국외 공무여행 결과 보고서

- 중국 계림 -

2017. 12.

기획조정연구부 권영현 연구실장
지역도시연구부 임준홍 연구위원
김원철 책임연구원

충남연구원
ChungNam Institute

목 차

1. 공무여행 개요

○ 출장기간 : 2017년 12월 10일(일) – 13일(수), 3박4일

○ 출장지역 : 중국 계림(Guilin)시 계림전자기술대학

○ 출 장 자 : 권영현 연구실장, 임준홍 연구위원, 김원철 책임연구원

2. 공무여행 목적

○ 중국 계림전자기술대학(Guilin University of Electronic Technology)과 공동연구, 인력교류, 등 연구 활성화를 위한과 양해각서(Memorandum of Unferstanding : MOU) 체결 (본원 지역도시연구부 및 중국 계림전자기술대학 건축교통공학과)

○ 계림전자기술대학에서 개최한 국제세미나에서 충남 지역도시정책 방향 및 교통연구 주제 발표 요청

3. 주요 세부일정

Date	Time	Schedule
10(일)	07:00～10:00	공주 ⇒ 인천국제공항
	12:00～19:00	인천국제공항 ⇒ 상하이푸동공항 ⇒ 구이린국제공항 (중국남방항공, 상하이항공)
	20:00～	호텔
11(월)	10:00～12:00	MOU 및 세미나 발표 준비 등
	14:00～17:00	MOU 체결
	19:00～	호텔
12(화)	10:00～17:00	세미나 참석 및 주제 발표 - 발표1 : The Impact of Development of Naepo New Town on Neighboring Cities (임준홍) - 발표2 : Influence of In-Vehicle Real-Time Traffic Safety Warning Information on Driving Stability at Limited Signal Visibility Approach (김원철)
	19:00～	호텔
13(수)	08:40～16:00	구이린국제공항 ⇒ 상하이푸동공항 ⇒ 인천공항 (중국남방항공, 아시아나)
	17:00～20:00	인천국제공항 ⇒ 공주

4. 공무여행 국가 개요

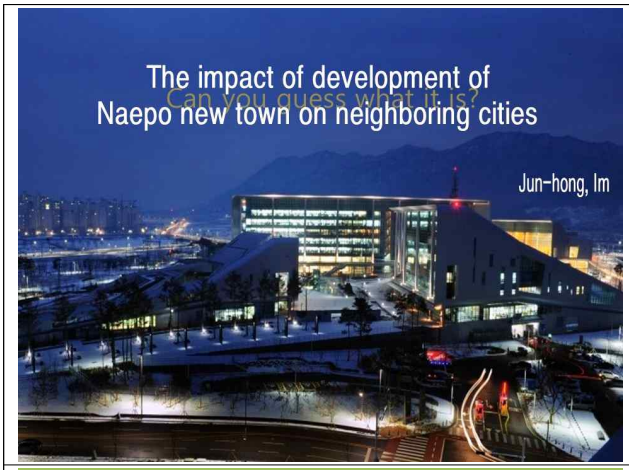
○ 계림시(구이린)는 중국의 남쪽에 위치하며 계림을 기준으로 서쪽으로 류저우, 남쪽으로 라이빈, 우저우, 동쪽으로 허저우와 후난 성 융저우, 북쪽으로 후난 성 사오양과 접하고 베트남과 국경을 이루고 있음.

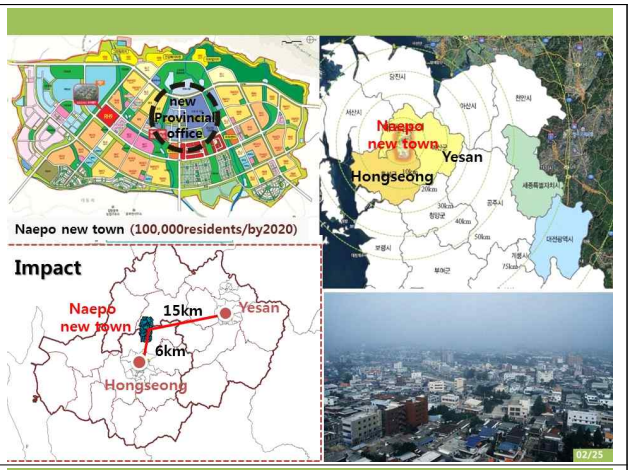
○ 이곳에 거주하고 있는 주민은 약 495만명 정도인데 장족(약 85% 차지), 한족, 묘족, 모한족 등 다양한 민족으로 형성되어 있고, 명·청때 광서성으로 불리다가 1958년에 자치구로 성립되었음

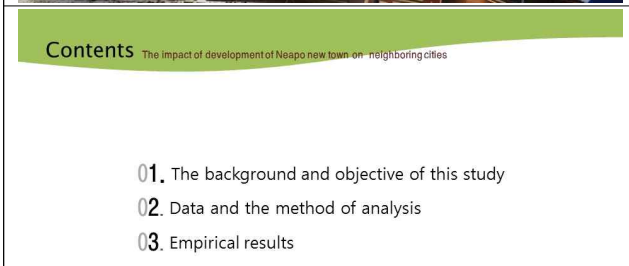
○ 해저에서 지각변동으로 육지가 된 카르스트 지형으로 '꾸이린산수갑천하'라는 명성으로 중국 10대 관광명승지 국제 관광도시, 국가지정 문화재 및 유적지가 109개소에 이르며 꾸이린산수를 찬미 한 시, 불교, 조각상들이 많이 산재하고 있는 역사, 문화의 도시로 시내교통이 매우 편리하며 관광객들을 위해 다른 도시에서 쉽게 볼 수 없는 무료셔틀버스를 운행하고 있음

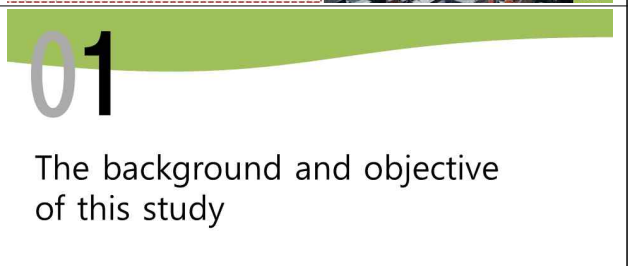
5. 발표 자료

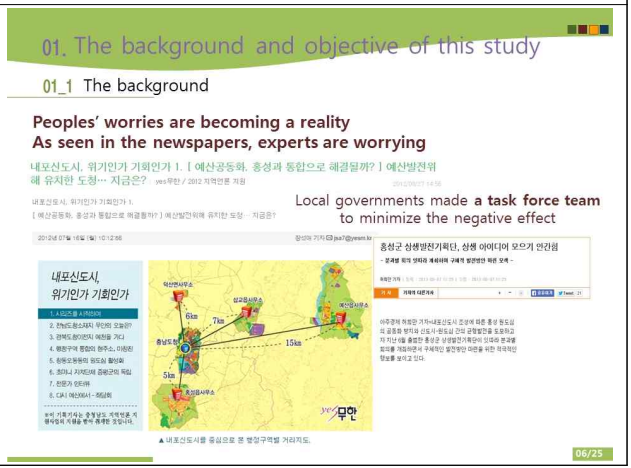
(1) The Impact of Development of Naepo New Town on Neighboring Cities











01. The background and objective of this study

01_2 The purpose

To *empirically evaluate* how the development of Naepo *would affect* the nearby cities

- **How many people** from nearby cities would move to Naepo?
- **What are the motives** of the people to move there?
  * Especially, the satisfaction with the residential environments will be analyzed
- What the **local governments** have to do?

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02

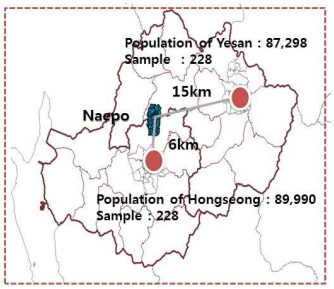
Data and the method of analysis

02. Data and the method of analysis

02_1 Data

- The empirical analysis : survey on 456 residents of Hongseong and Yesan

- The survey is asking
  - Intention of moving into Naepo
  - The degree of satisfaction with residential environments
  - Preferences on housing types



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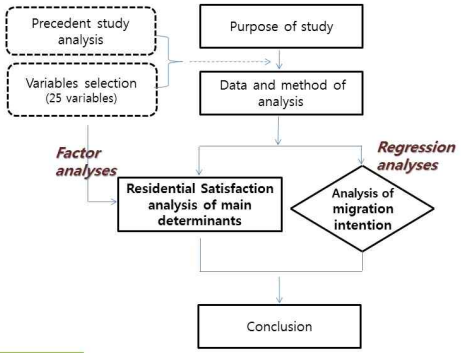
02. Data and the method of analysis

02_2 *Process* of analysis



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02. Data and the method of analysis

02_3 Input variables selection & factor extract

Literature review | Residential survey (central government) | Chungnam social survey (Chungnam province)

selection | *selection* / *measure* | *selection*

In the survey :
Satisfaction with residential environments (by 25 variables)

↓ *extract*

5 factors : Factor analysis → ***Regression analysis***

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02. Data and the method of analysis

02_4 Factor analyses

5 factors

	convenient facilities	environments	housing	Safety	Accessibility
Child care	.845	-,006	,014	,070	-,140
welfare	.782	-,064	,229	,036	-,011
Culture facilities	.772	-,112	,072	,167	-,050
Medical service	.753	-,103	,310	,026	,175
Education	.729	-,046	,095	,123	-,047
Shopping	.674	-,071	,298	,038	,302
Public facilities	.601	,004	,230	,023	,186
Water quality	-,111	.843	,025	,037	,171
Atmospheric environment	-,081	.802	,066	-,049	,165
Soil environment	-,082	.747	,014	,193	,073
Nature environment	-,148	.746	,009	,255	-,010
Aquatic ecology	,144	.722	,055	,234	-,037
Housing size	,090	,121	.808	,080	,122
Housing structure	,351	,014	.776	,132	,023
Housing facility	,437	-,026	.636	,169	,009
Housing price	,357	,101	.582	,207	,146
Fire safety	,091	,061	,093	.815	,092
Traffic safety	,096	,195	,133	.766	,073
Safety of building	,430	,142	,174	.463	,057
Public safety	,127	,241	,056	.433	,196
Cleanliness	-,013	,322	,199	.405	,207
Parking	-,046	,187	,084	,164	.607
Bus	,320	,033	-,081	,257	.685
Taxi	,480	-,047	,091	,153	.615
Commuter time	-,155	,139	,146	-,012	.564
Eigen-value	4,947	3,329	2,446	2,241	1,963
Variation(%)	19,8	13,3	9,8	9,0	7,9
cumulative variation(%)	19,8	33,1	42,9	51,9	59,7

25 variables

• Factor Rotation : Varimax method

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02. Data and the method of analysis

02_5 Regression analysis : GLMM

- Regression analysis_ GLMM(*Generalized Linear Mixed Models*)

To find the determinants of migration intention
I used regression analyses, especially GLMM.
Equation 1 is the usual regression equation for GLMM.

Response variable y_i, fixed factor $x_1, \ldots, x_p$, Variate factor $u_1, \ldots, u_p$

$$y_i | u_1 \sim G(u_i, \phi_i)$$

$y_i = n_1 \times 1$ response, $u_i = q \times 1$ Variate vector, ϕ_i = Scale of the distribution of G

$$g(u_i) = X_i\beta + Z_i u_i, \quad u_i \sim N(0, V) \qquad \text{------- (Equation 1)}$$

$X_i = n_i \times p$ Matrix model, $\beta = p \times 1$ Coefficient vector,
$Z_i = n_i \times q$ Matrix model, $u_i = q \times 1$ Variate vector, $V = q \times q$ Variate vector

※ $y_j = \alpha_0 + A_j\beta + C_j\gamma + \epsilon_j$ ------- (Equation 2)

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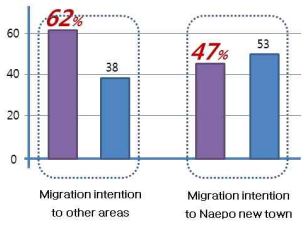
03

Empirical results

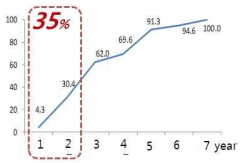
03. Empirical Results

03_1 How many people plan to move ?

- 62% of survey respondents **wanted to move** to other areas
  → from that 47% are thinking about moving to the Naepo



35% are planning to move **within 2 years**



03. Empirical results

03_2 Who would move ?

- Wage earners
- Short term residents
- Parents with pre-school – kid
- People in 20's and 30's

Migration Intention

		NO(%)	YES(%)	χ^2
gender	Mall	61.4	38.6	.084
	Female	62.7	37.3	
age	**Age under 20**	50.0	**50.0**	58.434***
	30's	37.6	**62.4**	
	40's	60.4	39.6	
	50's	70.9	29.1	
	Age over 60	87.4	12.6	
occupation	**Wage earners**	40.7	**59.3**	25.249***
	Private business (retailers, sales)	63.8	36.2	
	Housewives	66.7	33.3	
	Student, Etc.,	83.0	17.0	
income	Under 1million won	73.5	26.5	4.730
	1mil~2million won	65.0	35.0	
	2mil~3million won	55.6	44.4	
	Over 3million won	58.6	41.4	

		NO(%)	YES(%)	χ^2
Number of family member	Under 2	78.6	21.4	18.360***
	3 members	56.1	43.9	
	Over 4	56.5	43.5	
With Kid /preschool kid	**Yes**	34.2	**65.8**	31.555***
	No	67.9	32.1	
With elderly	Yes	71.5	28.5	7.461**
	No	58.0	42.0	*
Types of housing ownership	own	67.8	32.2	22.896***
	Rent	41.4	58.6	
Housing types	Apartment	49.0	51.0	9.281**
	Detached house and Etc.	65.7	34.3	*
Residence period	**Less than 3yrs**	32.6	**67.4**	55.534***
	3~5yrs	57.9	42.1	
	5~10yrs	64.2	35.8	
	More than 10yrs	78.2	21.8	

03. Empirical results

03_3 Why they want to move ?

- Which ***residential environments*** are so **unsatisfactory to cause** the residents to move out

< Influential Factors on residential satisfaction >

Model Term	Coefficient	Std.Error	t
Intercept	3.400	0.184	18.503***
convenient facilities	0.295	0.029	10.246***
environments	0.187	0.030	6.251
housing	0.290	0.023	12.514***
safety	0.192	0.024	8.113***
accessibility	0.101	0.023	4.346***

Statistics
Bayesian = 710.312 / Residual Estimate = 0.227***
Corrected Model F =60.833(Sig=.000) /Probability distribution :normal
Link function : Identity

* Dependent variable : residential environment satisfaction(Likert scale)

< Influential Factors on migration intention>

Model Term	Coefficient	Std.Error	t
Intercept	1.329	0.835	1.592
convenient facilities	0.472	0.129	3.654***
environments	0.081	0.120	0.678
housing	0.243	0.113	2.142**
safety	0.324	0.117	2.760***
accessibility	0.254	0.114	2.234**

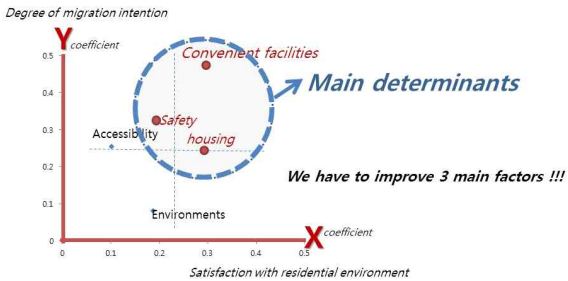
Statistics
Bayesian = 2,143.356
Accuracy = 73.9%
Corrected Model F=3.762***
Probability distributio
n : Binomial
Link function : Logit

* Dependent variable : Migration intention (Yes : 0, No 1)

03. Empirical results

03_3 Why they want to move ?

- Relationship between residential satisfaction and migration intention.



04

Conclusion

04. Conclusion

The largest development ***project*** ***To realize*** a balanced growth in Chungnam

•What do you think?•

The results of the analysis

Migration intention 47% *People that are thinking about moving to the Naepo*

- Recently people are **reserving to move** into Naepo new town apartments
- The 60% of **the apartment buyers** are from Hongseong and Yesan

People with intention to move People in 20' & 30' *The younger are leaving*

04. Conclusion

People with intention to move Children *The children are disappearing*

What do you think?

If this becomes a reality

simple problem → **donut phenomena**

It would lose its vitality

• The young and the elite leave the area •

04. Conclusion

How can we reduce the negative effect ?

Urban regeneration

- **Hongseong and Yesan :** Residential environments *have to be improved.*
  Satisfaction ✓convenient facilities ✓Safety ✓ Housing
- **Local governments :** Focus on ***urban regeneration*** rather than urban development.

The role of local governments

Naepo development •• ***Prevention*** of donut phenomena

- The purpose of Naepo development was **balanced growth** in Chungnam

➔ **Therefore,** we must make ***action plans*** to grow together.

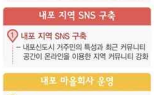
특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

안전한 오픈스트리트(open streets) 조성

① 자율주행 셔틀
- 단기 : 순환버스 노선 및 디자인/순환버스/순환버스 정류장/운전자 휴게공간, 이용자 휴게쉘터 등
- 중장기 : 자율순환 셔틀 운행
  ① ------ ALT1 – 중심지집중형
  ② ------ ALT2 – 방사형
  ③ ------ ALT3 – 거점연결형

② 자전거도로
- 차원이 다른 자전거 도로
- 섬세한 자전거 시설/자전거 주차장

③ 보행중심/ 세그웨이 중심 ·····
- 차원이 다른 세그웨이 중심의 내포신도시



내포 지역 SNS 구축

① 내포 지역 SNS 구축
- 내포신도시 거주민의 특성과 최근 커뮤니티 공간이 온라인을 이용한 지역 커뮤니티 강화

내포 마을회사 운영

① 내포 마을회사 운영
- 지속적인 내포신도시 건설 만들기를 위해 주민주도-행정-주민기가 협력하는 '내포 마을회사' 를 운영

〈전체〉

열린 오픈스트리트(open streets) 조성

① 디자인가로
- 도로의 여유공간을 활용하여 디자인특화를 통한 특색있는 가로 연출

② 도로변 체험 놀이터
- 도로변(어린이)공원 체험 놀이터 조성

③ 노천까페
- 도로변 여유로운 즐거움과 휴식 제공

④ 프리마켓(중심상점가)
- 지역 예술가/주민에게는 참여 활동을, 방문객들에게는 새로운 볼거리 제공

내포 상상도서관 네트워크 구축

① 도서관 네트워크
- 내포도서관~학교~마을내 작은도서관 ~거리도서관 등 네크워크 체계 강화

특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

안전한 오픈스트리트(open streets) 조성

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③ 보행중심/ 세그웨이 중심 ·····
- 차원이 다른 세그웨이 중심의 내포신도시

1 open streets

특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

자율주행셔틀 1 open streets

특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

자율주행셔틀 1 open streets

▶ AFTER

특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

열린 오픈스트리트(open streets) 조성

① 디자인가로
- 도로의 여유공간을 활용하여 디자인특화를 통한 특색있는 가로 연출

② 도로변 체험 놀이터
- 도로변(어린이)공원 체험 놀이터 조성

③ 노천까페
- 도로변 여유로운 즐거움과 휴식 제공

④ 프리마켓(중심상점가)
- 지역 예술가/주민에게는 참여 활동을, 방문객들에게는 새로운 볼거리 제공

1 open streets

특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

도로변 체험놀이터 1 open streets

▶ BEFORE

특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

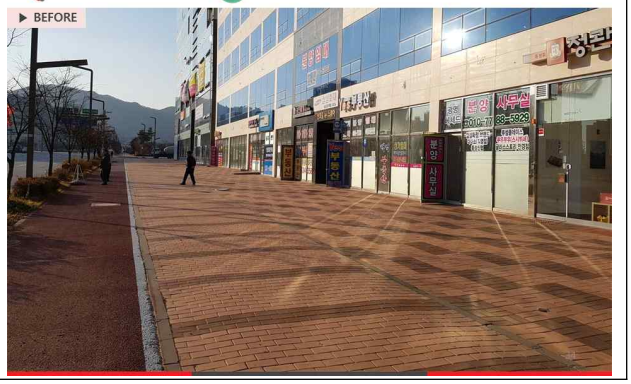
도로변 체험놀이터 1 open streets

▶ AFTER

특화 개념 협의체 아이디어 특화 기본컨셉 **특화 실천전략**

노천까페 1 open streets

▶ BEFORE



노천까페 1 open streets

▶ AFTER

프리마켓(중심상점가) 1 open streets

▶ BEFORE

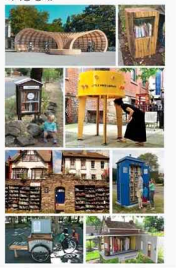
프리마켓(중심상점가) 1 open streets

▶ AFTER

내포 상상도서관 네트워크 구축

도서관 네트워크

- 내포신도시 충남도서관~학고도서관~마을도서관~기린도서관 네트워크 강화를 통한 지역문제해결, 공동체 강화
- 기존의 도서관과 차별된 문제해결의 공간, 커뮤니티 강화를 통한 내포신도시 사회의 지속성 강화.



2 내포 상상도서관

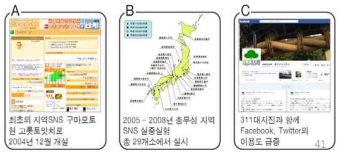
내포 상상도서관 네트워크 구축 2 내포 상상도서관

▶ BEFORE

내포 상상도서관 네트워크 구축 2 내포 상상도서관

▶ AFTER

버튼업 내포SNS 구축 3 내포 SNS



버튼업 내포SNS 구축 3 내포 SNS

1. 문제제기_문제점파악

2. 컨텐츠 및 스토리텔링

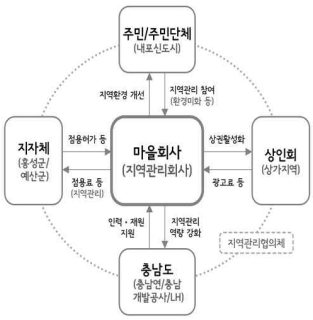
지역에 남아있는 다양한 인적, 물적, 환경적 역사적 자원을 3차원 지도 기반으로 누적해서 업로드할 수 있는 기능

3. 법제검토

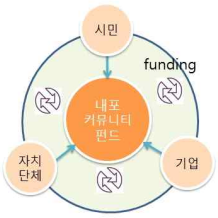
4. 투표 및 실행방안검토

내포 마을회사 설립 및 운영 방안_ 주체간 역할

4 내포 마을회사+펀드

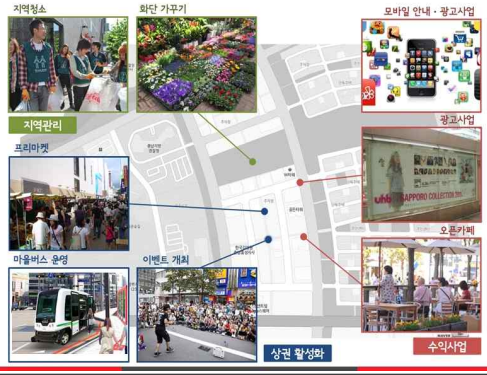


내포 커뮤니티펀드
+80 조성
구, 충남도청사
매각 800억 10% 활용



내포 마을회사 설립 및 운영_ 검토 가능한 사업들

4 내포 마을회사+펀드



Attached information

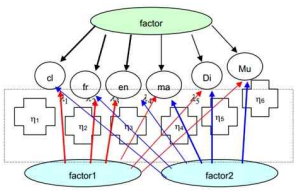
What is the meaning of Naepo?

- Chungnam is historical place of culture of Baekje, Kiho and Naepo.
- Naepo means the local culture of Joseon Dynasty period.
- It's location is today's location of Hongseong and Yesan.
- It's named through the public naming contest. * **Naepo new town**

Why was the factor analysis chosen?

2 reasons why I chose factor analysis is
- To minimize the number of variables(factors) : 25 variables → 5 factors
- To use independent variables in the next analysis method GLMM

* Because, this way can solve **the problem of multicollinearity** in the regression analysis



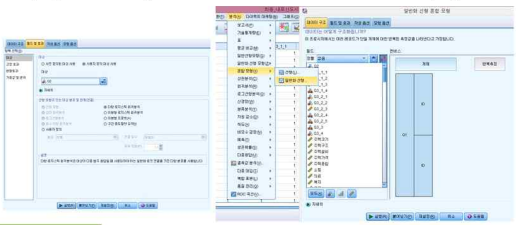
$$classic = \lambda_1 f + \eta_1$$
$$french = \lambda_2 f + \eta_2$$
$$english = \lambda_3 f + \eta_3$$
$$math = \lambda_4 f + \eta_4$$
$$discover = \lambda_5 f + \eta_5$$
$$music = \lambda_6 f + \eta_6$$

Why was GLMM chosen ?

GLMM is similar to regression model and logistic regression model,
but the difference is as followings.
1. GLMM allows us to perform various analyses by changing the scale freely.
2. GLMM is that we can control for other variables.

For example, the statistical difference across regions caused by sampling can be controlled for.
In this study, the regional difference between Hong-seong and Ye-san can be controlled for.

* **SPSS program made analysis easier than other difficult advanced statistical programs.**

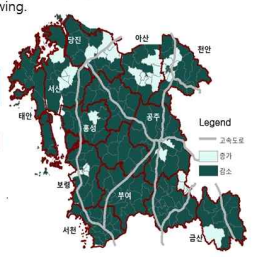


Why balanced growth in Chung-nam?

Not only national balanced growth is important, but also balanced growth in Chung-nam
The problem is that **cities close to capital area** are developed,
but **cities away from capital area** stopped growing.

* 자료 : http://kosis.kr (2014.4) _ 통계청 장래인구추계 자료 참조 재작성

Population change in capital area and non-capital area



Population change in Chung-nam(2010~2040)

What do local governments have to do? *action plans*

Local governments have not taken action but just worried.
Action plans must be made and implemented.
For example, specific plan must be made to improve residential environment and increase the job opportunity related to Nae-po new town.

For example,
Hongsoeng and Yesan have to find right plan to improve residential environment as in the chart.

(2) Influence of In-Vehicle Real-Time Traffic Safety Warning Information on Driving Stability at Limited Signal Visibility Approach

Influence of In-Vehicle Real-Time Traffic Safety Warning Information on Driving Stability at Limited Signal Visibility Approach: Use of Ordered Probit Model

Wonchul Kim, Ph.D
ChungNam Institute

Contents

Introduction

1 Preface

- Cause of Traffic Accident
  - → Interaction of extraordinary geometry, driver error, and vehicle problem
  - → Accident frequency to be 52% higher at sites with sight distance restrictions due to vertical curvature than at control sites - TRB (1987)
- Road safety strategies
  - → Generally, 3*E* (*E*ducation, *E*nforcement, *E*ngineering)
  - → Recently, applications of Intelligent Transportation System
- Smart 2-miles Hiroshima ITS project
  - → Commenced in 2006
  - → Improving traffic safety at signalized intersection
  - → Provision of In-vehicle Real-time Traffic Safety Warning Information (RTSWI)

Introduction

2 Purpose of Study

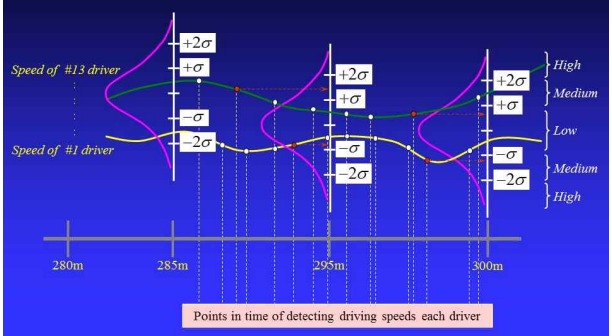
- Evaluating the effectiveness of In-vehicle RTSWI
  - → Driving Stability Risk Model
  - → Utility of the in-vehicle RTSWI incorporating driver's short-term memory
- Our research hypothesis
  - → In-vehicle RTSWI will improve traffic safety at signalized intersection by means of reducing the driving stability risk

Backgrounds

1 Importance of Speed Deviation

- Use of speed deviation as a surrogate for accidents
  - → No accidents records (in preliminary road design level)
  - → Often used in practice for evaluating the consistency of a geometry design
    - Criterion I and II (i.e., 10km/h deviation) is well recommended for transportation engineers in some Europe countries, Japan, Hungry, and Israel
- Road safety depends on the magnitude of speed deviation
  - → Solomon (1964) , Cirillo (1986)
    - *The greater the deviation between average speed and operating speed of a driver the more chance of involvement in a crash*
    - The lowest accident rate occurred within a speed range "15% to 20%" higher than the average speed
  - → Recently, Gaber et al. (1989)
    - Crash rates increase with speed variance
  - → Gaber et al. (2000)
    - Crash rate increases as *the standard deviation* of speed increases for all flow rates

Backgrounds



Traffic operation factors, Geometric factors, and Environmental factors varies in each road section

Backgrounds

2 Ordered Response Probit Model

$$y_n^* = \beta' x_n + \varepsilon_n$$

$$y_n = \begin{cases} 1 & \text{if } -\infty \le y_n^* \le \mu_1 \quad \text{(Low driving stability risk)} \\ 2 & \text{if } \mu_1 < y_n^* \le \mu_2 \quad \text{(Medium driving stability risk)} \\ 3 & \text{if } \mu_2 < y_n^* \le \infty \quad \text{(High driving stability risk)} \end{cases}$$

$$\begin{aligned} P_n(y_n = 1) &= \Pr(y_i^* \le \mu_1) = \Pr(\beta' x_i + \varepsilon_i \le \mu_1) \\ &= \Pr(\varepsilon_i \le \mu_1 - \beta' x_i) = \Phi(\mu_1 - \beta' x_i) = \Phi(-\beta' x_i) \\ P_n(y_n = 2) &= \Pr(\mu_1 < y_i^* \le \mu_2) \\ &= \Pr(\varepsilon_i \le \mu_2 - \beta' x_i) - \Pr(\varepsilon_i \le \mu_1 - \beta' x_i) = \Phi(\mu_2 - \beta' x_i) - \Phi(-\beta' x_i) \\ P_n(y_n = 3) &= \Pr(\mu_2 < y_i^*) \\ &= 1 - \Phi(\mu_2 - \beta' x_i) \end{aligned}$$

$$L = \sum_{n=1}^{N} \sum_{k=1}^{3} \delta_n^k \ln(P_n(y_n = k))$$

Data Collection

- Area & Time
  - → November 21 (Tuesday) - 27 (Monday), 2006, Hiroshima City, Japan
- The west approach of Hiranobashi-higashi intersection
  - → Signalized intersection approach with a limited traffic signal visibility
  - → Bride structure
  - → Crest vertical alignment being a crest at 120m from stop-line
  - → The most jeopardize signalized intersection in Hiroshima City

(i) General view of the approach

(ii) flow into the intersection from the approach

Data Collection

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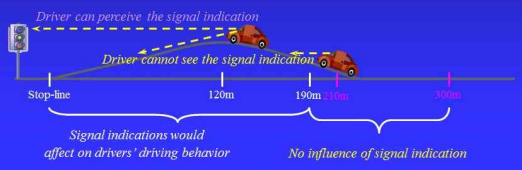
■ Scenarios for the RTSWI provision

Scenario	Timing for provision	HMI pattern
1	no	no
2	210m from the stop line	Only voice
3	210m from the stop line	Voice & image
4	300m from the stop line	Only voice
5	300m from the stop line	Voice & image

Type	Static RTSWI	Dynamic RTSWI
Only voice	Attention! Traffic signal ahead	Attention! Stopping vehicle ahead
Voice & Image		



Data Collection

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■ Experiment design
→ Participants
- 14 young drivers (13 Male, 1 Female) having a year more driving experience
- Two drivers were allowed to driving a day

→ Driving route
- 7 intersections along 2-miles strength on "route 2" in Hiroshima City

Driving route "route 2"

Data Collection

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■ Apparatus
→ GPS to support to gathering data by 0.1 sec
→ HMI (Human Machine Interface) to provide voice and image information
→ Cameras to tape a driver's face and the scene of jeopardize traffic situation
→ HUD (Head-up Display) on windshield with the same level of drivers eyes
→ Speed, de-/(ac)celeration, lateral de-/(ac)celeration, gap distance, brake pressure, de-/(ac)celeration pressure, handling pressure, position of probe vehicle, etc.

(i) Probe vehicle

(ii) HUD Image

Utility of In-vehicle RTSWI

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Importance of the Utility of in-vehicle RTSWI

■ Effects of Traffic Safety Warning Information (TSWI)
→ Carson et al. (2001) for ice-accident
→ Al-Ghamdi et al. (2004) for camel-vehicle collision
→ Charlton (2007) for countermeasures in horizontal curve
→ Al-Ghamdi (2007) for fog warning system

■ Utility of In-vehicle RTSWI
→ *Provision of the TSWI might surely be valuable if drivers can easily understand, memorize, and use it for making a safe driving*
- Inversely, the value of the TSWI might be worthless, if drivers forget the information

→ Same situation holds in provision of the in-vehicle RTSWI
→ In this sense, it is reasonable to assume that there is *a strong relationship between the utility of the in-vehicle RTSWI and the memory of drivers*

Utility of In-vehicle RTSWI

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Assumptions for the Utility of in-vehicle RTSWI

■ Short-term memory (or working memory)
→ Ogden (1995) - Lay (1986), Wickens (1984), Cumming (1964)
- Short term memory is requires *processing is temporarily stored*
- It has a *very limited capacity* and information is lost after *30s* unless it is actively reinforced by repetition or by use in some other activity
- Information cannot be recalled once it has faded
- Information in the short-term memory *fades if another task is interposed*

■ Assumptions for the utility of in-vehicle RTSWI
(A) Utility of the in-vehicle RTSWI reaches its *maximum (i.e. unity) at the time when provided to drivers*
(B) Utility of the in-vehicle RTSWI *decrease over time after its provision*
(C) Utility of the in-vehicle RTSWI *disappears after 30s of its provision*
(D) *Minimum* utility of the in-vehicle RTSWI is approximate to *zero*

Utility of In-vehicle RTSWI

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Utility of In-vehicle RTSWI

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Specification of Utility function of the in-vehicle RTSWI

■ Candidate functions for utility of in-vehicle RTSWI
→ Parameters were endogenously estimated from the data

$U = -\kappa(t)$ Linear function with (-) slope

$U = -\varphi(t^K) \quad K = 1, \Lambda, N$ Polynomial function with (-) slope

$$U = \begin{cases} \exp(\gamma(t - t_0)) & if\ t \geq t_0 \\ 0 & if\ t < t_0 \end{cases}$$ Exponential function

$$U = \begin{cases} \frac{1}{\nu\sqrt{2\pi}} \exp(-\frac{1}{2}\frac{(t-t_0)^2}{\nu^2}) & if\ t \geq t_0 \\ 0 & if\ t < t_0 \end{cases}$$ Normal density function

Driving Stability Risk Model Incorporating Short-Term Memory

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■ Specification of a model build
→ 4836 observations
→ Non-stop behaviors
→ Estimating the influence of the in-vehicle RTSWI on the driving stability risk
→ Ordered response probit model

■ Employed variables
→ Traffic operation factors
→ Geometry factors
→ Environmental factors
→ Driver factors
→ Provision of the in-vehicle RTSWI (dummy variable)
→ Utility of the in-vehicle RTSWI (the normal density function)

■ Estimation
→ Maximum Likelihood method
→ TSP 5.0

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Variables	Definition	mean	S.D
Traffic operation factors			
Speed difference	Absolute value of the difference between current speed and past speed [km/h]	0.169	0.251
Gap distance	Distance from the rear end of preceded vehicle to the front end of the probe vehicle divided by 1000 [m]	0.104	0.034
Geometry factors			
Signal visibility	Ability of drivers to see the traffic signal indication [0 = visibility (190m from the stop line); 1 = limited]	0.351	0.477
Vertical grades	Absolute value of vertical grades divided by 10 [%]	0.285	0.199
Environment factors			
Road surface	The condition of road surface when driving was performed on the subject road [0 = dry; 1 = wet]	0.432	0.495
Time slot	The time of day implementing the driving experiment during a day [0 = morning; 1 = afternoon]	0.491	0.500
Day slot	The day of recording the scene either weekday or weekend [0 = weekday; 1 = weekend (holiday)]	0.589	0.492
Driver factors			
Trial number	The number of driving trials on the subject road during a day divided by 10 [integer, positive sign]	0.300	0.135
Driving experience	The real driving experience of each driver divided by 10 [integer, positive sign]	0.196	0.108
Provision of in-vehicle RTSWI			
Provision of the In-vehicle RTSWI	Provision of the in-vehicle RTSWI [0 = without; 1 = provision]	0.659	0.474
Utility of RTSWI	A value of in-vehicle RTSWI is assumed to follow the normal density function multiplied by [0 = without provision; 1=provision]	-	-

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Estimation results

Variables	*Existing method*		*Proposed method*	
	Estimate	t-statistic	Estimate	t-statistic
Constant	0.913	10.982†	0.838	10.018†
Speed difference	0.400	4.381†	0.410	4.475†
Gap distance	–7.443	–14.514†	–6.384	–11.928†
Signal visibility	0.323	8.305†	0.412	10.808†
Vertical grades	–1.173	–13.176†	–1.424	–15.517†
Road surface (wet)	–1.110	–26.888†	–1.050	–24.769†
Time slot	0.250	4.846†	0.203	3.911†
Day slot	-	-	-	-
Trial number	1.902	9.596†	2.570	14.649†
Driving experience	1.328	8.005†	1.613	9.773†
Provision of in-vehicle RTSWI	***0.096***	***2.004****	***–10.626***	***–10.699†***
σ^2 **(for short-term memory)**	-	-	39.092	8.349†
μ (for driving stability risk model)	1.167	51.568†	1.196	51.423†
Observations	4836		4836	
Log-likelihood (LL) with zero coefficients	–5924.732		–5971.105	
Log-likelihood (LL) for estimated model	–4533.361		–4456.993	
Adjusted R-squared	***0.233***		***0.252***	
Aakaike's Information Criterion (AIC)	***1.879***		***1.848***	

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Driving Stability Risk Model Incorporating Short-Term Memory

- Elasticity
  - → All estimates (absolute value) are significantly less than one
    - 1% change in continuous variable will lead to small change in the driving stability risk
  - → 1% increase in the gap distance between cars (or utility of in-vehicle RTSWI) will give a larger increase in the probability of low than that of vertical grade
- Gap distance
  - → Needs to see car-following aspect

Continuous variables	Driving stability risk		
	low	medium	high
1% increase in speed difference	–0.080	0.005	0.088
1% increase in gap distance	***0.766***	***–0.048***	***–0.848***
1% increase in vertical grades	0.468	–0.030	–0.517
1% increase in trial number	–0.888	0.056	0.982
1% increase in driving experience	–0.365	0.023	0.404
1% increase in utility RTSWI	***0.470***	***–0.030***	***–0.519***

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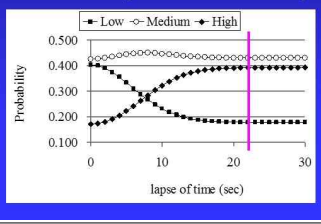
Driving Stability Risk Model Incorporating Short-Term Memory

- Probabilities of driving stability risk
  - → Sensitivity analysis was performed by controlling the utility of the in-vehicle RTSWI, while taking a value of zero for all discontinuous variables and average values for other continuous variables
  - → Low, medium, and high driving stability risk are 0.403, 0.426, and 0.171 when the in-vehicle RTSWI is provided. *These probabilities are changing until nearly 22 sec, and become a constant*, showing 0.178, 0.430, and 0.392 respectively



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Conclusions

- Use of Ordered Response Probit (ORP) model
  - → It is an appropriate evaluation model for traffic safety using driving speeds in case of no traffic accident data
  - → Our proposal can be used for assessment of the effectiveness of ITS applications in terms of traffic safety analysis
- Concept of Utility of in-vehicle RTSWI
  - → A type of exponential function can relax the assumptions for utility of in-vehicle RTSWI based on the characteristics of driver's short-term memory in driving condition
  - → Provision of in-vehicle RTSWI give a positive influence to traffic safety but its capacity is not long
  - → Elaborate analysis is possible compared to the existing method, which can produce more exact analysis results

Thank You

(참고 1) 충남연구원 - 계림전자기술대학교 교류협약서(MOU)

한국 충남연구원 – 중국 계림전자기술대학교

연구교류 및 협력 협약서

한국 충남연구원과 중국 계림전자기술대학교는 호혜평등의 원칙에 의거하여 지속적인 협력을 추진하기 위해 다음과 같은 협력사항을 추진하기로 협약한다.

제1조 (목적) 양 기관은 지역 및 도시 개발, 농업 농촌 등 다양한 분야에서 상호 발전을 위한 지속적인 교류에 힘쓴다.

제2조 (협력분야)

1. 지역 교통 및 물류 등 지역개발, 농업 농촌 발전 등 다양한 분야에 대한 인적 교류
2. 공통관심사를 주제로 한 국제 학술세미나 공동 개최
3. 학술자료 및 정보 공유와 공동 조사연구
4. 기타 상호 교류 협력이 필요하다고 인정되는 사항

제3조 (사업경비) 이 협약의 이행에 필요한 인력과 자금투입은 각 기관이 스스로 부담함을 원칙으로 한다. 다만 필요시 협의에 의해 결정할 수 있다.

제4조 (협약 효력 및 기간) 본 협약 효력은 서명한 날로부터 발생한다. 협약의 유효기간은 체결일로부터 2년으로 하되, 별도의 서면 통보가 없는 한 매년 1년씩 자동 연장되는 것으로 한다.

제5조 (기타) 양 기관은 이 협약내용의 준수와 성실한 이행을 위해 서명하고 각 1부씩 보관한다.

2017년12월11일

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	국제교류학과
원장:	과장:

(참고 2) MOU 및 계림전자기술대학교 방문 사진