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Research on Campus New Facilities Arrangement Based on SLP Method

Yingyi HUANG[1,2], Jianhong GUO[1,2] *
[1.] TSL School of Busines, Quanzhou Normal University
[2.] The Cloud Computing & Internet of Things & Electronic Commerce University Engineering Center in Fujian Province
Quanzhou, China

***Abstract*—The facility layout has a great influence on teaching activities and entertainment for teachers and students. The appropriate and reasonable campus facility layout is beneficial for the development of school. The paper takes a certain university as a research object and uses SLP from to chart, job related graph method, logistics related graph, etc, to analyze the logistics relation between essentials and facilities on campus. Finally, it gets a comprehensive correlation results among work units. And it can offer academic support for the decision of new facilities layout on campus.**

Keywords— facility layout; campus; new facilities

I. INTRODUCTION

Whether facilities location is reasonable or not will influence the campus environment construction. And reasonable and scientific campus facilities location is good for constructing favorable campus environment and promotes the sustainable development for the environment. The paper takes a university as an example, combining its features to study its new facilities arrangement.

II. ANALYSIS OF CAMPUS FACILITIES

.We get five elements of campus facilities arrangement by combining SLP method and campus features, such as people, quantity, routine, structure, time. Firstly, as shown in Fig. 1, we drew a campus plan so that we can know the relative position of campus facilities. Then used map to measure the distance between each two location points on the basis of campus plan. Finally, a traffic from to chart is given based on the assumption of flow among campus facilities, as seen in the following in TABLE I.

TABLE I. TRAFFIC FROM TO CHART (UNIT:METERS)

From \ To	No.1	No.2	No.3	No.4	No.5	No.6	No.7	No.8	No.9	No.10	No.11	No.12	No.13	No.14	No.15	No.16	No.17	No.18	No.19	No.20	No.21	No.22	No.23
No.1 Facility		100		100			100	100	100														
No.2 Facility							300	300	600					500	500								
No.3 Facility							400	400	500					200	300								
No.4 Facility							350	350	500					100	400								
No.5 Facility							100	100	100					100	100								
No.6 Facility																							
No.7 Facility										300	300	300		400	200						200	200	200
No.8 Facility										300	200	200		300	300						100	100	100
No.9 Facility										600	100	100		200	400						200	200	200
No.10 Facility											100	100		100	100						100	100	100
No.11 Facility																							
No.12 Facility																							
No.13 Facility																							
No.14 Facility																					300	300	500
No.15 Facility																					500	500	300
No.16 Facility																							
No.17 Facility																							
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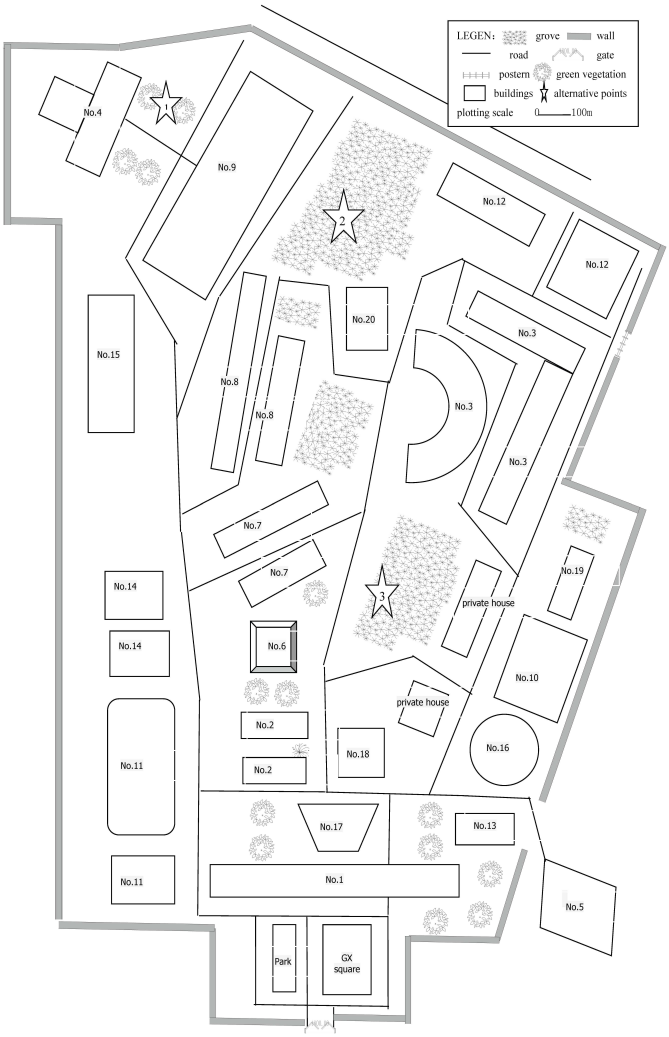

Fig. 1. Campus plan.

III. ANALYSIS OF NEW FACILITIES ARRANGEMENT

A. Logistics intension from to chart

Logistics intension is the sum of the product of the traffic and distance. We calculated the logistics intension of facilities according to TABLE I and the assumption of flow among campus facilities, as seen in the following in TABLE II.

B. Logistics related graph

It can reveal the grade of logistics intension base on TABLE II. Then obtain the proportion of each logistics intension grade (see TABLE III) by combining the famous "A,E,I,O,U" hierarchy classification method. And also can get a logistics intension related graph, just seen in the following Fig. 2.

TABLE II. LOGISTICS INTENSION CORRELATION TABLE OF FACILITIES

No.	Route	Logistics Intension	Grade	No.	Route	Logistics Intension	Grade	No.	Route	Logistics Intension	Grade
1	3-9	750	A	22	10-22	130	I	43	2-14	75	O
2	9-10	720	A	23	10-21	130	I	44	8-23	73	O
3	2-9	396	A	24	2-8	123	I	45	5-14	71	O
4	3-8	360	A	25	8-11	122	I	46	1-8	71	O
5	3-15	360	A	26	5-9	120	I	47	7-15	70	O
6	3-7	356	A	27	7-22	116	I	48	10-14	69	O
7	14-23	300	A	28	15-21	115	I	49	4-14	68	O
8	8-10	288	E	29	4-9	110	I	50	9-22	64	O
9	2-15	280	E	30	1-4	110	I	51	10-11	61	O
10	15-23	264	E	31	7-21	108	I	52	1-7	54	O
11	7-10	237	E	32	4-15	108	I	53	10-12	51	O
12	7-12	225	E	33	7-23	104	I	54	10-23	49	O
13	4-7	217	E	34	9-14	100	I	55	8-22	48	O
14	9-23	192	E	35	1-9	100	I	56	8-21	45	O
15	4-8	186	E	36	5-8	97	I	57	9-15	36	O
16	3-14	186	E	37	9-11	85	I	58	7-14	36	O
17	14-22	186	E	38	5-7	80	O	59	9-21	32	O
18	14-21	174	E	39	8-15	78	O	60	1-2	28	O
19	8-12	152	E	40	8-14	78	O	61	5-15	11	O
20	15-22	150	I	41	9-12	76	O	62	10-15	11	O
21	7-11	132	I	42	2-7	75	O				

C. Analysis of non-logistics factors of campus facilities

In addition, there is still non-logistics relation among campus facilities. We generally adopt qualitative methods to analyze these factors. According to grading reasons(factors of noise, security, life service, campus large-scale activities, administration, entertainment, etc, are chosen in this paper),we provide relation grades of A,E,I,O,U and X6 qualitatively, and draw a non-logistics related graph among campus facilities in Fig. 3, and got non-logistics intension of campus facilities(see TABLE IV).In related graph, each rhombus unit reflects relation grade between each two facilities. And the codes in this figure are grading reasons.

D. Comprehensive analysis of corrected campus facilities

Logistics and non-logistics factors have an effect on campus facilities location to each other. We can mark off a logistics intension to determine campus facilities location to each other through synthesizing two factors, and considering the relative importance of logistics and non-logistics factors. And it can use the ratio *m*:*n* to describe When elative these importance. Accordingly, we set the ratio *m*:*n* of relative importance on logistics and non-logistics factors equal to 3:1.

TABLE III. THE PROPORTION OF LOGISTICS INTENSION GRADE

Logistics Intension grade	Symbol	The Proportion of Logistics Route(%)	The Proportion of Logistics Volume(%)
Ultrahigh Logistics Intension	A	11	35
High Logistics Intension	E	19	28
Relative High Logistics Intension	I	29	22
Normal High Logistics Intension	O	41	15
Ignorable Transition	U	-	-

According to this ratio, we evaluate the grades in TABLE II and TABLE IV, and choose A=4,E=3,I=2,O=1,U=0,X=-1.When weighted calculating the logistics and non-logistics factors on the basis of the ratio 3:1,the calculating results are shown in TABLE V and TABLE VI.

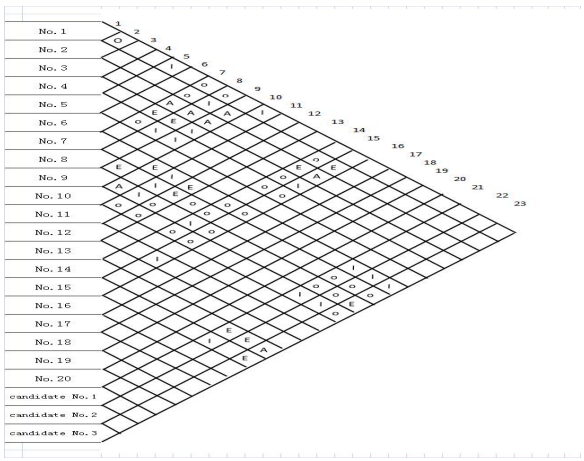

Fig. 2. Logistics intension related graph of campus facilities.

TABLE IV. NON-LOGISTICS INTENSION OF CAMPUS FACILITIES

No.	Work Unit Pair (Logistics Route)	Non-logistics closeness grade	Reason's Number
1	1-11	X	1
2	1-12	X	1
3	1-13	I	5
4	2-11	X	1
5	2-12	X	1
6	2-13	I	5
7	3-11	X	1 2
8	3-12	X	1 2
9	3-13	I	5
10	3-14	X	1 2
11	3-15	X	1 2
12	4-11	X	1
13	4-12	X	1
14	4-13	I	5
15	5-11	X	1
16	5-12	X	1
17	5-13	I	5
18	6-13	I	5
19	7-11	I	4 6
20	7-12	I	4 6
21	7-14	E	3
22	7-15	E	3
23	8-11	I	4 6
24	8-12	I	4 6
25	8-14	E	4 3
26	8-15	E	3
27	9-11	I	4 6
28	9-12	I	4 6
29	9-14	E	3
30	9-15	E	3
31	10-11	X	1
32	10-12	X	2
33	11-21	I	4 6
34	11-22	I	4 6
35	11-23	I	4 6
36	12-21	I	6
37	12-22	I	6
38	12-23	I	6
39	14-21	E	3
40	14-22	E	3
41	14-23	E	3
42	15-21	E	3
43	15-22	E	3
44	15-23	E	3

E. Determining campus new facilities location

The location of campus new facilities will be chosen among 3 uncertain locations. On the basis of TABLE VI, we calculate the sum of the comprehensive related score of work unit pairs of uncertain locations 1,2,3,and get the TABLE VII.

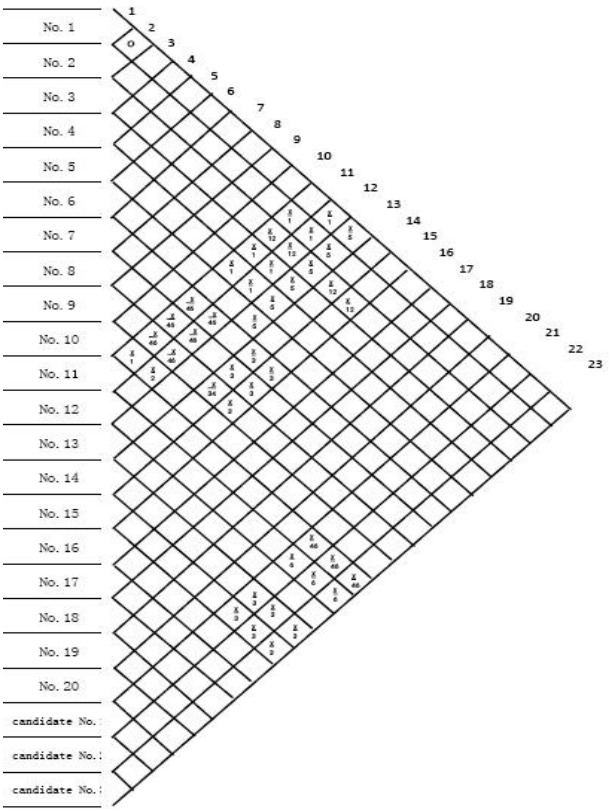

Fig. 3. Non-logistics related graph of campus facilities.

The higher of the comprehensive relation score of facilities is, the closer between this facility and other facilities is. Because uncertain location 3's comprehensive relation score is the highest, the location of campus new teaching building is in uncertain location 3.

TABLE V. COMPREHENSIVELY CORRELATION OF CAMPUS FACILITIES

No.	Work Unit Pair	Closeness Degree				Comprehensive correlation	
		Logistics Factor(Weight value:3)		Non-logistics Factor(Weight value:1)			
		Grade	Score	Grade	Score	Score	Grade
1	1-2	O	1	U	0	3	O
2	1-4	I	2	U	0	6	I
3	1-7	O	1	U	0	3	O
4	1-8	O	1	U	0	3	O
5	1-9	I	2	X	-1	-1	X
6	1-11	U	0	X	-1	-1	X
7	1-12	U	0	I	2	2	O
8	2-7	0	1	U	0	3	O
9	2-8	I	2	U	0	6	I
10	2-9	A	4	U	0	12	A
11	2-11	U	0	X	-1	-1	X
12	2-12	U	0	X	-1	-1	X
13	2-13	U	0	I	2	2	O
14	2-14	O	1	U	0	3	O
15	2-15	E	3	U	0	9	E
16	3-7	A	4	U	0	12	A
17	3-8	A	4	U	0	12	A

Cont.to TABLE V							
18	3-9	A	4	U	0	12	A
19	3-11	U	0	X	-1	-1	X
20	3-12	U	0	X	-1	-1	X
21	3-13	U	0	I	2	2	O
22	3-14	O	1	X	-1	2	O
23	3-15	I	2	X	-1	5	I
24	4-7	E	3	U	0	9	E
25	4-8	E	3	U	0	9	E
26	4-9	I	2	U	0	6	E
27	4-11	U	0	X	-1	-1	X
28	4-12	U	0	X	-1	-1	X
29	4-13	U	0	I	2	2	O
30	4-14	E	3	U	0	9	E
31	4-15	A	4	U	0	12	A
32	5-7	O	1	U	0	3	O
33	5-8	I	2	U	0	6	I
34	5-9	I	2	U	0	6	I
35	5-11	U	0	X	-1	-1	X
36	5-12	U	0	X	-1	-1	X
37	5-13	U	0	I	2	2	O
38	5-14	O	1	U	0	3	O
39	5-15	O	1	U	0	3	O
40	6-13	U	0	I	2	6	I
41	7-10	E	3	U	0	9	E
42	7-11	I	2	I	2	8	E
43	7-12	E	3	I	2	11	E
44	7-14	O	1	E	3	6	I
45	7-15	O	1	E	3	6	I
46	7-21	I	2	U	0	6	I
47	7-22	I	2	U	0	6	I
48	7-23	I	2	U	0	6	I
49	8-10	E	3	U	0	9	E
50	8-11	I	2	I	2	8	E
51	8-12	E	3	I	2	11	E
52	8-14	O	1	E	3	6	I
53	8-15	O	1	E	3	6	I
54	8-21	O	1	U	0	3	O
55	8-22	O	1	U	0	3	O
56	8-23	O	1	U	0	3	O
57	9-10	A	4	U	O	12	A
58	9-11	I	2	I	2	8	E
59	9-12	O	1	I	2	5	I
60	9-14	I	2	E	3	9	E
61	9-15	O	1	E	3	6	I
62	9-21	O	1	U	0	3	O
63	9-22	O	1	U	0	3	O
64	9-23	E	3	U	0	9	E
65	10-11	O	1	X	-1	2	O
66	10-12	O	1	X	-1	2	O
67	10-14	O	1	U	0	3	O
68	10-15	O	1	U	0	3	O
69	10-21	I	2	U	0	6	I
70	10-22	I	2	U	0	6	I
71	10-23	O	1	U	0	3	O
72	11-21	U	0	E	3	3	O
73	11-22	U	0	E	3	3	O
74	11-23	U	0	E	3	3	O
75	12-21	U	0	E	3	3	O

Cont.to TABLE V							
76	12-22	U	0	E	3	3	O
77	12-23	U	0	E	3	3	O
78	14-21	E	3	E	3	12	A
79	14-22	E	3	E	3	12	A
80	14-23	A	4	E	3	15	A
81	15-21	I	2	E	3	9	E
82	15-22	I	2	E	3	9	E
83	15-23	E	3	E	3	12	A

TABLE VI. CALCULATION RESULTS OF GRADING DIVIDING

The Number of Work Unit Pair	Percentage(%)	Sum	Correlation Grade
10	4.00%	12-15	A
15	6.00%	8-11	E
18	7.00%	5-7	I
30	12.00%	1-4	O
170	67.00%	0-1	U
10	4.00%	-1	X
253	100%	Sum	

TABLE VII. THE COMPREHENSIVE RELATION SCORE OF UNCERTAIN LOCATIONS

Facility	The Sum of Comprehensive Relation Score
Uncertain Location 1	66
Uncertain Location 2	67
Uncertain Location 3	77

IV. CONCLUSION

The link between campus facilities layout and environment construction is close. Reasonable and scientific campus new facilities layout will make full use of new facilities functions and promote the sustainable development of campus environment. And favorable campus environment is beneficial for holding teachers' and students' teaching activities and recreational activities, increasing students' satisfaction to campus, and facilitating campus development.

This paper combining the actual situation of a certain college assumes three facility points as the uncertain locations and uses SLP method to firstly analyze and input data of five SLP elements on campus, to draw the campus plan, traffic and distance from to chart, then to analyze the logistics and non-logistics relation of campus facilities by using these basic data and from to chart, related graph and A,E,I,O,U hierarchy classification method, finally to choose 3 uncertain location as the ultimate location by generally considering the comprehensive relation between uncertain locations and other facility locations. In this paper, decision support is provided for campus new facility layout problem.

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