367	0.62	4.37	0.84	8032	0.87	6.07	1.63	7	0.81	7	1.88	6.24	2
36	PY B 1	5	0.58	5	0.19	716,241	0.20	1.40	0.27	8192	0.85	5.95	1.60	3	0.35	7	1.88	4.87	17
37	PY B 2	5	0.58	5	0.19	867,846	0.24	1.70	0.33	8200	0.85	5.95	1.60	5	0.58	7	1.88	5.16	12
38	PY C 1	3	0.35	3	0.12	75,022	0.02	0.15	0.03	7114	0.98	6.85	1.84	1	0.12	5	1.35	3.80	32
39	PY C 2	3	0.35	3	0.12	50,250	0.01	0.10	0.02	7134	0.98	6.83	1.84	1	0.12	5	1.35	3.78	33
40	PY C 3	3	0.35	3	0.12	3,278	0.00	0.01	0.00	7113	0.98	6.85	1.85	1	0.12	5	1.35	3.77	35
41	PY C 4	3	0.35	3	0.12	286,321	0.08	0.56	0.11	8011	0.87	6.09	1.64	1	0.12	5	1.35	3.67	42
42	PY C 5	3	0.35	3	0.12	172,125	0.05	0.34	0.06	8050	0.87	6.06	1.63	1	0.12	3	0.81	3.08	58
43	PY C 6	3	0.35	3	0.12	193,834	0.05	0.38	0.07	7934	0.88	6.15	1.65	3	0.35	3	0.81	3.34	50
44	LP B 1	5	0.58	7	0.27	2,344,488	0.65	4.58	0.88	8030	0.87	6.07	1.63	5	0.58	7	1.88	5.82	4
45	LP B 2	5	0.58	7	0.27	550,363	0.15	1.08	0.21	8040	0.87	6.06	1.63	5	0.58	7	1.88	5.15	13
46	LP C 1	3	0.35	3	0.12	297,095	0.08	0.58	0.11	8024	0.87	6.08	1.64	1	0.12	5	1.35	3.67	41
47	LP C 2	3	0.35	3	0.12	576,529	0.16	1.13	0.22	8047	0.87	6.06	1.63	1	0.12	5	1.35	3.77	34
48	LP C 3	3	0.35	3	0.12	260,338	0.07	0.51	0.10	7931	0.88	6.15	1.66	1	0.12	5	1.35	3.68	40
49	LP C 4	3	0.35	3	0.12	275,274	0.08	0.54	0.10	8008	0.87	6.09	1.64	1	0.12	5	1.35	3.67	43
50	PH B 1	5	0.58	7	0.27	1,260,019	0.35	2.46	0.47	10616	0.66	4.59	1.24	5	0.58	7	1.88	5.02	16
51	PH C 1	3	0.35	5	0.19	477,197	0.13	0.93	0.18	10551	0.66	4.62	1.24	3	0.35	3	0.81	3.12	57
52	PH C 2	3	0.35	3	0.12	505,857	0.14	0.99	0.19	10599	0.66	4.60	1.24	1	0.12	5	1.35	3.35	49
53	PH C 3	3	0.35	3	0.12	85,796	0.02	0.17	0.03	10280	0.68	4.74	1.28	1	0.12	5	1.35	3.23	53
54	PH C 4	3	0.35	3	0.12	11,515	0.00	0.02	0.00	10232	0.68	4.76	1.28	1	0.12	5	1.35	3.21	55
55	UD B 1	5	0.58	5	0.19	1,066,102	0.30	2.08	0.40	13339	0.52	3.65	0.98	3	0.35	7	1.88	4.38	23
56	PL D 1	7	0.81	7	0.27	3,579,487	1.00	7.00	1.35	19480	0.36	2.50	0.67	7	0.81	7	1.88	5.79	5
57	PL B 1	5	0.58	7	0.27	656,223	0.18	1.28	0.25	19588	0.36	2.49	0.67	5	0.58	7	1.88	4.22	24
58	PL B 2	5	0.58	5	0.19	335,836	0.09	0.66	0.13	19453	0.36	2.51	0.67	5	0.58	7	1.88	4.03	28
59	PL B 3	5	0.58	3	0.12	368,107	0.10	0.72	0.14	19487	0.36	2.50	0.67	3	0.35	7	1.88	3.74	37

Table B-6: Calculation table of VRP 8 crossdocks

C i	Place	Place Name	Demand	Out Depot	Ci	In Depot	V 1	Cut	Rou nd	Gro up	Cum.	V 2	Cut	Rou nd	Gro up	Cum.	V 3	Cut	Rou nd	Gro up	Cum.	
				Distance	Distan ce	Distan ce		Dema nd	V1	V1	Distan ce		Dema nd	V2	V2	Distan ce		Dema nd	V3	V3	V3	Distan ce
1	CM PN	Distribution Center, Chiang Mai						51657					179267					360533				
2	LA B 1	Wholesale, Lamphun	132172	32.6	32.6	31.7	0	0	3	0	0.0	1	47094	1	1	429.3	0	0	1	0	0.0	
8	PL D 1	Distribution Center, Phitsanulok	267793	365.0	338.0	361.0	0	0	6	0	0.0	1	90740	2	3	533.3	0	0	1	0	0.0	
7	UD B 1	Friday Department Store, Uttaradit	56834	240.0	104.0	241.0	0	0	2	0	0.0	1	33907	1	3	977.3	0	0	1	0	0.0	
6	PH B 1	Big-C Supercenter, Phrae	118661	203.0	74.0	203.0	0	0	3	0	0.0	1	60606	1	4	1343.3	0	0	1	0	0.0	
4	PY D 1	Distribution Center, Phayao	137574	163.0	140.0	162.0	0	0	3	0	0.0	1	41692	1	5	1606.3	0	0	1	0	0.0	
5	LP B 1	Big-C Supercenter, Lampang	146609	101.0	135.0	100.0	0	0	3	0	0.0	1	32658	1	6	1706.3	0	0	1	0	0.0	
3	CR B 1	Big-C Supercenter, Chiang Rai	275192	197.0	0.0	196.0	0	0	6	0	0.0	0	0	2	6	1706.3	1	85342	1	1	196.0	

Table B-7: Calculation table of VRP 7 crossdocks

C i	Place	Place Name	Demand	Out Depot	Ci	In Depot	V 1	Cut	Rou nd	Gro up	Cum.	V 2	Cut	Rou nd	Gro up	Cum.	V 3	Cut	Rou nd	Gro up	Cum.	
				Distance	Distan ce	Distan ce		Dema nd	V1	V1	Distan ce		Dema nd	V2	V2	Distan ce		Dema nd	V3	V3	V3	Distan ce
1	CM PN	Distribution Center, Chiang Mai						51657					179267					360533				
2	LA B 1	Wholesale, Lamphun	132172	32.6	32.6	31.7	0	0	3	0	0.0	1	47094	1	1	267.3	0	0	1	0	0.0	
6	PH B 1	Big-C Supercenter, Phrae	175495	203.0	176.0	203.0	0	0	4	0	0.0	1	3772	1	2	633.3	0	0	1	0	0.0	
4	PY D 1	Distribution Center, Phayao	137574	163.0	140.0	162.0	0	0	3	0	0.0	1	41692	1	3	896.3	0	0	1	0	0.0	
5	LP B 1	Big-C Supercenter, Lampang	146609	101.0	135.0	100.0	0	0	3	0	0.0	1	32658	1	4	1193.3	0	0	1	0	0.0	
3	CR B 1	Big-C Supercenter, Chiang Rai	275192	197.0	228.0	196.0	0	0	6	0	0.0	1	83342	2	6	1389.3	0	0	1	0	0.0	
7	PL D 1	Distribution Center, Phitsanulok	267793	365.0	404.0	361.0	0	0	6	0	0.0	0	0	2	6	1389.3	1	92740	1	1	361.0	

Table B-8: Calculation table of VRP 6 crossdocks

C i	Place	Place Name	Demand	Out Depot	Ci	In Depot	V 1	Cut	Rou nd	Gro up	Cum.	V 2	Cut	Rou nd	Gro up	Cum.	V 3	Cut	Rou nd	Gro up	Cum.	
				Distance	Distan ce	Distan ce		Dema nd	V1	V1	Distan ce		Dema nd	V2	V2	Distan ce		Dema nd	V3	V3	Distan ce	
1	CM PN	Distribution Center, Chiang Mai						51657					17926 7					36053 3				
5	PH B 1	Big-C Supercenter, Phrae	175495	203.0	203.0	203.0	0	0	4	0	0.0	1	3772	1	1	569.0	0	0	1	0	0.0	
3	PY D 1	Distribution Center, Phayao	137574	163.0	140.0	162.0	0	0	3	0	0.0	1	41692	1	2	832.0	0	0	1	0	0.0	
4	LP B 1	Big-C Supercenter, Lampang	146609	101.0	135.0	100.0	0	0	3	0	0.0	1	32658	1	3	1129.0	0	0	1	0	0.0	
2	CR B 1	Big-C Supercenter, Chiang Rai	275192	197.0	228.0	196.0	0	0	6	0	0.0	1	83342	2	5	1325.0	0	0	1	0	0.0	
6	PL D 1	Distribution Center, Phitsanulok	267793	365.0	404.0	361.0	0	0	6	0	0.0	0	0	2	5	1325.0	1	92740	1	1	361.0	

Table B-9: Calculation table of VRP 5 crossdocks

C i	Place	Place Name	Demand	Out Depot	Ci	In Depot	V 1	Cut	Rou nd	Gro up	Cum.	V 2	Cut	Rou nd	Gro up	Cum.	V 3	Cut	Rou nd	Gro up	Cum.	
				Distance	Distan ce	Distan ce		Dema nd	V1	V1	Distan ce		Dema nd	V2	V2	Distan ce		Dema nd	V3	V3	Distan ce	
1	CM PN	Distribution Center, Chiang Mai						51657					17926 7					36053 3				
4	PH B 1	Big-C Supercenter, Phrae	175495	203.0	203.0	203.0	0	0	4	0	0.0	1	3772	1	1	507.0	0	0	1	0	0.0	
3	LP B 1	Big-C Supercenter, Lampang	146609	101.0	108.0	100.0	0	0	3	0	0.0	1	32658	1	2	607.0	0	0	1	0	0.0	
2	CR B 1	Big-C Supercenter, Chiang Rai	412766	197.0	228.0	196.0	0	0	8	0	0.0	0	0	3	2	607.0	1	30830 1	2	2	601.0	
5	PL D 1	Distribution Center, Phitsanulok	267793	365.0	404.0	361.0	0	0	6	0	0.0	0	0	2	2	607.0	1	40508	1	2	962.0	

Table B-10: Calculation table of VRP 4 crossdocks

C i	Place	Place Name	Demand	Out Depot	Ci	In Depot	V 1	Cut	Rou nd	Gro up	Cum.	V 2	Cut	Rou nd	Gro up	Cum.	V 3	Cut	Rou nd	Gro up	Cum.	
				Distance	Distan ce	Distan ce		Dema nd	V1	V1	Distan ce		Dema nd	V2	V2	Distan ce		Dema nd	V3	V3	Distan ce	
1	CM PN	Distribution Center, Chiang Mai						51657					17926 7					36053 3				
3	PH B 1	Big-C Supercenter, Phrae	322104	203.0	203.0	203.0	0	0	7	0	0.0	1	36430	2	2	812.0	0	0	1	0	0.0	
2	CR B 1	Big-C Supercenter, Chiang Rai	412766	197.0	234.0	196.0	0	0	8	0	0.0	0	0	3	2	812.0	1	30830 1	2	2	601.0	
4	PL D 1	Distribution Center, Phitsanulok	267793	365.0	404.0	361.0	0	0	6	0	0.0	0	0	2	2	812.0	1	40508	1	2	962.0	

Table B-11: Calculation table of VRP 3 crossdocks

C i	Place	Place Name	Demand	Out Depot	Ci	In Depot	V 1	Cut	Rou nd	Gro up	Cum.	V 2	Cut	Rou nd	Gro up	Cum.	V 3	Cut	Rou nd	Gro up	Cum.	
				Distance	Distan ce	Distan ce		Dema nd	V1	V1	Distan ce		Dema nd	V2	V2	Distan ce		Dema nd	V3	V3	Distan ce	
1	CM PN	Distribution Center, Chiang Mai						51657					17926 7					36053 3				
2	CR B 1	Big-C Supercenter, Chiang Rai	412766	197.0	197.0	196.0	0	0	8	0	0.0	1	12503 4	3	3	1179.0	0	0	2	0	0.0	
3	PH B 1	Big-C Supercenter, Phrae	589897	203.0	234.0	203.0	0	0	12	0	0.0	0	0	4	3	1179.0	1	13117 0	2	2	609.0	

Table B-12: VRP of 8 crossdocks to customers

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
1	CM PN	Distribution Center, Chiang Mai	268,773			Pick-up	459.2
1	CM B 1	Central Airport Plaza, Chiang Mai	50,874	7	2,981	1	11.6
2	CM B 2	Big-C Supercenter, Hang Dong	46,784	2	46,784	1	27.1
3	CM B 3	Big-C Supercenter, Chiang Mai	32,450	5	47,434	2	32.9
4	CM B 4	Big-C X-tra, Chiang Mai	16,038	8	8,014	3	49.6
5	CM B 5	Tesco Lotus, Kam Thieng	47,434	10	12,255	3	64.6
6	CM B 6	Central Kad Suan Kheaw	25,145	6	25,145	3	77.2
7	CM B 7	Som Prech Market, Chiang Mai	2,981	1	50,874	4	230.3
8	CM C 1	Behind CMU	8,014	11	21,494	5	401.3
9	CM C 2	Boar Sang, Chiang Mai	4,912	4	16,038	5	415.6
10	CM C 3	Big-C X-tra North Chiang Mai U.	12,255	3	32,450	6	423.3
11	CM C 4	Tesco Lotus, Fang	21,494	9	4,912	6	438.1
12	CR C 1	Bangchak Gas Staion, Doi Sa Ked	392	12	392	6	459.2
2	LA B 1	Wholesale, Lamphun	132,172			Pick-up	17.48
1	LA B 2	Jam Fah Plaza, Lamphun	15,391	2	40,220	1	15.1
2	LA B 3	Big-C Supercenter, Lamphun	40,220	1	15,391	2	16.28
3	LA C 1	Suan Bunyo Phatum School	539	3	539	2	17.48
3	PH B 1	Big-C Supercenter, Phrae	118,661			Pick-up	92.3
1	PH C 1	Mark Four Plaza, Phrae	52,004	2	16,862	1	44.2
2	PH C 2	K.Ja-ded, Phrae	16,862	4	384	1	46.4
3	PH C 3	K.Kanlaya, Phrae	4,179	3	4,179	1	86.1
4	PH C 4	K.Suweena,, Phrae Hospital	384	1	52,004	2	92.3
4	PL D 1	Distribution Center, Phitsanulok	267,793			Pick-up	8.2
1	PL B 1	Big-C Supercenter, Phitsanulok	21,874	1	21,874	1	6.2
2	PL B 2	Topland Plaza, Phitsanulok	11,195	3	12,270	1	7
3	PL B 3	Train Station, Phitsanulok	12,270	2	11,195	1	8.2
5	UD B 1	Friday Department Store, Uttaradit	56,834				

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
6	LP B 1	Big-C Supercenter, Lampang	146,609			Pick-up	22.9
1	LP B 2	Tesco Lotus, Lampang	18,345	2	9,903	1	2.5
2	LP C 1	K.Berm, Lampang	9,903	3	19,218	1	4.6
3	LP C 2	K.Nittaya, Lampang	19,218	1	18,345	1	11
4	LP C 3	K.Narong, Pang Ma-O Lampang	8,678	4	8,678	2	16.5
5	LP C 4	K.Sunan, Nam Tong Market, Lampang	9,176	5	9,176	2	22.9
7	PY D 1	Distribution Center, Phayao	137,574			Pick-up	272.35
1	PY B 1	Charoen Pun Department Store, Phayao	25,025	7	5,737	1	22.1
2	PY B 2	Tesco Lotus, Phayao	28,928	8	6,461	1	38.8
3	PY C 1	K.Nay, Wangnuea	2,501	6	9,544	1	43
4	PY C 2	K.Tadsanee, Wangnuea	1,675	1	25,025	1	52.4
5	PY C 3	K.Wilaiwan, Wangnuea	109	2	28,928	2	108.5
6	PY C 4	Mae Tum, Phayao	9,544	4	1,675	2	109
7	PY C 5	K.Noie, Phayao University	5,737	5	109	2	125.6
8	PY C 6	Tom mart, Phayao University	6,461	9	583	2	125.95
9	CR C 2	Kru Tuu, Transportation Station Mae Kha Chan	583	11	1,544	2	127.05
10	CR C 3	K.Phung, Mae Kha Chan	980	12	813	2	128.15
11	CR C 4	Group of Mae Kha Chan's Customers	1,544	10	980	2	166.95
12	CR C 5	Kru Noom, Mae Kha Chan	813	16	255	2	187.75
13	CR C 6	K.Larh, Vieng Pa Pao Hospital	5,301	15	1,758	2	187.75
14	CR C 7	K.Sasitorn, Vieng Pa Pao	2,183	14	2,183	2	190.05
15	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	1,758	13	5,301	2	218.95
16	CR C 9	Moo Hao Chalearn	255	3	2,501	2	272.35
8	CR B 1	Big-C Supercenter, Chiang Rai	275,192			Medium	131.054
1	CR B 2	Central Plaza, Chiang Rai	55,296	7	24,792	1	6.4
2	CR B 3	Tesco Lotus, Mae Chan	28,126	6	14,055	1	7.4
3	CR B 4	Tesco Lotus, Mae Sai	45,818	5	4,686	1	66.4
4	CR C 10	K.Rung, Chiang Rai	8,799	3	45818.5	1	98.3
5	CR C 11	K.Oa, Chiang Rai	4,686	2	28126	1	98.354

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
6	CR C 12	K.Sripun, Chiang Rai	14,055	8	33349.9	1	125.954
7	CR C 13	K.Oranuch , San Khong Chiang Rai	24,792	4	8798.75	1	130.054
8	CR C 14	K.Srila Yanisa, Chiang Sand	33,350	1	55295.6	2	131.054

Table B-13: VRP of 7 crossdocks to customers

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
1	CM PN	Distribution Center, Chiang Mai	268,773			Pick-up	459.2
1	CM B 1	Central Airport Plaza, Chiang Mai	50,874	7	2,981	1	11.6
2	CM B 2	Big-C Supercenter, Hang Dong	46,784	2	46,784	1	27.1
3	CM B 3	Big-C Supercenter, Chiang Mai	32,450	5	47,434	2	32.9
4	CM B 4	Big-C X-tra, Chiang Mai	16,038	8	8,014	3	49.6
5	CM B 5	Tesco Lotus, Kam Thieng	47,434	10	12,255	3	64.6
6	CM B 6	Central Kad Suan Kheaw	25,145	6	25,145	3	77.2
7	CM B 7	Som Prech Market, Chiang Mai	2,981	1	50,874	4	230.3
8	CM C 1	Behind CMU	8,014	11	21,494	5	401.3
9	CM C 2	Boar Sang, Chiang Mai	4,912	4	16,038	5	415.6
10	CM C 3	Big-C X-tra North Chiang Mai U.	12,255	3	32,450	6	423.3
11	CM C 4	Tesco Lotus, Fang	21,494	9	4,912	6	438.1
12	CR C 1	Bangchak Gas Staion, Doi Sa Ked	392	12	392	6	459.2
2	LA B 1	Wholesale, Lamphun	132,172			Pick-up	17.48
1	LA B 2	Jam Fah Plaza, Lamphun	15,391	2	40,220	1	15.1
2	LA B 3	Big-C Supercenter, Lamphun	40,220	1	15,391	2	16.28
3	LA C 1	Suan Bunyo Phatum School	539	3	539	2	17.48
3	PH B 1	Big-C Supercenter, Phrae	118,661			Medium	212.1
1	PH C 1	Mark Four Plaza, Phrae	52,004	2	16,862	1	2.8
2	PH C 2	K.Ja-ded, Phrae	16,862	1	52,004	1	44.8
3	PH C 3	K.Kanlaya, Phrae	4,179	4	384	1	47
4	PH C 4	K.Suweena,, Phrae Hospital	384	3	4,179	1	138.1

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
5	UD B 1	Friday Department Store, Uttaradit	56,834	5	56,834	1	212.1
4	PL D 1	Distribution Center, Phitsanulok	267,793			Pick-up	8.2
1	PL B 1	Big-C Supercenter, Phitsanulok	21,874	1	21,874	1	6.2
2	PL B 2	Topland Plaza, Phitsanulok	11,195	3	12,270	1	7
3	PL B 3	Train Station, Phitsanulok	12,270	2	11,195	1	8.2
5	LP B 1	Big-C Supercenter, Lampang	146,609			Pick-up	22.9
1	LP B 2	Tesco Lotus, Lampang	18,345	2	9,903	1	2.5
2	LP C 1	K.Berm, Lampang	9,903	3	19,218	1	4.6
3	LP C 2	K.Nittaya, Lampang	19,218	1	18,345	1	11
4	LP C 3	K.Narong, Pang Ma-O Lampang	8,678	4	8,678	2	16.5
5	LP C 4	K.Sunan, Nam Tong Market, Lampang	9,176	5	9,176	2	22.9
6	PY D 1	Distribution Center, Phayao	137,574			Pick-up	272.35
1	PY B 1	Charoen Pun Department Store, Phayao	25,025	7	5,737	1	22.1
2	PY B 2	Tesco Lotus, Phayao	28,928	8	6,461	1	38.8
3	PY C 1	K.Nay, Wangnuea	2,501	6	9,544	1	43
4	PY C 2	K.Tadsanee, Wangnuea	1,675	1	25,025	1	52.4
5	PY C 3	K.Wilaiwan, Wangnuea	109	2	28,928	2	108.5
6	PY C 4	Mae Tum, Phayao	9,544	4	1,675	2	109
7	PY C 5	K.Noï, Phayao University	5,737	5	109	2	125.6
8	PY C 6	Tom mart, Phayao University	6,461	9	583	2	125.95
9	CR C 2	Kru Tuu, Transportation Station Mae Kha Chan	583	11	1,544	2	127.05
10	CR C 3	K.Phung, Mae Kha Chan	980	12	813	2	128.15
11	CR C 4	Group of Mae Kha Chan's Customers	1,544	10	980	2	166.95
12	CR C 5	Kru Noom, Mae Kha Chan	813	16	255	2	187.75
13	CR C 6	K.Larh, Vieng Pa Pao Hospital	5,301	15	1,758	2	187.75
14	CR C 7	K.Sasitorn, Vieng Pa Pao	2,183	14	2,183	2	190.05
15	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	1,758	13	5,301	2	218.95
16	CR C 9	Moo Hao Chalearn	255	3	2,501	2	272.35
7	CR B 1	Big-C Supercenter, Chiang Rai	275,192			Medium	131.054

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
1	CR B 2	Central Plaza, Chiang Rai	55,296	7	24,792	1	6.4
2	CR B 3	Tesco Lotus, Mae Chan	28,126	6	14,055	1	7.4
3	CR B 4	Tesco Lotus, Mae Sai	45,818	5	4,686	1	66.4
4	CR C 10	K.Rung, Chiang Rai	8,799	3	45818.45083	1	98.3
5	CR C 11	K.Oa, Chiang Rai	4,686	2	28125.96667	1	98.354
6	CR C 12	K.Sripun, Chiang Rai	14,055	8	33349.88717	1	125.954
7	CR C 13	K.Oranuch , San Khong Chiang Rai	24,792	4	8798.75	1	130.054
8	CR C 14	K.Srila Yanisa, Chiang Sand	33,350	1	55295.5575	2	131.054

Table B-14: VRP of 6 crossdocks to customers

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
1	CM PN	Distribution Center, Chiang Mai	268,773			Medium	485
1	CM B 1	Central Airport Plaza, Chiang Mai	50,874	7	2,981	1	10
2	CM B 2	Big-C Supercenter, Hang Dong	46,784	3	32,450	1	21
3	CM B 3	Big-C Supercenter, Chiang Mai	32,450	2	46,784	1	29
4	CM B 4	Big-C X-tra, Chiang Mai	16,038	10	12,255	1	41
5	CM B 5	Tesco Lotus, Kam Thieng	47,434	1	50,874	1	45
6	CM B 6	Central Kad Suan Kheaw	25,145	8	8,014	1	49
7	CM B 7	Som Prech Market, Chiang Mai	2,981	6	25,145	1	60
8	CM C 1	Behind CMU	8,014	4	16,038	2	75
9	CM C 2	Boar Sang, Chiang Mai	4,912	12	392	2	98
10	CM C 3	Big-C X-tra North Chiang Mai U.	12,255	9	4,912	2	126
11	CM C 4	Tesco Lotus, Fang	21,494	16	539	2	127
12	CR C 1	Bangchak Gas Staion, Doi Sa Ked	392	14	15,391	2	127
13	LA B 1	Wholesale, Lamphun	76,022	13	76,022	2	133
14	LA B 2	Jam Fah Plaza, Lamphun	15,391	15	40,220	2	163
15	LA B 3	Big-C Supercenter, Lamphun	40,220	5	47,434	3	311
16	LA C 1	Suan Bunyo Phatum School	539	11	21,494	3	485

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
2	PH B 1	Big-C Supercenter, Phrae	118,661			Medium	212
1	PH C 1	Mark Four Plaza, Phrae	52,004	2	16,862	1	3
2	PH C 2	K.Ja-ded, Phrae	16,862	1	52,004	1	45
3	PH C 3	K.Kanlaya, Phrae	4,179	4	384	1	47
4	PH C 4	K.Suweena,, Phrae Hospital	384	3	4,179	1	138
5	UD B 1	Friday Department Store, Uttaradit	56,834	5	56,834	1	212
3	PL D 1	Distribution Center, Phitsanulok	267,793			Pick-up	8
1	PL B 1	Big-C Supercenter, Phitsanulok	21,874	1	21,874	1	6
2	PL B 2	Topland Plaza, Phitsanulok	11,195	3	12,270	1	7
3	PL B 3	Train Station, Phitsanulok	12,270	2	11,195	1	8
4	LP B 1	Big-C Supercenter, Lampang	146,609			Pick-up	23
1	LP B 2	Tesco Lotus, Lampang	18,345	2	9,903	1	3
2	LP C 1	K.Berm, Lampang	9,903	3	19,218	1	5
3	LP C 2	K.Nittaya, Lampang	19,218	1	18,345	1	11
4	LP C 3	K.Narong, Pang Ma-O Lampang	8,678	4	8,678	2	17
5	LP C 4	K.Sunan, Nam Tong Market, Lampang	9,176	5	9,176	2	23
5	PY D 1	Distribution Center, Phayao	137,574			Pick-up	272
1	PY B 1	Charoen Pun Department Store, Phayao	25,025	7	5,737	1	22
2	PY B 2	Tesco Lotus, Phayao	28,928	8	6,461	1	39
3	PY C 1	K.Nay, Wangnuea	2,501	6	9,544	1	43
4	PY C 2	K.Tadsanee, Wangnuea	1,675	1	25,025	1	52
5	PY C 3	K.Wilaiwan, Wangnuea	109	2	28,928	2	109
6	PY C 4	Mae Tum, Phayao	9,544	4	1,675	2	109
7	PY C 5	K.Noï, Phayao University	5,737	5	109	2	126
8	PY C 6	Tom mart, Phayao University	6,461	9	583	2	126
9	CR C 2	Kru Tuu, Transportation Station Mae Kha Chan	583	11	1,544	2	127
10	CR C 3	K.Phung, Mae Kha Chan	980	12	813	2	128
11	CR C 4	Group of Mae Kha Chan's Customers	1,544	10	980	2	167
12	CR C 5	Kru Noom, Mae Kha Chan	813	16	255	2	188

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
13	CR C 6	K.Larh, Vieng Pa Pao Hospital	5,301	15	1,758	2	188
14	CR C 7	K.Sasitorn, Vieng Pa Pao	2,183	14	2,183	2	190
15	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	1,758	13	5,301	2	219
16	CR C 9	Moo Hao Chalearn	255	3	2,501	2	272
6	CR B 1	Big-C Supercenter, Chiang Rai	275,192			Medium	131
1	CR B 2	Central Plaza, Chiang Rai	55,296	7	24,792	1	6
2	CR B 3	Tesco Lotus, Mae Chan	28,126	6	14,055	1	7
3	CR B 4	Tesco Lotus, Mae Sai	45,818	5	4,686	1	66
4	CR C 10	K.Rung, Chiang Rai	8,799	3	45,818	1	98
5	CR C 11	K.Oa, Chiang Rai	4,686	2	28,126	1	98
6	CR C 12	K.Sripun, Chiang Rai	14,055	8	33,350	1	126
7	CR C 13	K.Oranuch , San Khong Chiang Rai	24,792	4	8,799	1	130
8	CR C 14	K.Srila Yanisa, Chiang Sand	33,350	1	55,296	2	131

Table B-15: VRP of 5 crossdocks to customers

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
1	CM PN	Distribution Center, Chiang Mai	268,773			Medium	485.38
1	CM B 1	Central Airport Plaza, Chiang Mai	50,874	7	2,981	1	10.1
2	CM B 2	Big-C Supercenter, Hang Dong	46,784	3	32,450	1	21
3	CM B 3	Big-C Supercenter, Chiang Mai	32,450	2	46,784	1	29.1
4	CM B 4	Big-C X-tra, Chiang Mai	16,038	10	12,255	1	40.9
5	CM B 5	Tesco Lotus, Kam Thieng	47,434	1	50,874	1	45.3
6	CM B 6	Central Kad Suan Kheaw	25,145	8	8,014	1	49.1
7	CM B 7	Som Prech Market, Chiang Mai	2,981	6	25,145	1	59.5
8	CM C 1	Behind CMU	8,014	4	16,038	2	75.4
9	CM C 2	Boar Sang, Chiang Mai	4,912	12	392	2	97.6
10	CM C 3	Big-C X-tra North Chiang Mai U.	12,255	9	4,912	2	125.6
11	CM C 4	Tesco Lotus, Fang	21,494	16	539	2	126.6

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
12	CR C 1	Bangchak Gas Station, Doi Sa Ked	392	14	15,391	2	126.78
13	LA B 1	Wholesale, Lamphun	76,022	13	76,022	2	132.88
14	LA B 2	Jam Fah Plaza, Lamphun	15,391	15	40,220	2	163.38
15	LA B 3	Big-C Supercenter, Lamphun	40,220	5	47,434	3	311.38
16	LA C 1	Suan Bunyo Phatum School	539	11	21,494	3	485.38
2	PH B 1	Big-C Supercenter, Phrae	118,661			Medium	212.1
1	PH C 1	Mark Four Plaza, Phrae	52,004	2	16,862	1	2.8
2	PH C 2	K.Ja-ded, Phrae	16,862	1	52,004	1	44.8
3	PH C 3	K.Kanlaya, Phrae	4,179	4	384	1	47
4	PH C 4	K.Suweena,, Phrae Hospital	384	3	4,179	1	138.1
5	UD B 1	Friday Department Store, Uttaradit	56,834	5	56,834	1	212.1
3	PL D 1	Distribution Center, Phitsanulok	267,793			Pick-up	8.2
1	PL B 1	Big-C Supercenter, Phitsanulok	21,874	1	21,874	1	6.2
2	PL B 2	Topland Plaza, Phitsanulok	11,195	3	12,270	1	7
3	PL B 3	Train Station, Phitsanulok	12,270	2	11,195	1	8.2
4	LP B 1	Big-C Supercenter, Lampang	146,609			Pick-up	22.9
1	LP B 2	Tesco Lotus, Lampang	18,345	2	9,903	1	2.5
2	LP C 1	K.Berm, Lampang	9,903	3	19,218	1	4.6
3	LP C 2	K.Nittaya, Lampang	19,218	1	18,345	1	11
4	LP C 3	K.Narong, Pang Ma-O Lampang	8,678	4	8,678	2	16.5
5	LP C 4	K.Sunan, Nam Tong Market, Lampang	9,176	5	9,176	2	22.9
5	CR B 1	Big-C Supercenter, Chiang Rai	412,766			Medium	516.954
1	CR B 2	Central Plaza, Chiang Rai	55,296	5	8,799	1	62.1
2	CR B 3	Tesco Lotus, Mae Chan	28,126	4	45,818	1	94
3	CR B 4	Tesco Lotus, Mae Sai	45,818	3	28,126	1	94.054
4	CR C 10	K.Rung, Chiang Rai	8,799	9	33349.88717	1	123.254
5	CR C 11	K.Oa, Chiang Rai	4,686	6	4685.5	1	125.654
6	CR C 12	K.Sripun, Chiang Rai	14,055	8	24792.1725	1	127.154
7	CR C 13	K.Oranuch , San Khong Chiang Rai	24,792	7	14054.98	1	219.454

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
8	CR C 14	K.Srila Yanisa, Chiang Sand	33,350	12	28928.2	2	221.154
9	PY D 1	Distribution Center, Phayao	44,177	11	25,025	2	225.254
10	PY B 1	Charoen Pun Department Store, Phayao	25,025	10	44,177	2	228.154
11	PY B 2	Tesco Lotus, Phayao	28,928	16	9,544	2	279.854
12	PY C 1	K.Nay, Wangnuea	2,501	15	109	2	281.754
13	PY C 2	K.Tadsanee, Wangnuea	1,675	13	2,501	2	282.504
14	PY C 3	K.Wilaiwan, Wangnuea	109	14	1,675	2	336.304
15	PY C 4	Mae Tum, Phayao	9,544	17	5,737	2	343.604
16	PY C 5	K.Noie, Phayao University	5,737	18	6,461	2	408.804
17	PY C 6	Tom mart, Phayao University	6,461	20	980	2	409.154
18	CR C 2	Kru Tuu, Transportation Station Mae Kha Chan	583	19	583	2	410.554
19	CR C 3	K.Phung, Mae Kha Chan	980	22	813	2	411.654
20	CR C 4	Group of Mae Kha Chan's Customers	1,544	21	1,544	2	427.454
21	CR C 5	Kru Noom, Mae Kha Chan	813	23	5,301	2	429.754
22	CR C 6	K.Larh, Vieng Pa Pao Hospital	5,301	24	2,183	2	429.754
23	CR C 7	K.Sasitorn, Vieng Pa Pao	2,183	25	1,758	2	450.554
24	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	1,758	26	255	2	515.954
25	CR C 9	Moo Hao Chalearn	255	2	55,296	3	516.954

Table B-16: VRP of 4 crossdocks to customers

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
1	CM PN	Distribution Center, Chiang Mai	268,773			Medium	485
1	CM B 1	Central Airport Plaza, Chiang Mai	50,874	7	2,981	1	10.1
2	CM B 2	Big-C Supercenter, Hang Dong	46,784	3	32,450	1	21
3	CM B 3	Big-C Supercenter, Chiang Mai	32,450	2	46,784	1	29.1
4	CM B 4	Big-C X-tra, Chiang Mai	16,038	10	12,255	1	40.9
5	CM B 5	Tesco Lotus, Kam Thieng	47,434	1	50,874	1	45.3
6	CM B 6	Central Kad Suan Kheaw	25,145	8	8,014	1	49.1

7	CM B 7	Som Prech Market, Chiang Mai	2,981	6	25,145	1	59.5
8	CM C 1	Behind CMU	8,014	4	16,038	2	75.4
9	CM C 2	Boar Sang, Chiang Mai	4,912	12	392	2	97.6
10	CM C 3	Big-C X-tra North Chiang Mai U.	12,255	9	4,912	2	125.6
11	CM C 4	Tesco Lotus, Fang	21,494	16	539	2	126.6
12	CR C 1	Bangchak Gas Station, Doi Sa Ked	392	14	15,391	2	126.78
13	LA B 1	Wholesale, Lamphun	76,022	13	76,022	2	132.88
14	LA B 2	Jam Fah Plaza, Lamphun	15,391	15	40,220	2	163.38
15	LA B 3	Big-C Supercenter, Lamphun	40,220	5	47,434	3	311.38
16	LA C 1	Suan Bunyo Phatum School	539	11	21,494	3	485.38
2	PH B 1	Big-C Supercenter, Phrae	118,661			Medium	373.3
1	PH C 1	Mark Four Plaza, Phrae	52,004	5	56,834	1	145.8
2	PH C 2	K.Ja-ded, Phrae	16,862	2	16,862	1	147.5
3	PH C 3	K.Kanlaya, Phrae	4,179	1	52,004	1	257
4	PH C 4	K.Suweena,, Phrae Hospital	384	6	81,289	2	259.3
5	UD B 1	Friday Department Store, Uttaradit	56,834	7	18,345	2	260.9
6	LP B 1	Big-C Supercenter, Lampang	81,289	9	19,218	2	262.2
7	LP B 2	Tesco Lotus, Lampang	18,345	8	9,903	2	266.4
8	LP C 1	K.Berm, Lampang	9,903	11	9,176	2	271.8
9	LP C 2	K.Nittaya, Lampang	19,218	10	8,678	2	333
10	LP C 3	K.Narong, Pang Ma-O Lampang	8,678	4	384	2	335.2
11	LP C 4	K.Sunan, Nam Tong Market, Lampang	9,176	3	4,179	2	373.3
3	PL D 1	Distribution Center, Phitsanulok	267,793			Pick-up	8.2
1	PL B 1	Big-C Supercenter, Phitsanulok	21,874	1	21,874	1	6.2
2	PL B 2	Topland Plaza, Phitsanulok	11,195	3	12,270	1	7
3	PL B 3	Train Station, Phitsanulok	12,270	2	11,195	1	8.2
4	CR B 1	Big-C Supercenter, Chiang Rai	412,766			Medium	516.954
1	CR B 2	Central Plaza, Chiang Rai	55,296	5	8,799	1	62.1
2	CR B 3	Tesco Lotus, Mae Chan	28,126	4	45,818	1	94
3	CR B 4	Tesco Lotus, Mae Sai	45,818	3	28,126	1	94.054

4	CR C 10	K.Rung, Chiang Rai	8,799	9	33349.88 717	1	123.254
5	CR C 11	K.Oa, Chiang Rai	4,686	6	4685.5	1	125.654
6	CR C 12	K.Sripun, Chiang Rai	14,055	8	24792.17 25	1	127.154
7	CR C 13	K.Oranuch , San Khong Chiang Rai	24,792	7	14054.98	1	219.454
8	CR C 14	K.Srila Yanisa, Chiang Sand	33,350	12	28928.2	2	221.154
9	PY D 1	Distribution Center, Phayao	44,177	11	25,025	2	225.254
10	PY B 1	Charoen Pun Department Store, Phayao	25,025	10	44,177	2	228.154
11	PY B 2	Tesco Lotus, Phayao	28,928	16	9,544	2	279.854
12	PY C 1	K.Nay, Wangnuea	2,501	15	109	2	281.754
13	PY C 2	K.Tadsanee, Wangnuea	1,675	13	2,501	2	282.504
14	PY C 3	K.Wilaiwan, Wangnuea	109	14	1,675	2	336.304
15	PY C 4	Mae Tum, Phayao	9,544	17	5,737	2	343.604
16	PY C 5	K.Noi, Phayao University	5,737	18	6,461	2	408.804
17	PY C 6	Tom mart, Phayao University	6,461	20	980	2	409.154
18	CR C 2	Kru Tuu, Transportation Station Mae Kha Chan	583	19	583	2	410.554
19	CR C 3	K.Phung, Mae Kha Chan	980	22	813	2	411.654
20	CR C 4	Group of Mae Kha Chan's Customers	1,544	21	1,544	2	427.454
21	CR C 5	Kru Noom, Mae Kha Chan	813	23	5,301	2	429.754
22	CR C 6	K.Larh, Vieng Pa Pao Hospital	5,301	24	2,183	2	429.754
23	CR C 7	K.Sasitorn, Vieng Pa Pao	2,183	25	1,758	2	450.554
24	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	1,758	26	255	2	515.954
25	CR C 9	Moo Hao Chalearn	255	2	55,296	3	516.954

Table B-17: VRP of 3 crossdocks to customers

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
1	CM PN	Distribution Center, Chiang Mai	268,773			Medium	485.38
1	CM B 1	Central Airport Plaza, Chiang Mai	50,874	7	2,981	1	10.1
2	CM B 2	Big-C Supercenter, Hang Dong	46,784	3	32,450	1	21
3	CM B 3	Big-C Supercenter, Chiang Mai	32,450	2	46,784	1	29.1
4	CM B 4	Big-C X-tra, Chiang Mai	16,038	10	12,255	1	40.9
5	CM B 5	Tesco Lotus, Kam Thieng	47,434	1	50,874	1	45.3
6	CM B 6	Central Kad Suan Kheaw	25,145	8	8,014	1	49.1
7	CM B 7	Som Prech Market, Chiang Mai	2,981	6	25,145	1	59.5
8	CM C 1	Behind CMU	8,014	4	16,038	2	75.4
9	CM C 2	Boar Sang, Chiang Mai	4,912	12	392	2	97.6
10	CM C 3	Big-C X-tra North Chiang Mai U.	12,255	9	4,912	2	125.6
11	CM C 4	Tesco Lotus, Fang	21,494	16	539	2	126.6
12	CR C 1	Bangchak Gas Station, Doi Sa Ked	392	14	15,391	2	126.78
13	LA B 1	Wholesale, Lamphun	76,022	13	76,022	2	132.88
14	LA B 2	Jam Fah Plaza, Lamphun	15,391	15	40,220	2	163.38
15	LA B 3	Big-C Supercenter, Lamphun	40,220	5	47,434	3	311.38
16	LA C 1	Suan Bunyo Phatum School	539	11	21,494	3	485.38
2	PH B 1	Big-C Supercenter, Phrae	118,661			Medium	1340.2
1	PH C 1	Mark Four Plaza, Phrae	52,004	12	222,454	2	625
2	PH C 2	K.Ja-ded, Phrae	16,862	5	56,834	2	717.6
3	PH C 3	K.Kanlaya, Phrae	4,179	4	384	2	719.8
4	PH C 4	K.Suweena., Phrae Hospital	384	3	4,179	2	757.6
5	UD B 1	Friday Department Store, Uttaradit	56,834	1	52,004	2	867.1
6	LP B 1	Big-C Supercenter, Lampang	81,289	6	81,289	3	869.4
7	LP B 2	Tesco Lotus, Lampang	18,345	7	18,345	3	871
8	LP C 1	K.Berm, Lampang	9,903	9	19,218	3	872.3
9	LP C 2	K.Nittaya, Lampang	19,218	8	9,903	3	876.5
10	LP C 3	K.Narong, Pang Ma-O Lampang	8,678	11	9,176	3	881.9

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
11	LP C 4	K.Sunan, Nam Tong Market, Lampang	9,176	10	8,678	3	983.9
12	PL D 1	Distribution Center, Phitsanulok	222,454	2	16,862	3	1157
13	PL B 1	Big-C Supercenter, Phitsanulok	21,874	13	21,874	4	1160.4
14	PL B 2	Topland Plaza, Phitsanulok	11,195	15	12,270	4	1161.2
15	PL B 3	Train Station, Phitsanulok	12,270	14	11,195	4	1340.2
3	CR B 1	Big-C Supercenter, Chiang Rai	412,766			Medium	516.954
1	CR B 2	Central Plaza, Chiang Rai	55,296	5	8,799	1	62.1
2	CR B 3	Tesco Lotus, Mae Chan	28,126	4	45,818	1	94
3	CR B 4	Tesco Lotus, Mae Sai	45,818	3	28,126	1	94.054
4	CR C 10	K.Rung, Chiang Rai	8,799	9	33349.887 17	1	123.254
5	CR C 11	K.Oa, Chiang Rai	4,686	6	4685.5	1	125.654
6	CR C 12	K.Sripun, Chiang Rai	14,055	8	24792.172 5	1	127.154
7	CR C 13	K.Oranuch , San Khong Chiang Rai	24,792	7	14054.98	1	219.454
8	CR C 14	K.Srila Yanisa, Chiang Sand	33,350	12	28928.2	2	221.154
9	PY D 1	Distribution Center, Phayao	44,177	11	25,025	2	225.254
10	PY B 1	Charoen Pun Department Store, Phayao	25,025	10	44,177	2	228.154
11	PY B 2	Tesco Lotus, Phayao	28,928	16	9,544	2	279.854
12	PY C 1	K.Nay, Wangnuea	2,501	15	109	2	281.754
13	PY C 2	K.Tadsanee, Wangnuea	1,675	13	2,501	2	282.504
14	PY C 3	K.Wilaiwan, Wangnuea	109	14	1,675	2	336.304
15	PY C 4	Mae Tum, Phayao	9,544	17	5,737	2	343.604
16	PY C 5	K.No, Phayao University	5,737	18	6,461	2	408.804
17	PY C 6	Tom mart, Phayao University	6,461	20	980	2	409.154
18	CR C 2	Kru Tuu, Transportation Station Mae Kha	583	19	583	2	410.554

Ci	Code	Location Name	Demand	Sequence	Demand	Truck/ Trip	Cumulative Distance
		Chan					
19	CR C 3	K.Phung, Mae Kha Chan	980	22	813	2	411.654
20	CR C 4	Group of Mae Kha Chan's Customers	1,544	21	1,544	2	427.454
21	CR C 5	Kru Noom, Mae Kha Chan	813	23	5,301	2	429.754
22	CR C 6	K.Larh, Vieng Pa Pao Hospital	5,301	24	2,183	2	429.754
23	CR C 7	K.Sasitorn, Vieng Pa Pao	2,183	25	1,758	2	450.554
24	CR C 8	K.Ratchaneekorn, 108 shop Vieng Pa Pao	1,758	26	255	2	515.954
25	CR C 9	Moo Hao Chalearn	255	2	55,296	3	516.954

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Table B-12: VRP of CM PN crossdock to customers

Ci	Code	Location Name	Demand	Sequence	Pick-up	Cum. Distance
1	CM PN	Distribution Center, Chiang Mai	268,773			459.2
2	CM B 1	Central Airport Plaza, Chiang Mai	50,874	7	1	11.6
3	CM B 2	Big-C Supercenter, Hang Dong	46,784	2	1	27.1
4	CM B 3	Big-C Supercenter, Chiang Mai	32,450	5	2	32.9
5	CM B 4	Big-C X-tra, Chiang Mai	16,038	8	3	49.6
6	CM B 5	Tesco Lotus, Kam Thieng	47,434	10	3	64.6
7	CM B 6	Central Kad Suan Kheaw	25,145	6	3	77.2
8	CM B 7	Som Prech Market, Chiang Mai	2,981	1	4	230.3
9	CM C 1	Behind CMU	8,014	11	5	401.3
10	CM C 2	Boar Sang, Chiang Mai	4,912	4	5	415.6
11	CM C 3	Big-C X-tra North Chiang Mai U.	12,255	3	6	423.3
12	CM C 4	Tesco Lotus, Fang	21,494	9	6	438.1
13	CR C 1	Bangchak Gas Staion, Doi Sa Ked	392	12	6	459.2

Table B-13: VRP of CM PN crossdock to customers

Ci	Code	Location Name	Demand	Sequence	Pick-up	Cum. Distance
1	LA B 1	Wholesale, Lamphun	132,172			
2	LA B 2	Jam Fah Plaza, Lamphun	15,391	2	40,220	1
3	LA B 3	Big-C Supercenter, Lamphun	40,220	1	15,391	2
4	LA C 1	Suan Bunyo Phatum School	539	3	539	2

Table B-14: Table for IRR calculation

Day	Without Crossdock	With Crossdock	Current
0	(411,400)	(423,700)	
1	11,469	14,661	35,028
2	22,938	29,323	70,055
3	34,407	43,984	105,083
4	45,876	58,645	140,110
5	57,345	73,307	175,138
6	68,814	87,968	210,165
7	80,282	102,629	245,193
8	91,751	117,291	280,221
9	103,220	131,952	315,248
10	114,689	146,614	350,276
11	126,158	161,275	385,303
12	137,627	175,936	420,331
13	149,096	190,598	455,358
14	160,565	205,259	490,386
15	172,034	219,920	525,414
16	183,503	234,582	560,441
17	194,972	249,243	595,469
18	206,441	263,904	630,496
19	217,910	278,566	665,524
20	229,379	293,227	700,551
21	240,847	307,888	735,579
22	252,316	322,550	770,607
23	263,785	337,211	805,634
24	275,254	351,872	840,662
25	286,723	366,534	875,689
26	298,192	381,195	910,717
27	309,661	395,856	945,744
28	321,130	410,518	980,772
29	332,599	425,179 (BEP)	1,015,800
30	344,068	439,841	1,050,827
31	355,537	454,502	1,085,855
32	367,006	469,163	1,120,882
33	378,475	483,825	1,155,910
34	389,943	498,486	1,190,937
35	401,412	513,147	1,225,965
36	412,881 (BEP)	527,809	1,260,993
IRR	18%	20%	



APPENDIX C

VSM data Table

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Table C-1: Current stage data

Available Time (hr/shift)	12											Note
Break per Shift (min)	60											C/T = Cycle Time (Time per Unit)
Total Available Time per 1 shift (hr)	11.0											T/P = Time thru Process (Time per Batch)
Total Available Time per 2 shifts (hr)	22.0											C/O = Change Over Time (Set up Time)
Working Day per Month	30											FPY. = First Pass Yield
Customer Demand per Year (unit)	651031											Res. = Resource (Operator or Machine)
Customer Demand per Day (unit)	1809											B/S = Batch Size
Takt Time - 1 shift (sec)	22											
Takt Time - 2 shifts (sec)	44											

Name	C/T	T/P	Resource	FPY.	Uptime	B/S	WIP	Distance	Takt Time	Takt Time	C/T	C/O
	(sec/unit)	(sec)	(unit)	(%)	(%)	(unit)	(unit)	(m)	(1 shift)	(2 shifts)	for Takt	(sec./unit)
Mixing	3.75	3000.00	1	100.00	98.00	800	800	22.00	22	44	3.75	0.2
Cutting #1	0.87	696.00	1	100.00	100.00	800	800	5.00	22	44	0.87	0.02
Forming	4.66	3728.00	1	100.00	100.00	800	700	5.00	22	44	4.66	0.02
Dressing	4.12	824.00	1	100.00	100.00	200	400	10.00	22	44	4.12	0.1
Baking	1.80	720.00	1	100.00	98.00	400	800	24.00	22	44	1.80	0.01
Rolling	6.20	4960.00	1	100.00	100.00	800	800	2.00	22	44	6.20	0.1
Cutting #2	12.00	360.00	1	100.00	100.00	30	200	0.00	22	44	12.00	0.01
Packing	10.00	8000.00	1	100.00	80.00	800	60	44.00	22	44	10.00	3
Checking	1.00	50.00	1	100.00	100.00	50	800		22	44	1.00	0.01

Curriculum Vitae

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Education Background

2008 – 2011 Bachelor Degree of Engineering in Industrial Engineering, Chiang Mai University.

2011 – 2013 Master of Degree of Engineering in Logistics and Supply Chain Management.

Extracurricular activities

2011 – 2012 Teacher Assistant: Statistics, Engineering Material.

2011 – 2012 Research Assistant: Supply Chain and Engineering Management Research Unit (SCEM).

Roles and Responsibility

- The draft of Thailand's National Strategic Framework of the Logistics and Supply Chain.
- The Logistics Software Creating Project under the Logistics Management Improvement Project of the Group of GMS Connected Provinces.
- The draft of logistics management action plan of the group of the Northern provinces under the logistics strategy of the Northern provinces group 1.
- Logistics Development Study of the GMS sub-region NSEC.
- Strategic Studies for the Development of Water Transport by Review the Needs of Clients and Stakeholders.

Researches

2011 Productivity Development in Artificial Leg Production of Protheses Foundation of H.R.H. The Princess Mother.

2012 – 2013 Improving Transportation Management System of Bakery Business by Using Genetic Algorithm.