

Appendix A. Production Parameters

Table A.1: 62 common fresh produce in Chinese grocery and corresponding MSU-making parameters

No	Name	GM ¹	W(kg) ²	MT(s) ³	MC(CNY) ⁴	HC(CNY) ⁵
1	Asparagus	Binding	0.5	8	0.1	0.05
2	Cabbage Mustard	Binding	0.5	8	0.1	0.05
3	Celery	Binding	0.5	8	0.1	0.05
4	Chinese Onion	Binding	0.5	8	0.1	0.05
5	Coriander	Binding	0.1	8	0.1	0.05
6	Fennel	Binding	0.5	8	0.1	0.05
7	Garland Chrysanthemum	Binding	0.5	8	0.1	0.05
8	Leek	Binding	0.5	8	0.1	0.05
9	Lettuce	Binding	0.5	8	0.1	0.05
10	Rape	Binding	0.5	8	0.1	0.05
11	Spinacia Oleracea	Binding	0.5	8	0.1	0.05
12	Vigna Unguiculata	Binding	0.5	8	0.1	0.03
13	Young Garlic Shoot	Binding	0.5	8	0.1	0.03
14	Cabbage	Incising	2	12	0.3	0.02
15	Chinese Cabbage	Incising	1.5	12	0.3	0.02
16	Chinese Yam	Incising	0.5	12	0.3	0.02
17	Iron Stick Yam	Incising	0.5	12	0.3	0.02
18	Lipu Taro	Incising	0.5	12	0.3	0.02
19	Pumpkin	Incising	0.5	12	0.3	0.01
20	Wax Gourd	Incising	0.5	12	0.3	0.01
21	Wild Cabbage	Incising	1	12	0.3	0.02
22	Apple	Palletizing	0.5	10	0.4	0.04
23	Apricot	Palletizing	0.5	10	0.4	0.08
24	Asparagus Lettuce	Palletizing	1.5	5	0.3	0.04
25	Big Summer Radish	Palletizing	0.5	8	0.4	0.03
26	Broccoli	Palletizing	1.5	5	0.2	0.04
27	Carrot	Palletizing	0.5	8	0.4	0.02
28	Cauliflower	Palletizing	1	5	0.2	0.04
29	Cucurbita Pepo	Palletizing	1	5	0.2	0.02
30	Flammulina Velutipes	Palletizing	0.2	8	0.4	0.04
31	Garlic	Palletizing	0.2	8	0.4	0.02
32	Ginger	Palletizing	0.2	8	0.4	0.03
33	Green Cucumber	Palletizing	0.5	8	0.4	0.04
34	Green Turnip	Palletizing	1.5	5	0.2	0.02
35	Long Eggplant	Palletizing	0.5	8	0.4	0.03
36	Kidney Bean	Palletizing	0.5	8	0.4	0.05
37	Onion	Palletizing	0.2	8	0.4	0.03
38	Pepper1	Palletizing	0.5	8	0.4	0.06

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Table A.1 – continued from previous page

No	Name	GM ¹	W(kg) ²	MT(s) ³	MC(CNY) ⁴	HC(CNY) ⁵
39	Pepper2	Palletizing	0.5	8	0.4	0.06
40	Pepper3	Palletizing	0.5	8	0.4	0.04
41	Pepper4	Palletizing	0.5	8	0.4	0.04
42	Plum	Palletizing	0.5	10	0.4	0.06
43	Potato	Palletizing	0.5	8	0.4	0.02
44	Purple Sweet Potato	Palletizing	0.5	8	0.4	0.01
45	Round Eggplant	Palletizing	0.5	8	0.4	0.03
46	Short Cucumber	Palletizing	0.5	8	0.4	0.04
47	Small Summer Radish	Palletizing	0.5	8	0.4	0.03
48	String Bean	Palletizing	0.5	8	0.4	0.05
49	Sweet Potato	Palletizing	1.5	5	0.2	0.01
50	Turnip	Palletizing	1.5	5	0.3	0.02
51	Tomato	Palletizing	0.5	10	0.4	0.06
52	Andrographis Paniculata	Boxing	0.2	10	0.4	0.05
53	Cherry	Boxing	0.5	10	0.4	0.06
54	Cherry Tomatoes	Boxing	0.5	12	0.4	0.06
55	Grape	Boxing	0.5	10	0.4	0.08
56	Green Bean Sprout	Boxing	0.2	10	0.4	0.05
57	Green Soy Bean	Boxing	0.2	10	0.4	0.05
58	Panax Notoginseng	Boxing	0.2	10	0.4	0.05
59	Pterocladia Tenuis	Boxing	0.2	10	0.4	0.05
60	Shii-take	Boxing	0.2	10	0.4	0.03
61	Snow Bean	Boxing	0.2	10	0.4	0.05
62	Yellow Bean Sprout	Boxing	0.2	10	0.4	0.05

¹ GM: Granulation mode;² W: Standard weight of a unit;³ MT: MSU-making time of a unit;⁴ MC: MSU-making cost of a unit;⁵ HC: MSU-holding cost per period per unit.

Table A.2: Switch cost/time between MSU-making modes

Switch Cost(CNY)/Time(s)	Binding	Incising	Palletizing	Boxing	Idle
Binding	0.00/0	3.20/32	1.80/18	1.80/18	5.00/100
Incising	2.40/24	0.00/0	2.40/24	2.4/24	5.00/100
Palletizing	1.80/18	3.20/32	0.00/0	1.8/18	5.00/100
Boxing	1.80/18	3.00/30	1.80/18	0.00/0	5.00/100
Idle	5.00/100	5.00/100	5.00/100	5.00/100	0.00/0

Table A.3: Order-packing processing parameters

Machine-related Parameters	Machine Setup Cost (CNY)	50.00
	Order-packing Cost(CNY)	$0.50 + 0.1 * \text{order quantity}$
	Order-packing Time(s)	$20 + 2 * \text{order quantity}$
Labor-related Parameters	Temporary Labor Cost per Period (CNY)	8.00
	Permanent Labor Cost per Day (CNY)	40.00
	Temporary Labor Working Rate	1
	Permanent Labor Working Rate	0.8
Order Holding Cost	Cost of order i per time unit	$0.0005 * \text{order quantity}$

Appendix B. Delivery Parameters

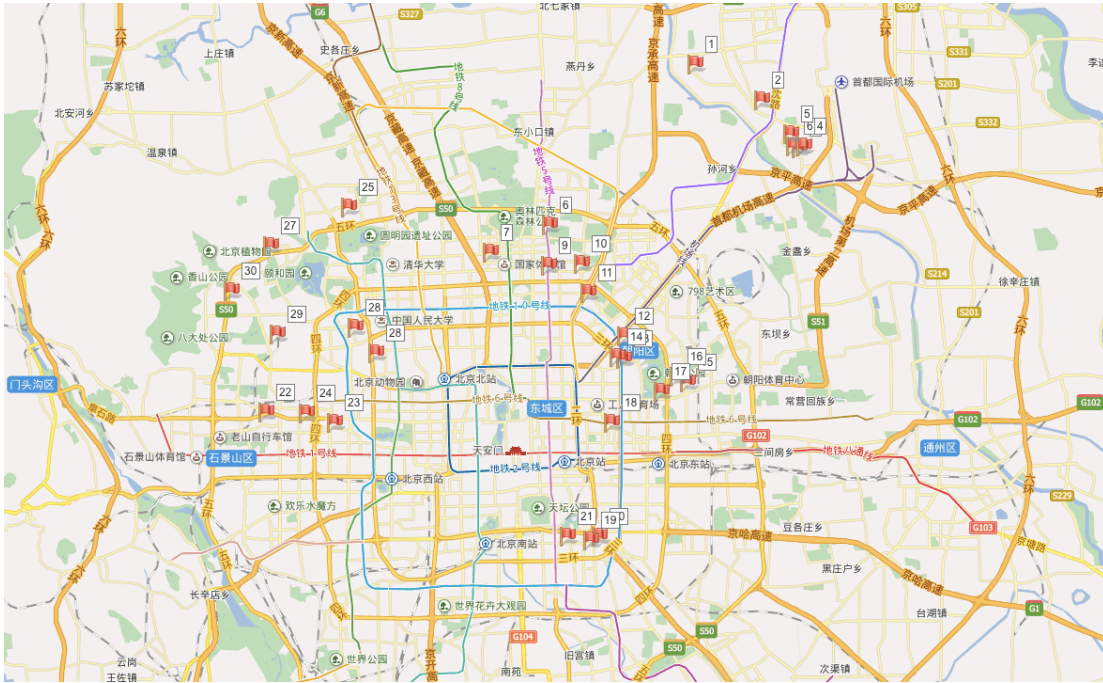


Figure B.1: A map of customer communities severed by our industry partner in Beijing

Table B.4: OD distance matrix of DC and customer nodes (in kilometers)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	118	9	20	21	22	23	24	25	26	27	28	29	30	
0	0.0	89.5	79.5	78.9	78.6	79.0	79.2	71.6	73	70.1	68.1	67.6	64.0	62.9	63.3	60.2	60.0	60.1	60.5	48.4	54.9	47.9	73	67.4	68.9	76.1	80.6	68.5	71.0	77.0	77.6	
1	88.3	0.0	4.9	9.0	9.0	8.7	9.4	19.6	23.9	20.6	10.8	19.9	23.4	24.7	25.0	26.4	26.2	26.5	28.9	35.9	35.7	29.6	45.5	38.9	38.4	30.7	33.3	31.8	32.8	39.5	39.4	
2	80.1	5.4	0.0	5.0	5.0	4.7	5.4	21.4	25.7	22.4	20.4	20.5	17.9	18.8	19.0	20.8	20.4	20.7	22.7	29.8	29.6	32.0	47.0	40.4	39.9	32.3	34.9	31.5	34.4	41.0	40.9	
3	79.5	8.5	5.1	0.0	0.76	1.6	1.1	20.9	23.6	20.7	18.3	19.9	17.5	18.7	18.6	20.2	20.1	19.9	22.3	29.6	29.2	31.6	40.6	38.6	38.1	31.3	33.9	31.1	31.1	36.3	36.9	
4	80.0	7.7	4.6	0.7	0.0	0.9	1	20.9	23.7	20.4	18.4	20.2	17.5	18.8	18.4	20.2	20.1	20.3	22.4	29.5	29.3	31.6	40.7	38.6	38.1	31.3	34.0	31.3	31.0	36.4	37.0	
5	79.9	7.5	4.8	0.64	0.9	0.0	0.81	20.8	23.6	20.3	18.2	19.9	17.4	19.1	18.3	20.1	19.9	20.2	22.7	29.4	29.2	31.5	40.3	38.5	38.0	31.2	33.9	30.9	30.8	36.3	36.8	
6	80.1	8.1	4.7	0.79	1.0	0.81	0.0	21.0	23.7	20.4	18.4	19.7	17.5	18.6	18.4	20.2	20.1	20.3	22.2	29.5	29.3	31.6	40.5	38.6	38.1	31.3	34.0	31.0	31.0	36.4	37	
7	79.3	19.1	21.5	20.8	20.8	20.9	21.1	0.0	4.4	2.6	10.0	11.6	15.1	15.8	16.1	17.5	17.4	17.6	20.0	27.1	26.9	30.7	29.0	21.3	20.8	14.1	16.7	20.4	19.4	22.9	22.8	
8	74.6	25.9	28.3	27.6	27.6	27.7	27.9	4.8	0.0	6.5	7.7	10.9	12.8	13.6	13.8	17.3	17.1	17.3	18.6	24.8	22.5	24.6	20.5	18.5	18.0	12.1	14.8	13.6	12.6	16.3	16.8	
9	76.1	19.7	24.0	22.3	22.3	22.4	22.5	2.3	3.4	0.0	2.4	5.6	7.7	9.2	8.7	13.4	13.2	13.5	13.3	19.7	19.5	20.7	21.6	19.6	19.1	15.2	17.9	14.7	13.6	17.4	17.9	
10	70.3	18.4	20.8	20.2	20.2	20.3	20.4	5.4	5.9	2.6	0.0	4.7	9.0	9.5	10.0	11.3	11.1	11.4	13.6	21.0	20.8	24.5	22.7	20.8	20.3	22.8	20.1	15.9	14.9	18.6	19.1	
11	69.0	19.2	19.5	18.9	18.9	19.0	18.9	7.2	10.1	5.3	5.1	0.0	6.9	7.6	7.9	10.0	9.9	10.1	11.7	20.9	20.7	23.2	27.4	23.2	24.8	20.3	24.7	15.4	15.5	23.1	23.7	
12	63.7	21.6	18.1	17.5	17.5	17.6	17.8	10.8	11.4	8.6	6.9	4.2	0.0	1.5	1.4	8.6	8.5	4.4	5.6	12.7	12.5	14.2	28.9	22.9	26.4	22.0	25.0	15.2	15.4	24.6	25.2	
13	63.6	23.4	18.4	17.8	17.8	18.4	17.9	12.8	13.0	10.5	8.2	5.4	1.5	0.0	0.9	6.5	6.4	4.0	4.8	12.1	11.8	13.4	30.4	28.4	27.9	23.7	26.0	16.2	16.1	26.2	26.8	
14	63.6	22.4	18.9	18.3	18.3	18.4	18.5	12.8	13.8	10.5	8.6	5.8	1.9	0.7	0.0	7.0	6.8	4.0	4.1	12.3	12.1	13.8	23.2	21.0	20.6	23.6	26.6	15.4	17.0	20.9	27.2	
15	61.0	24.7	20.1	19.5	19.5	19.6	19.7	13.7	14.9	11.6	9.6	10.0	6.0	5.3	5.7	0.0	1.2	2.1	8.1	12.9	12.7	15.2	31.9	30.7	30.3	24.8	29.2	24.9	23.9	27.6	28.1	
16	60.7	24.6	20.0	19.4	19.4	19.5	19.7	13.6	14.8	11.5	9.5	9.7	5.8	5.0	6.1	0.7	0.0	1.4	7.8	12.6	12.4	14.9	31.7	30.7	30.0	24.7	29.0	24.8	23.6	27.5	28.2	
17	60.8	25.1	20.5	19.9	19.9	20.0	20.2	14.1	15.3	12.0	10.0	8.6	4.7	3.9	4.3	2.1	1.5	0.0	4.8	12.7	12.5	15.0	32.0	22.1	29.8	25.2	29.6	19.3	19.6	28.0	28.6	
18	60.7	26.5	22.6	22.0	22.0	22.6	22.1	16.5	15.5	14.7	12.3	9.5	5.6	4.4	4.3	9.3	9.1	4.7	0.0	9.8	9.1	10.8	24.5	20.5	21.9	26.4	29.2	17.5	20.5	22.8	30.9	
19	48.9	34.2	29.8	29.2	29.2	29.3	29.5	23.7	21.1	21.5	19.5	16.7	12.8	12.2	12.4	14.1	14.0	11.6	9.5	0.0	1.1	1.6	25.8	21.6	23.3	30.3	37.2	22.4	25.2	28.3	32.1	
20	50.1	35.1	30.8	30.2	30.2	30.3	30.5	24.6	21.4	22.5	20.8	17.7	13.8	13.0	13.4	13.7	13.5	12.6	8.5	1.9	0.0	2.3	26.8	22.8	24.5	31.4	38.6	23.6	26.4	29.5	33.3	
21	48.8	36.1	31.6	31.0	31.0	31.1	31.2	25.5	23.1	23.3	21.3	18.7	15.4	15.1	15.4	15.5	15.2	15.3	10.2	2.5	2.2	0.0	24.8	20.5	22.2	29.3	36.5	21.4	24.2	27.2	31.0	
22	74.0	44.8	47.2	46.5	46.6	46.4	46.6	28.7	20.5	22.0	23.1	23.2	23.4	23.5	23.1	32.8	32.6	32.5	23.9	25.0	24.9	23.9	0.0	5.3	2.9	16.1	12.4	10.1	11.4	5.5	9.6	
23	67.9	38.4	40.8	35.5	35.5	35.6	35.8	21.4	18.2	19.7	20.9	24.6	21.3	19.9	21.2	30.6	30.4	30.7	16.6	21.8	22.0	20.7	5.5	0.0	2.2	14.1	17.1	6.8	7.8	7.8	11.8	
24	68.7	38.1	40.5	39.1	39.1	39.2	39.3	21.1	17.9	19.4	20.6	20.6	20.9	20.9	20.6	30.2	29.2	30.3	21.3	22.4	22.6	21.4	2.9	2.0	0.0	13.8	14.7	7.8	9.1	5.4	8.6	
25	76.5	30.1	32.5	31.8	31.8	31.8	31.9	32.0	14.0	14.5	15.1	23.2	19.3	21.9	23.4	23.0	25.9	25.7	26.0	25.9	30.2	30.2	28.9	19.1	13.7	13.2	0.0	7.4	9.0	7.9	11.8	12.4
26	80.8	33.1	35.6	34.9	34.8	35.0	35.1	17.0	17.5	19.4	23.8	23.5	25.3	26.0	26.3	31.6	31.4	31.7	30.1	32.5	32.7	31.5	12.9	12.6	12.1	5.9	0.0	13.2	10.8	6.9	6.8	
27	68.1	32.9	31.5	30.8	30.9	31.0	31.1	16.9	13.8	15.3	17.7	15.5	15.2	15.3	14.9	22.8	22.6	18.9	17.5	22.1	22.1	20.9	9.7	7.8	7.4	11.5	15.8	0.0	5.2	7.8	12.1	
28	76.2	32.1	34.9	33.4	33.4	33.6	33.7	15.4	12.3	13.8	15.0	13.6	15.6	16.1	16.6	24.6	24.4	19.3	21.2	24.7	24.7	23.4	11.7	9.9	9.4	8.5	9.3	3.0	0.0	7.7	8.3	
29	78.3	39.6	42.0	41.3	41.3	41.1	41.6	23.5	17.6	19.1	20.3	23.8	21.6	21.6	21.3	29.8	29.7	29.9	23.8	28.4	28.6	27.3	6.0	8.0	6.0	11.0	7.4	9.6	10.6	0.0	4.1	
30	77.9	38.6	40.1	40.4	40.3	40.5	40.6	22.5	16.6	18.1	19.3	22.8	24.6	25.3	24.0	28.9	28.7	28.9	26.4	32.1	31.3	30.1	8.5	11.2	8.3	10.0	6.4	11.7	9.7	3.2	0.0	

Table B.5: OD time matrix of DC and customer nodes (in minutes)

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	118	9	20	21	22	23	24	25	26	27	28	29	30
0	0	105	104	95	92	93	94	96	90	92	89	88	85	84	85	84	84	84	83	77	75	76	76	72	73	82	82	73	77	81	83
1	108	0	12	21	21	21	22	27	34	28	25	28	33	34	34	33	34	35	41	44	44	47	49	47	44	35	39	39	40	49	52
2	101	13	0	12	12	13	29	31	26	24	29	25	29	27	28	28	28	28	32	37	38	42	47	47	44	36	37	40	41	46	46
3	94	17	11	0	2	4	3	29	28	23	21	22	20	23	22	23	24	23	33	33	33	38	46	44	41	38	40	35	37	42	44
4	94	15	9	2	0	2	2	29	27	22	20	22	19	22	21	22	23	22	26	31	31	35	44	42	38	36	39	35	36	41	43
5	99	16	11	2	2	0	2	28	27	22	20	21	19	23	21	22	22	19	27	31	31	35	44	42	39	36	38	33	37	41	42
6	92	16	10	2	2	2	0	25	28	22	19	20	18	21	20	22	22	22	25	30	30	34	44	41	38	34	36	32	35	41	43
7	92	23	26	22	22	22	22	0	10	8	14	17	19	21	21	21	22	21	27	32	32	36	31	29	26	18	19	26	26	29	29
8	87	29	33	29	28	28	29	11	0	12	14	14	18	19	19	21	22	22	26	30	30	32	27	24	21	16	17	20	18	22	24
9	88	26	28	23	24	24	24	7	9	0	7	16	18	18	20	18	19	19	24	29	29	32	28	25	22	23	26	21	20	24	26
10	87	23	26	21	21	22	22	14	12	7	0	10	14	16	17	15	16	16	21	26	26	30	29	27	24	30	24	22	21	25	27
11	86	23	24	19	20	20	19	18	16	12	10	0	12	13	14	14	14	14	19	25	25	28	35	30	28	27	30	22	22	30	32
12	81	24	24	18	19	20	20	19	16	12	11	7	0	7	6	13	13	10	12	17	17	21	35	28	29	26	29	20	21	31	33
13	88	27	24	18	19	20	19	20	18	15	13	9	6	0	5	15	15	11	12	17	17	21	37	34	31	31	31	23	23	32	35
14	83	28	26	19	19	19	20	21	20	15	13	10	7	3	0	16	16	10	12	18	17	21	37	28	31	29	32	22	24	34	35
15	77	28	25	20	20	20	20	21	20	15	13	17	13	13	15	0	4	5	14	18	18	21	38	35	32	29	33	30	29	33	37
16	78	28	24	19	20	20	20	21	20	15	12	17	13	13	15	3	0	4	14	19	19	22	37	34	32	30	32	30	29	34	36
17	78	30	27	21	21	22	22	22	22	17	14	14	10	11	12	6	5	0	13	18	18	21	39	37	33	32	33	27	28	35	37
18	78	32	30	24	26	26	25	27	23	21	19	15	12	14	18	15	16	13	0	15	14	18	40	33	34	33	35	25	30	35	41
19	72	37	35	29	30	30	30	32	28	25	23	21	17	18	21	19	19	17	15	0	4	7	33	27	28	37	41	28	32	35	43
20	73	40	37	33	33	33	33	34	30	28	27	24	20	20	21	20	21	19	17	6	8	8	34	28	29	38	43	29	34	37	42
21	72	41	38	33	34	34	34	35	30	29	27	25	22	22	33	21	22	21	18	9	8	0	35	27	29	38	43	29	34	35	42
22	77	45	47	43	44	43	43	31	26	28	30	33	34	36	31	39	41	37	40	32	34	33	0	14	8	25	16	20	21	12	18
23	73	41	43	37	40	39	39	27	23	24	26	28	29	28	29	33	34	33	33	27	28	27	11	0	6	21	22	14	14	16	21
24	73	40	41	37	38	38	38	25	21	22	24	27	28	29	28	33	34	32	33	26	27	26	8	5	0	19	20	14	15	12	19
25	86	33	35	32	32	33	33	20	20	21	30	26	29	28	29	31	30	37	36	38	37	22	20	18	0	13	16	15	21	23	23
26	83	36	37	34	35	35	36	23	23	26	26	29	31	33	34	35	34	34	38	40	41	40	16	14	0	22	19	14	15	14	15
27	74	37	35	30	32	34	31	23	18	20	22	20	19	21	18	28	38	25	27	26	27	27	18	16	14	19	22	0	10	16	24
28	81	36	37	33	34	34	34	21	17	18	20	19	23	23	24	28	29	26	30	32	34	33	17	14	16	20	9	0	17	19	19
29	85	45	47	43	45	45	44	31	26	28	33	36	34	35	34	43	40	39	41	38	39	15	20	16	26	17	22	21	0	11	11
30	85	42	45	41	41	42	43	34	24	28	28	31	33	34	34	37	36	35	42	38	40	39	20	23	18	22	14	21	19	7	0