

Space Guideline for a Humanitarian Logistics Base in an Airport

September 11th, 2014

Sunkyung Choi and Hanaoka Shinya



TOKYO INSTITUTE OF TECHNOLOGY

The Graduate School of Science and Engineering

Department of International Development Engineering

Outline

1. Introduction

2. Methodology

3. Result

4. Case study

5. Conclusion

1. Introduction

Importance of air transport in post-disaster



Great East Japan Earthquake
in 2011

Loss of transportation modes

Sendai airport shut down for a
while right after disaster

**Other airports in Tohoku
region played a critical role**

- immediate disaster response through air transport
- air transport as a node for accepting goods and personnel
- attention from not only academics but also practitioners.

Background

Role of airport in post-disaster



Personnel transport



Transport of aid goods



Rescue activity



Medical care

Research problem

Problems occurring in airport in post-disaster

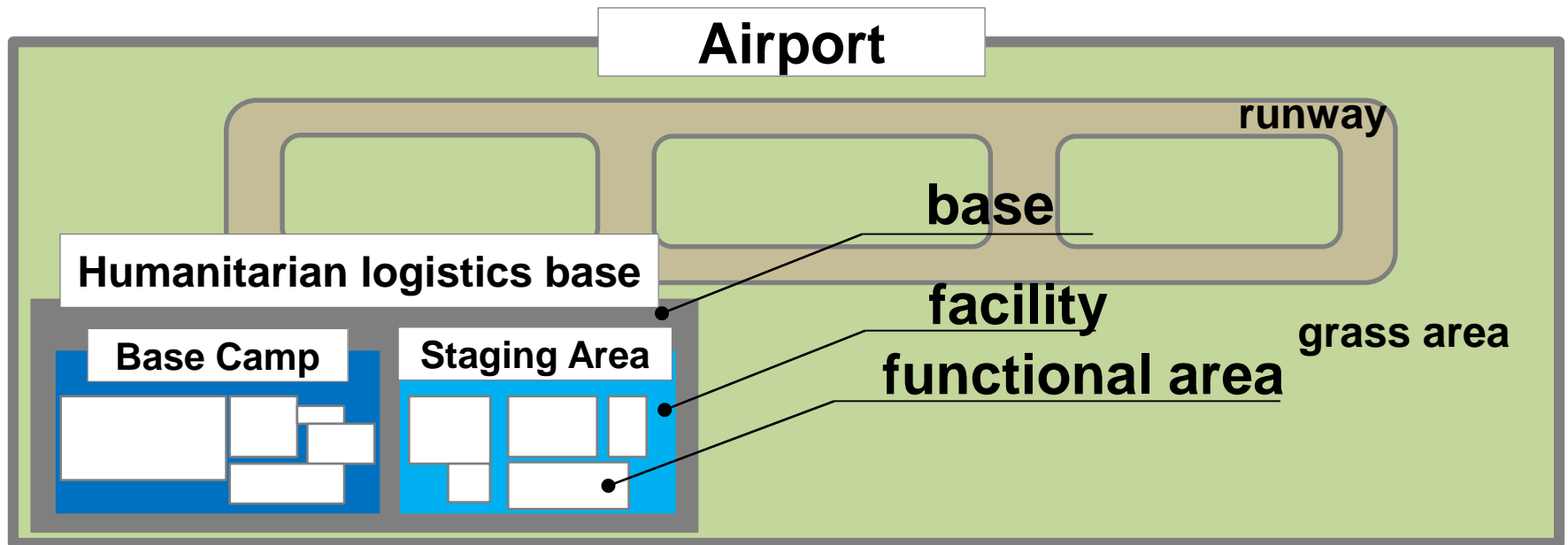
Hanaoka *et al.* (2013)

1. Limited fueling system capacity, lighting facilities
2. Lack of aircraft parking space
3. Undesignated space for medical emergency team
- 4. Inadequate place to sort and store relief supplies**
- 5. Insufficient lodging spaces for emergency workers**



Humanitarian logistics base

Airport as a humanitarian logistics base :
an airport that is prepared with facilities and equipment in order to support humanitarian logistics such as storing and sorting relief goods, lodging spaces for human resources and evacuees.



- **Base camp:** a temporary accommodation facility for emergency support staff such as military, police, fire fighters, etc.
- **Staging area:** a temporary site close to disaster impact area where personnel, equipment, and commodities are kept

Humanitarian logistics base

Current practices in humanitarian logistics base

Regional humanitarian logistics base was mentioned in several practical projects. Previous studies mention approximate whole area of each facility.

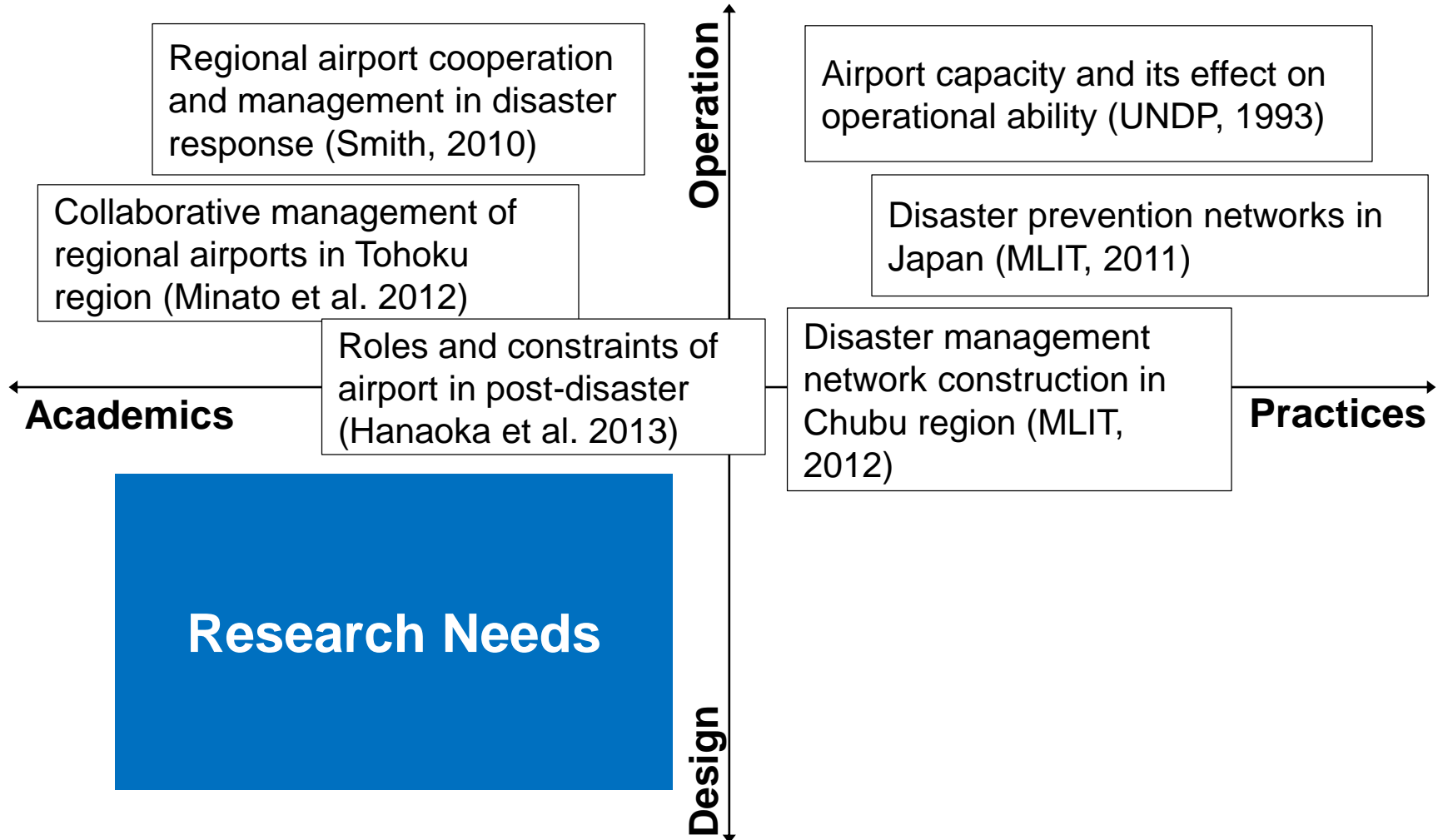
Therefore, this research tries to define functional area inside of facility as a humanitarian logistics base.

Name	Location	Coverage	Expected roles	Features	Component
Regional logistics hub for Humanitarian Assistance in Panama(2011)	Panama	International	Supporting humanitarian logistics activities, warehousing, staging, cooperation between international relief organizations	Planned in a part of airport planning	Staging area (warehouse)
ASEAN coordinating center for Humanitarian Assistance(2008)	Indonesia	International	Sharing data and knowledge about disaster management within ASEAN region, enabling efficient and effective disaster management plan by cooperation	Coordinated center for disaster management among ASEAN	-
State Emergency Response Team Unified Logistics plan(2009)	Florida, USA	Domestic	Providing base camps for emergency workers, securing staging area and warehouse prior to disaster	Recommended to be set up near major airports	Staging area, base camp
Chubu Region Disaster Management Network, Humanitarian logistics base(2013)	Japan	Domestic	Providing base camps for emergency workers, securing staging area and warehouse prior to disaster	Planned as a part of airport planning	Staging area, base camp

Research position

Previous studies on use of airports in post-disaster

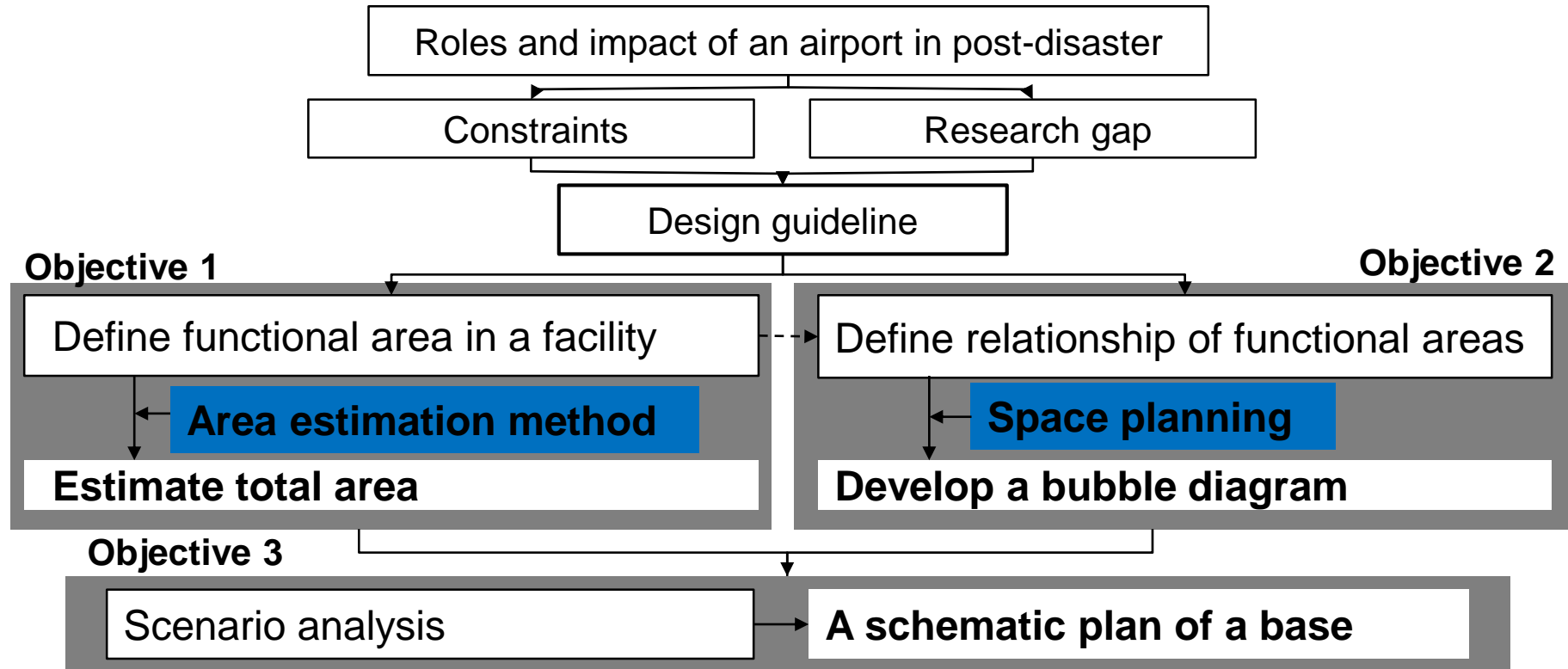
- most studies on operational issues in academics and practices.
- attempt in perspective of airport design planning.



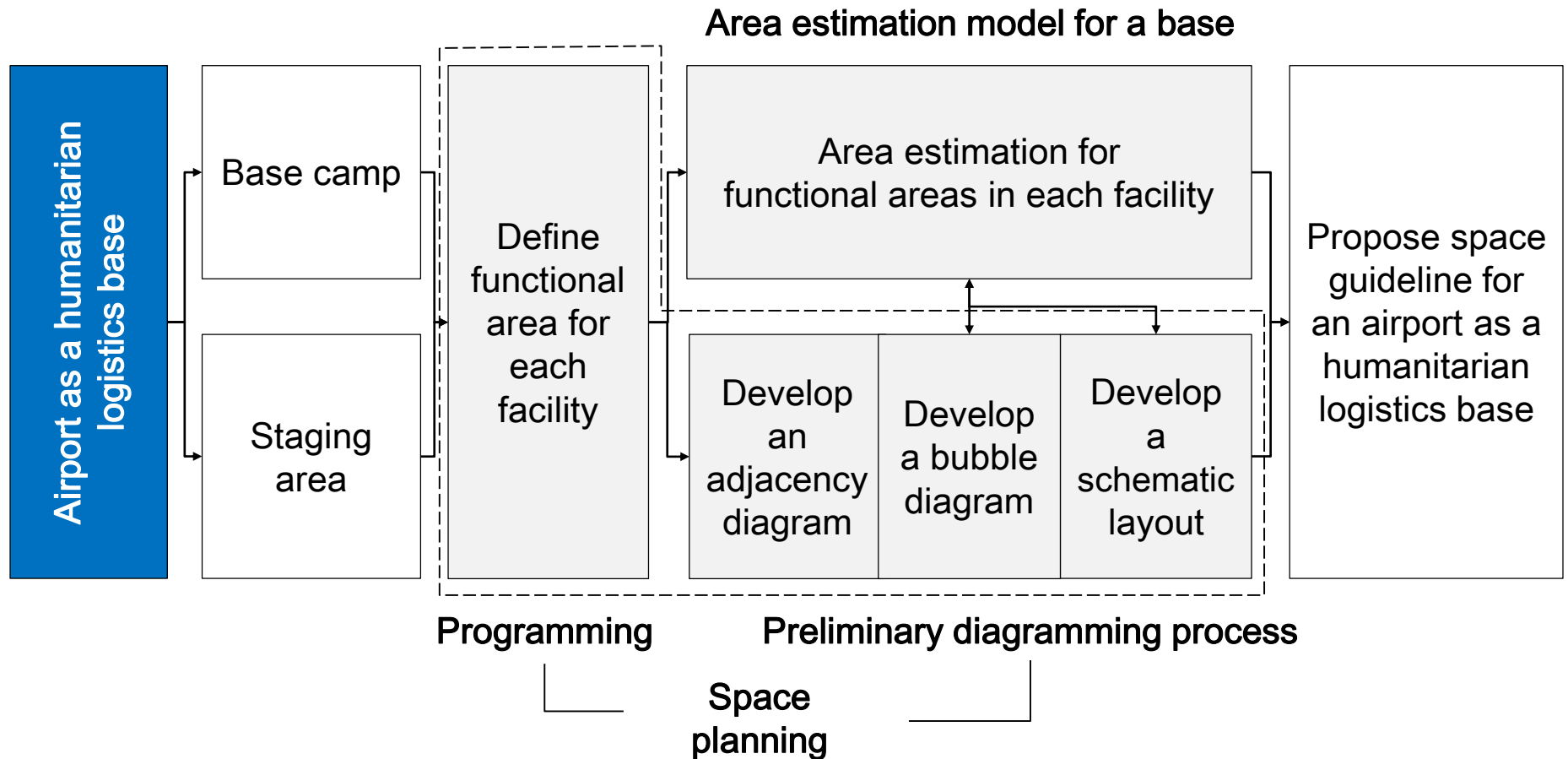
Research goal and objectives

To propose design guideline for an airport as a humanitarian logistics base

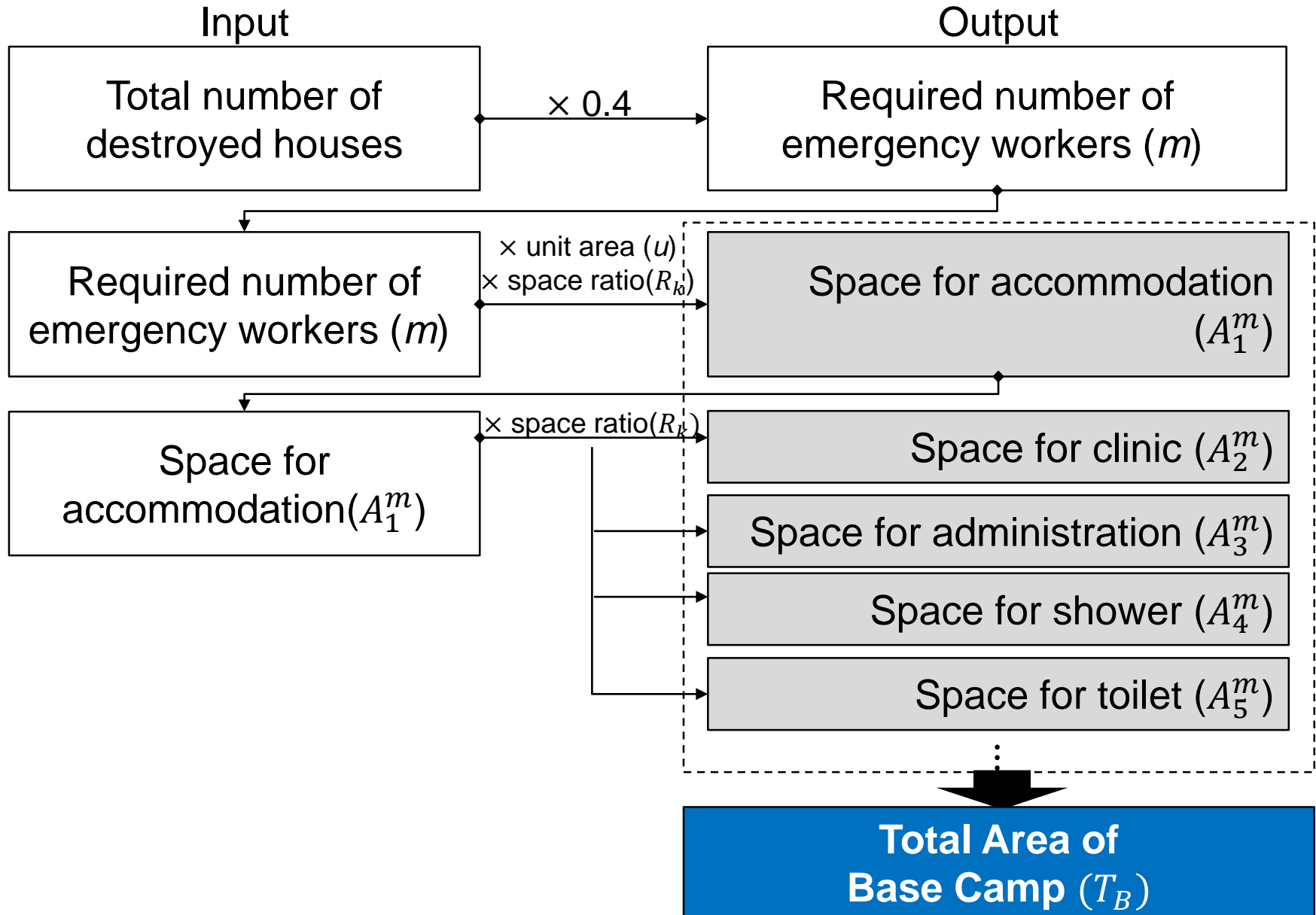
1. Estimate area of required facilities in a humanitarian logistics base
2. Make a space planning for each facility based on adjacency matrix and bubble diagram concept
3. Propose a schematic plan as a case study for Shizuoka Airport



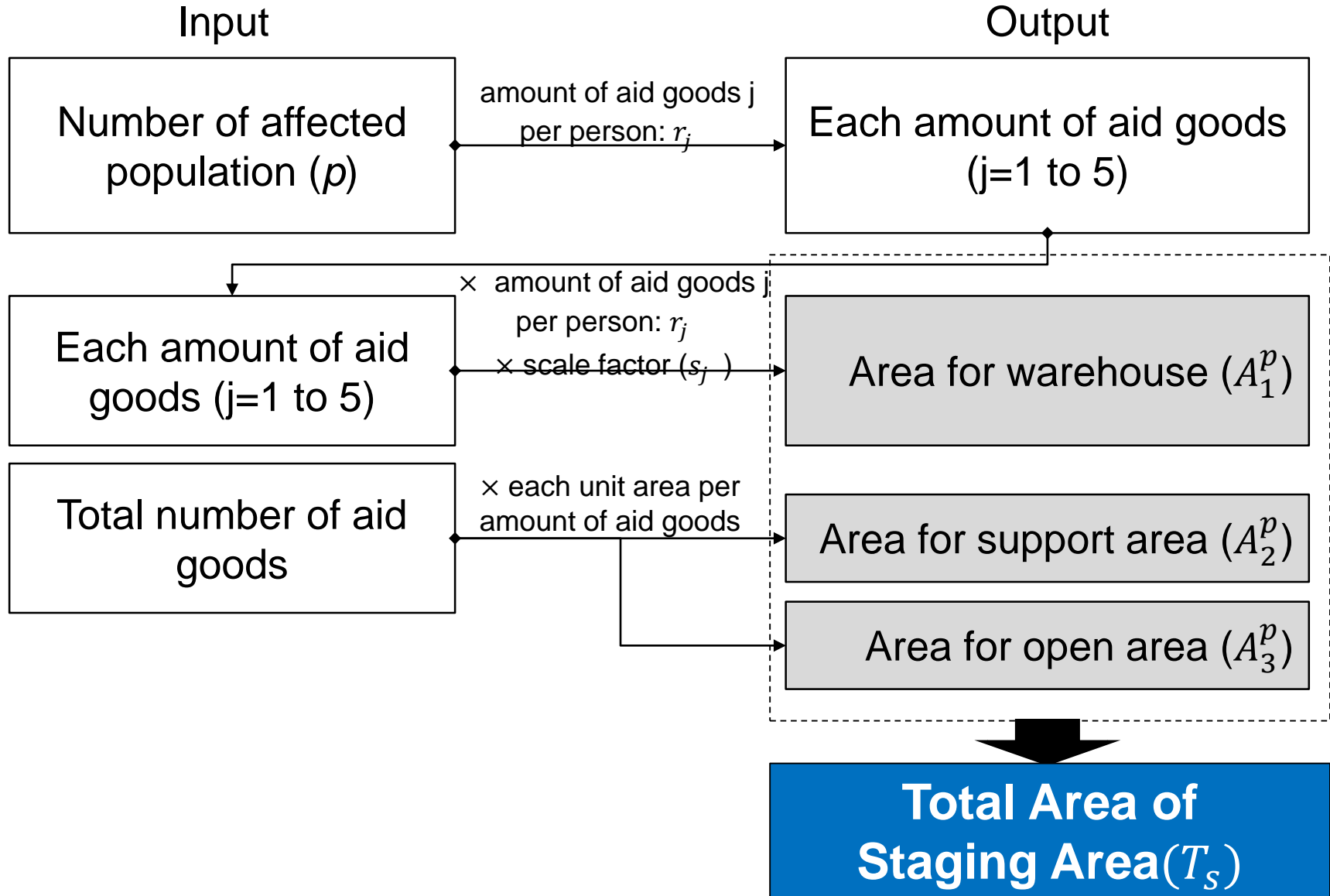
2. Methodology



Area estimation for a base camp

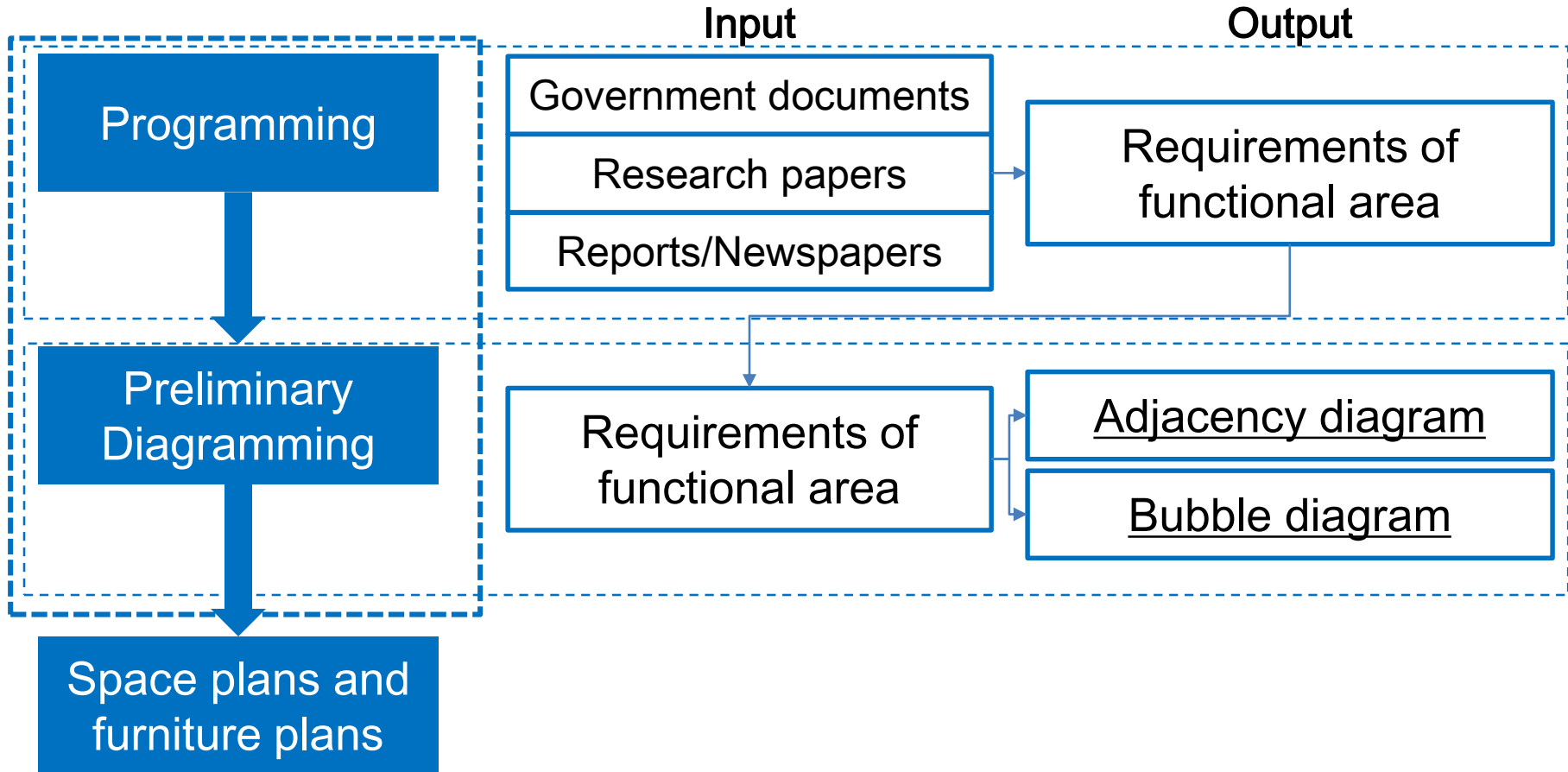


Area estimation for a staging area



Space planning method

Space planning process: find a solution for space layout with given conditions



Space planning method

1. Adjacency diagram and requirement

VICE PRESIDENT	●
DIRECTOR	○
DEPUTY DIRECTOR	○
ENVIRONMENTAL PLANNING	○
CENTER FOR DEVELOPMENT	○
OFFICE OF RESEARCH & DEVELOPMENT	○
RESOURCE CENTER	○
PUBLIC INFORMATION	○
COMMUNITY RELATIONS	○
ADMINISTRATIVE SERVICES	○
OFFICE OF NEW PROGRAMS	○
PERSONNEL	○
PUBLIC	○

● IMMEDIATE PROXIMITY ○ CONVENIENT PROXIMITY

- used in architectural planning
- visualize relationship between each functional area in a planning process

Source: Adapted from The Architect's Handbook of Professional Practice, 2001

2. Bubble diagram and schematic plan

<h3>Adjacency requirements</h3> <table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 10%;">1</td><td style="width: 50%;">ADJACENT TO</td><td style="width: 40%;">2 4</td></tr> <tr><td>2</td><td>—————</td><td>3 4 1</td></tr> <tr><td>3</td><td>—————</td><td>2 4</td></tr> <tr><td>4</td><td>—————</td><td>1 2 3</td></tr> </table>	1	ADJACENT TO	2 4	2	—————	3 4 1	3	—————	2 4	4	—————	1 2 3	<h3>Bubble diagram</h3>	<h3>Schematic plan</h3>
1	ADJACENT TO	2 4												
2	—————	3 4 1												
3	—————	2 4												
4	—————	1 2 3												

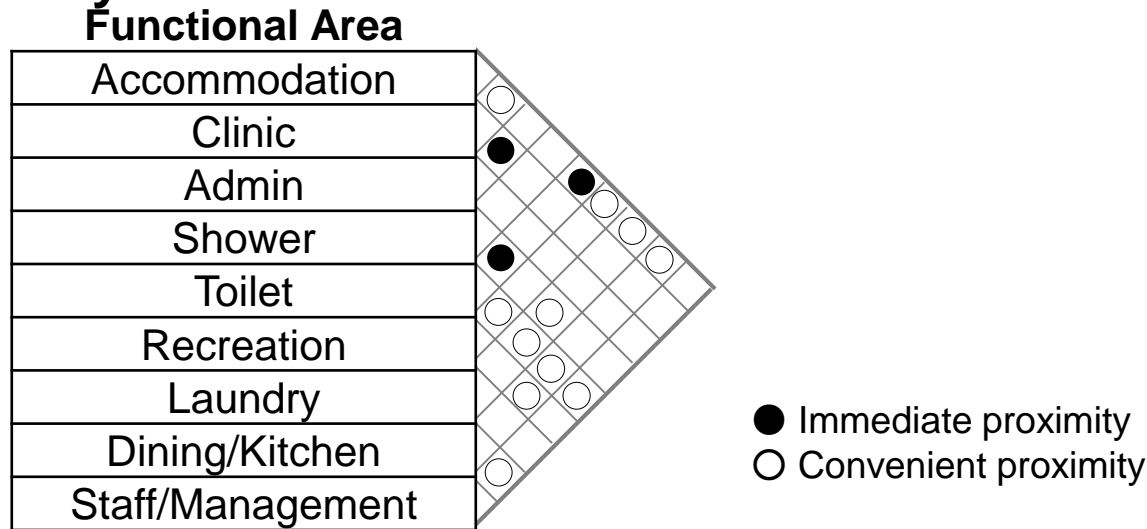
Source: Adapted from Ruch (1978)

3. Result: area estimation for a base camp

		Unit: m ²					
Emergency workers	1000	750	500	250	150	100	
1	Accommodation	9009	6756	4504	2252	1351	900
2	Clinic	1126	844	563	281	168	112
3	Admin	1126	844	563	281	168	112
4	Shower	1407	1055	703	351	211	140
5	Toilet	1407	1055	703	351	211	140
6	Recreation center	2252	1689	1126	563	337	225
7	Laundry	563	422	281	140	84	56
8	Dining/Kitchen	12263	9197	6131	3065	1839	1226
9	Staff	563	422	281	140	84	56
9	Management	281	211	140	70	42	28
Total		30000	22500	15000	7500	4500	3000
Total(ha)		3	2.25	1.5	0.75	0.45	0.3

Adjacency analysis of a base camp

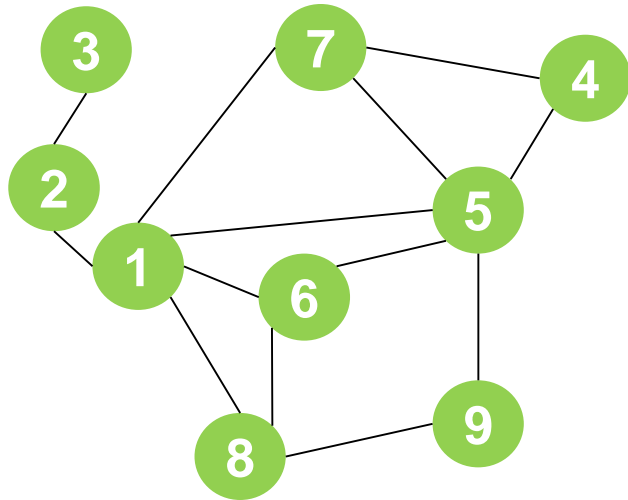
Adjacency matrix



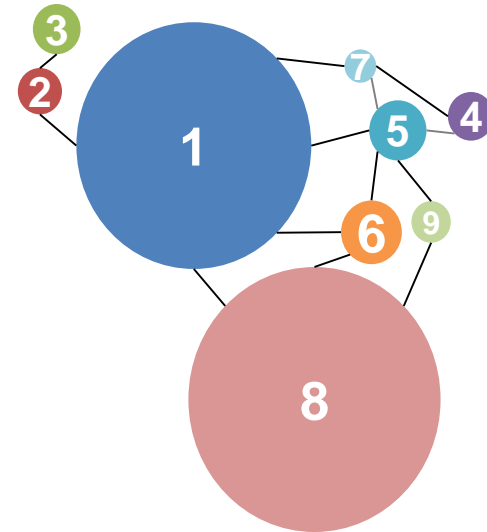
Adjacency requirement

Functional Area	Number	Adjacency requirement
Accommodation	1	adjacent to 2,5,6,7,8
Clinic	2	adjacent to 1,3
Admin	3	adjacent to 2
Shower	4	adjacent to 5,7
Toilet	5	adjacent to 1,4,6,7,9
Recreation	6	adjacent to 1,5,8
Laundry	7	adjacent to 1,4,5
Dining/Kitchen	8	adjacent to 9
Staff/Management	9	adjacent to 5,8

Bubble diagram of a base camp



Initial diagram without area consideration



Space bubble diagram under area consideration

Functional Area	Number
Accommodation	1
Clinic	2
Admin	3
Shower	4
Toilet	5
Recreation	6
Laundry	7
Dining/Kitchen	8
Staff/Management	9

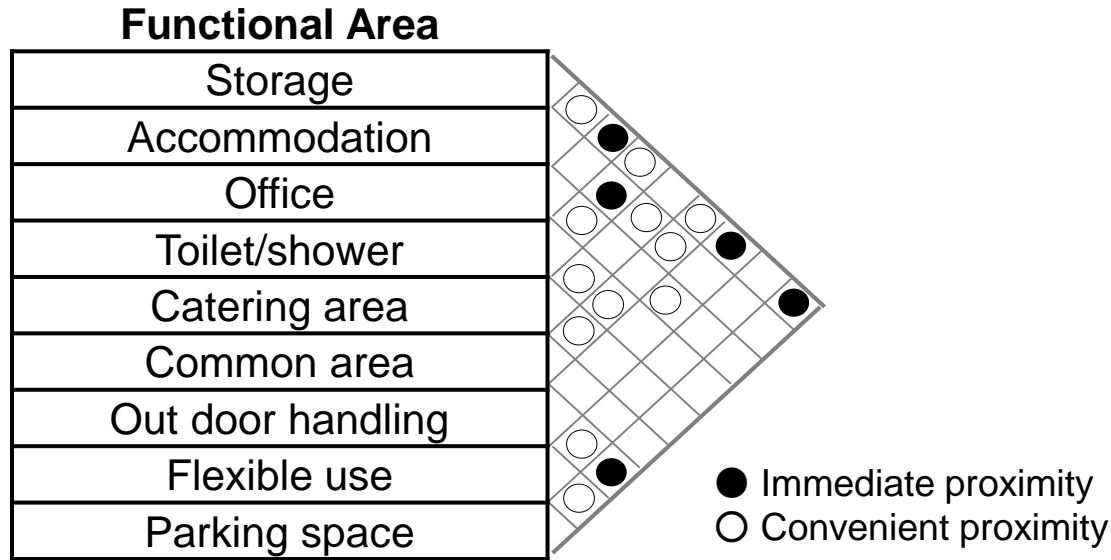
Area estimation result of a staging area

Unit: m²

		Affected population	10000	30000	50000	70000
Storage area	1	Water	342.3	1026.9	1711.5	2396.1
		Food	396.9	1190.7	1984.5	2778.3
		Blanket	133.2	399.6	666.0	932.4
		Mandatory kit	111.0	333.0	555.0	777.0
		Toilet	90.7	272.2	453.7	635.2
Support Area	2	Accommodation	3234.0	9702.0	16170.0	22638.0
	3	Office	202.1	606.3	1010.6	1414.8
	4	Toilet/shower	202.1	606.3	1010.6	1414.8
	5	Catering area	202.1	606.3	1010.6	1414.8
	6	Common area	202.1	606.3	1010.6	1414.8
Open space	7	Outdoor handling and staging	4812.5	14437.5	24062.5	33687.5
	8	Flexible use	4812.5	14437.5	24062.5	33687.5
	9	Parking space	9625.0	28875.0	48125.0	67375.0
Total Staging Area			24581.4	73744.4	122907.4	172070.3
Total Staging Area(ha)			2.45	7.37	12.2	17.2

Adjacency matrix of a staging area

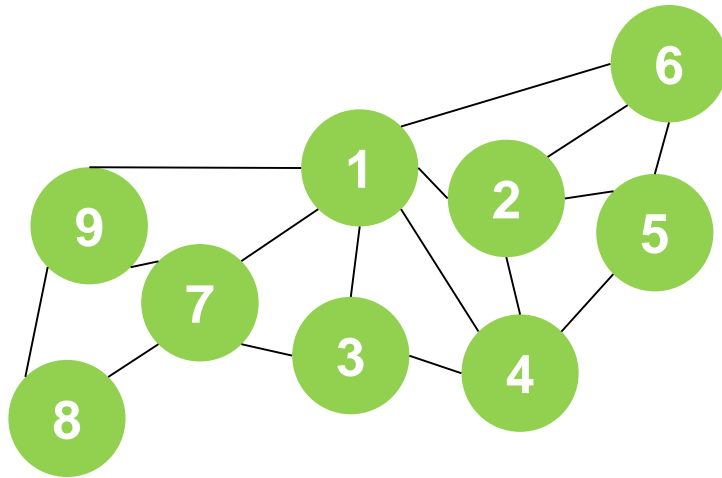
Adjacency matrix



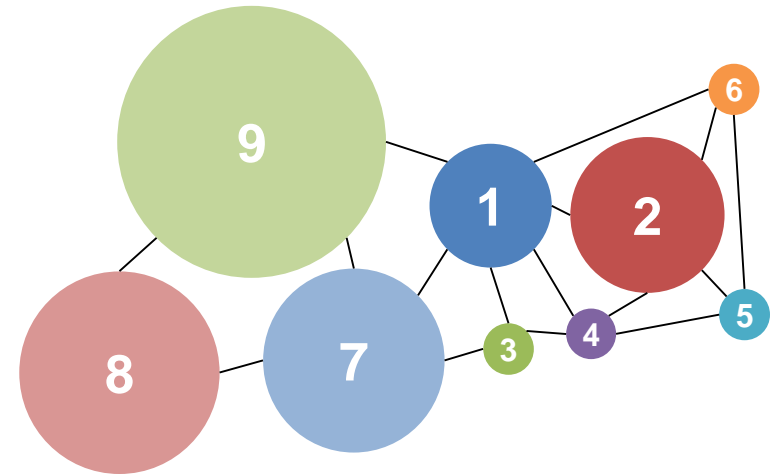
Adjacency requirement

Functional Area	Number	Adjacency requirement
Storage	1	adjacent to 2,3,4,6,7,9
Accommodation	2	adjacent to 1,4,5,6
Office	3	adjacent to 1,4,7
Toilet/shower	4	adjacent to 1,2,3,5,6
Catering area	5	adjacent to 2,4,6
Common area	6	adjacent to 1,2,4,5
Outdoor handling	7	adjacent to 1,3,8,9
Flexible use	8	adjacent to 7,9
Parking space	9	adjacent to 1,7,8










Bubble diagram of a staging area



Initial diagram without area consideration



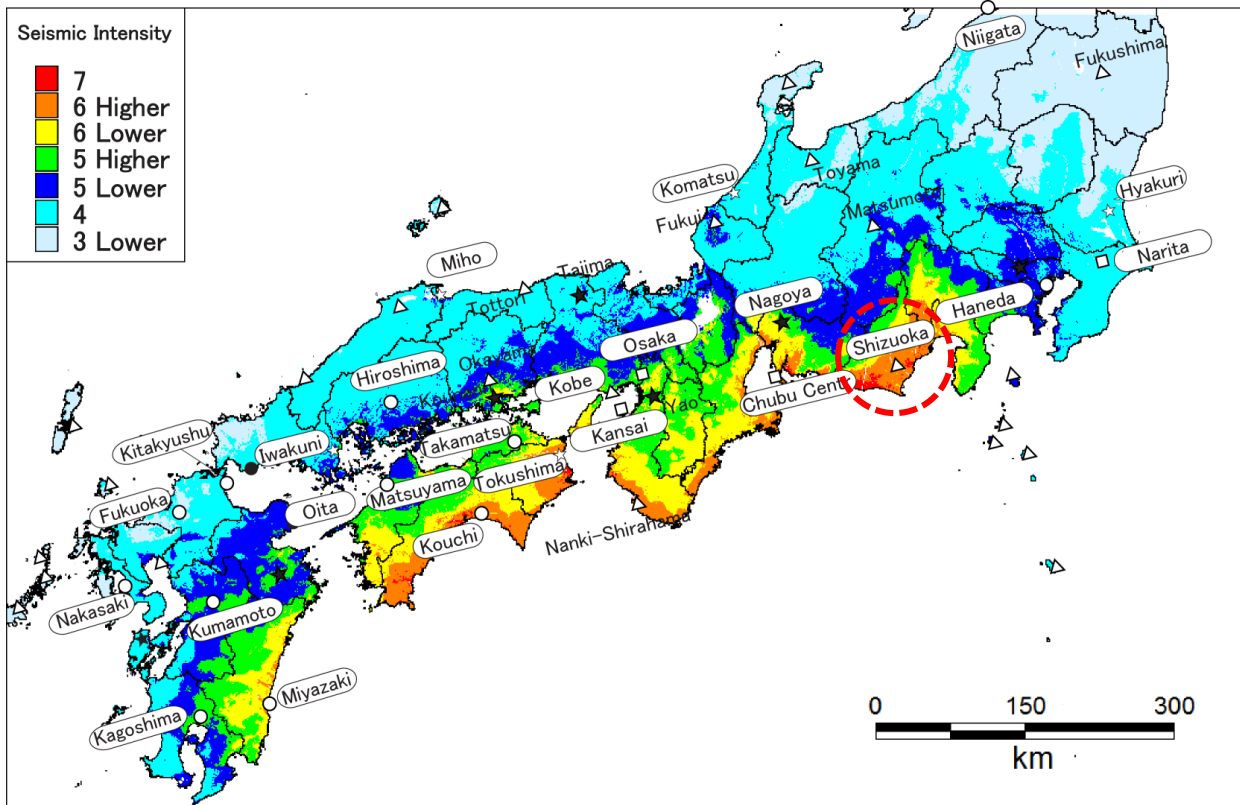
Space bubble diagram under area consideration

Functional Area	Number
 Storage	1
 Accommodation	2
 Office	3
 Toilet/shower	4
 Catering area	5
 Common area	6
 Out door handling/staging	7
 Flexible use	8
 Parking space	9

4. Case study

Shizuoka Airport: selected as a humanitarian logistics base in Chubu Region (MLIT, 2013)

- Estimated that 17,000 emergency workers and 43,000 affected population under Tonankai scenario in Shizuoka Prefecture would be required
- Earthquakes and tsunamis are considered in scenario
- Located in high mountain area of Shizuoka Prefecture



Date Opened	June 4, 2009
Type of Airport	Locally managed airport built and operated by Shizuoka Prefecture
Runway	Length 2,500m, Width 60m
Controlled Area	Airport Proper Approx. 190ha Total Area Approx. 500ha
Aprons	Eight berths

Current plan of Shizuoka Airport

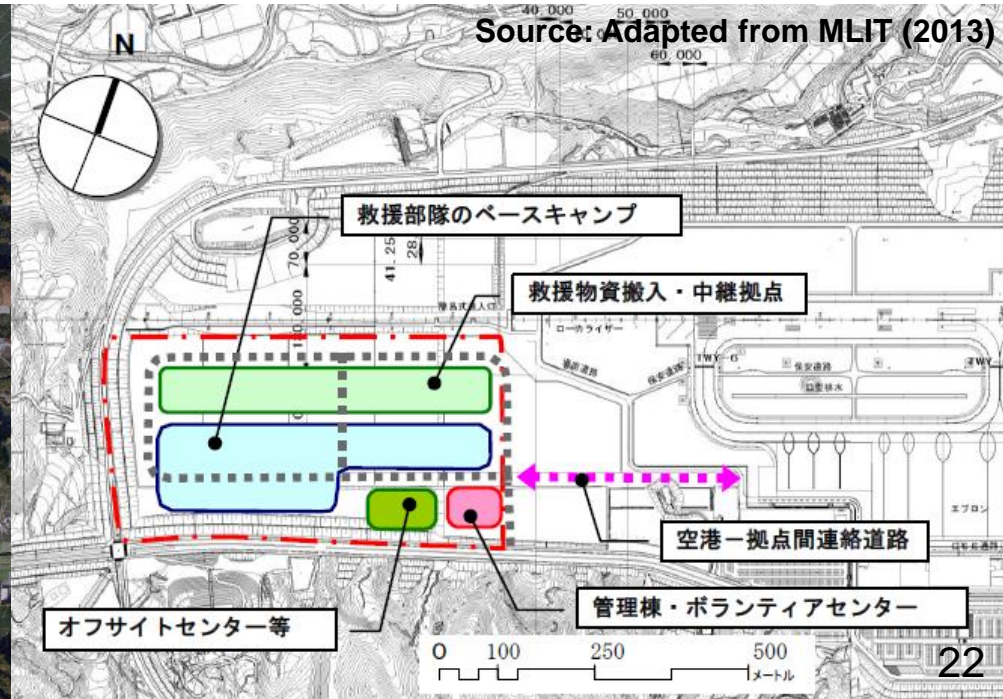
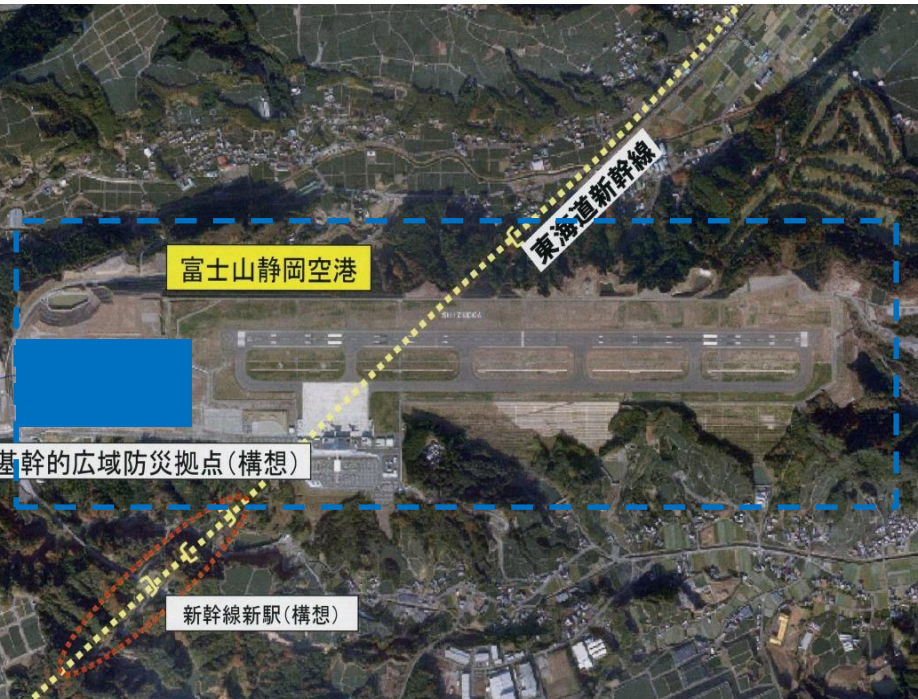
- Approximate current site size is 280m by 580m and area is about 16ha.
- Three facilities considered in current planning phase

1. Humanitarian logistics space (staging area)

2. Base Camp area: accommodate emergency workers such as police, military, volunteer, etc. in case of disaster

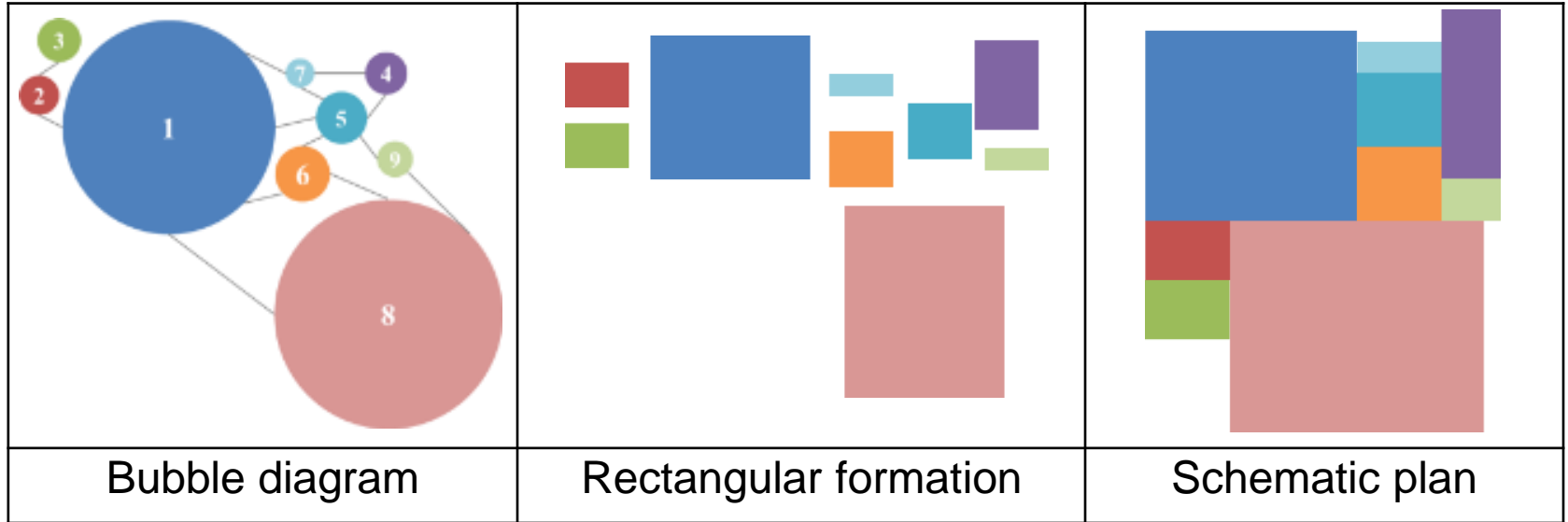
3. Staging Care Unit: space equipped with medical supplies and bedding

Humanitarian logistics base plan of Shizuoka Airport

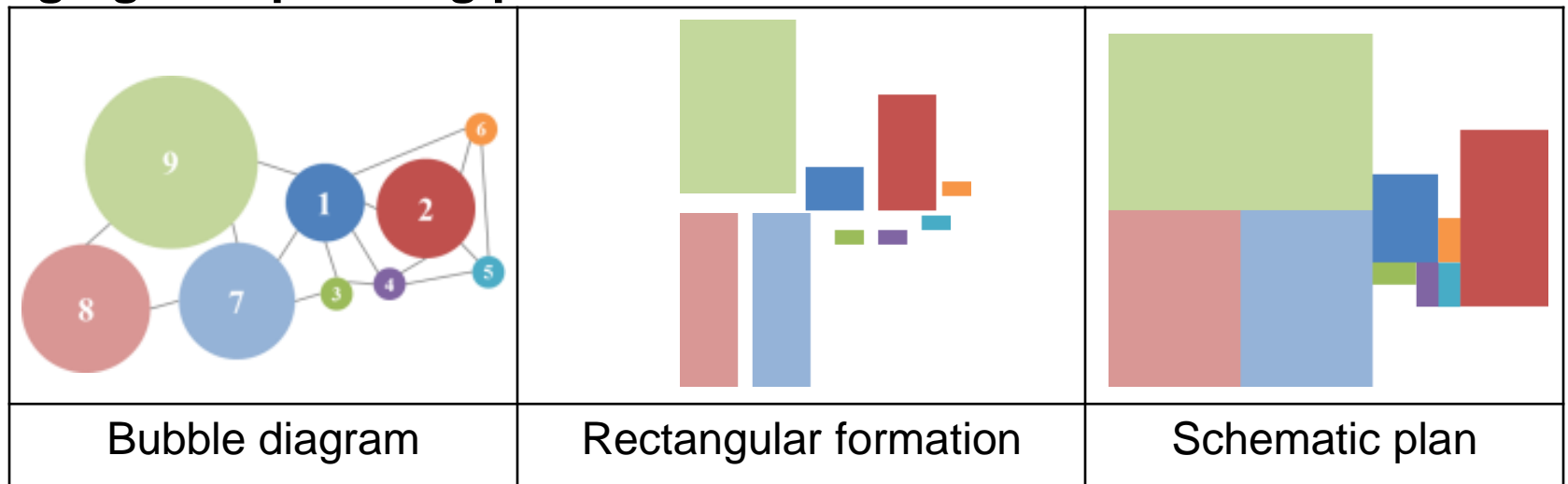


Space planning of a base

Base camp planning process

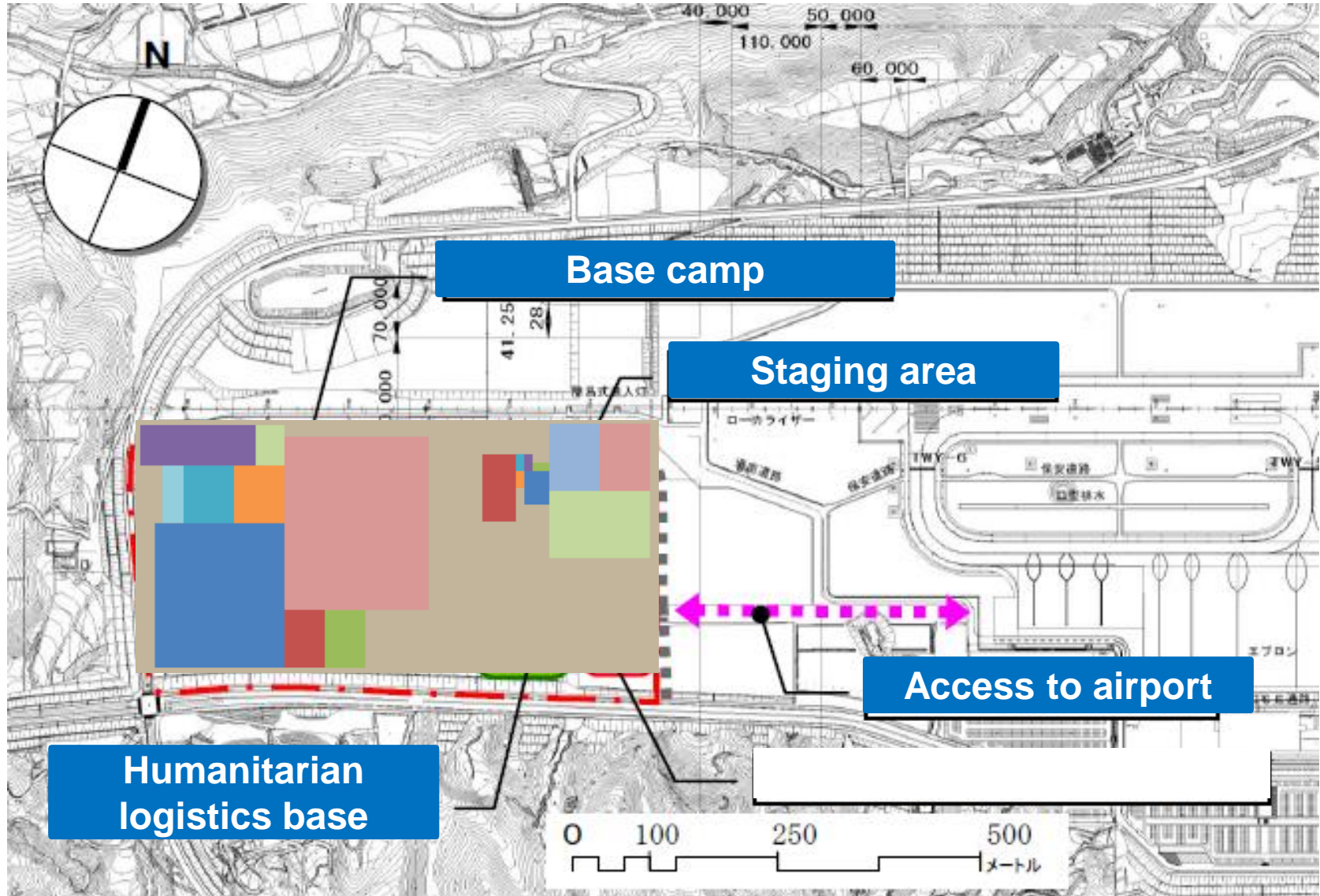


Staging area planning process



Site plan for Shizuoka Airport

- Maximum coverage rate of the scenario is between 25% and 30% within 16ha.
- Base camp area is about 12.7 ha, and staging area is about 2.6ha



5. Conclusions

This study attempted defining a framework for space layout in an airport as a humanitarian logistics base.

- **dealt two space layout problems occurring in an airport in post-disaster:** insufficient accommodation for emergency workers and undesignated site for staging humanitarian aid goods
- **proposed a methodology for design guideline as a humanitarian logistics base in an airport** by integrating estimation method and architectural planning
- **tackled an issue in border with three fields;** architectural planning, humanitarian logistics and air transport studies

- **Future works:**

- development of a mathematical model incorporating constraints of an airport and considering flow of humanitarian logistics
- consideration on not only one airport but also the other airports as a whole network

Thank you for your attention.