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Integrating Geographic Information System and Building Information Model for Real Estate Valuation

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CHRISTCHURCH, NEW ZEALAND 2–6 MAY 2016

Recovery from disaster

3 May, 2016

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Part 1 — **Introduction**

Part 2 — **Solution**

Part 3 — **Case study**

Part 4 — **Conclusions**

Introduction

- The accuracy of valuation
  - the data
  - the professionality of qualified appraisers
  - the technology and tools

- GIS for real estate valuation
  - spatial data management
  - knowledge information management
  - efficient tools for spatial related analysis
  - 3D environment visualization

Introduction

- The deficiency of GIS for real estate valuation
  - not support modeling components inside of buildings

- Building Information Model (BIM)
  - an engineering data model based on the 3D digital technology and integrated of all relevant information of construction projects
  - support scheduling, cost estimation, and optimize facility management and maintenance
  - BIM for quantity take-off (cost approach)
  - BIM for green building analyses

Solution

- Integrating GIS and BIM for real estate valuation
- Real Estate Valuation System Based on BIM
  - system architecture
  - data transmission
- Sales Comparison Approach Improvement
  - BIM based analyses

Real Estate Valuation System Based on BIM

- Four layer System architecture
  - Data layer
    - valuation essential data, spatial data, valuation thematic data
  - Engine layer
    - ArcGIS Server, Terra Gate, Lucene
  - Supporting layer
    - 3D data model, 3D visualization, valuation model, green building analysis (BIM)
  - Application layer
    - software interface, system management and analysis functions

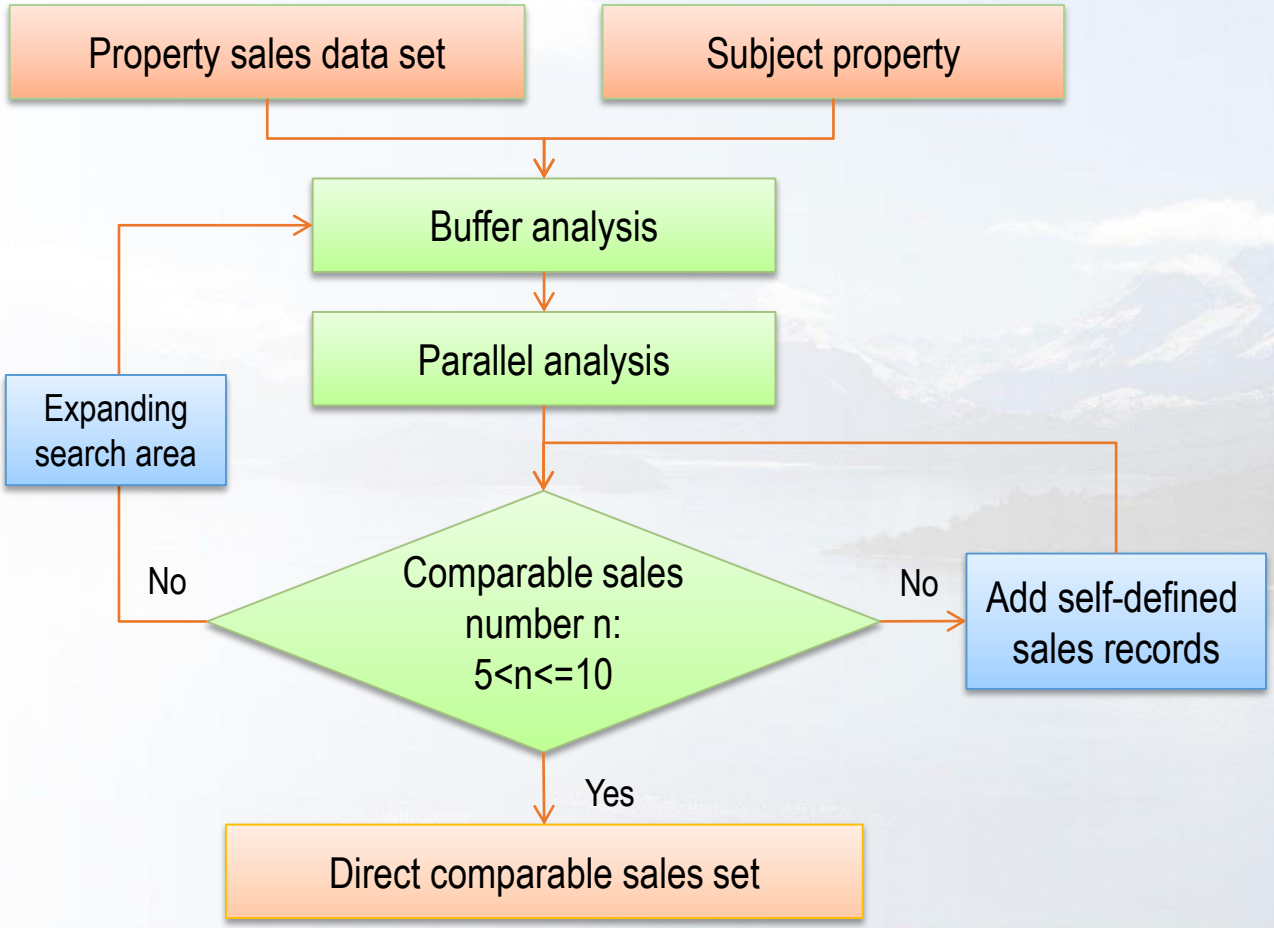
Real Estate Valuation System Based on BIM

- Data transmission
  - GIS for valuation system & BIM
  - physically independent, logically connected
  - shows in :
    - BIM model exchange
    - BIM related analyses request
    - analysis results push and extract

Sales Comparison Approach Improvement

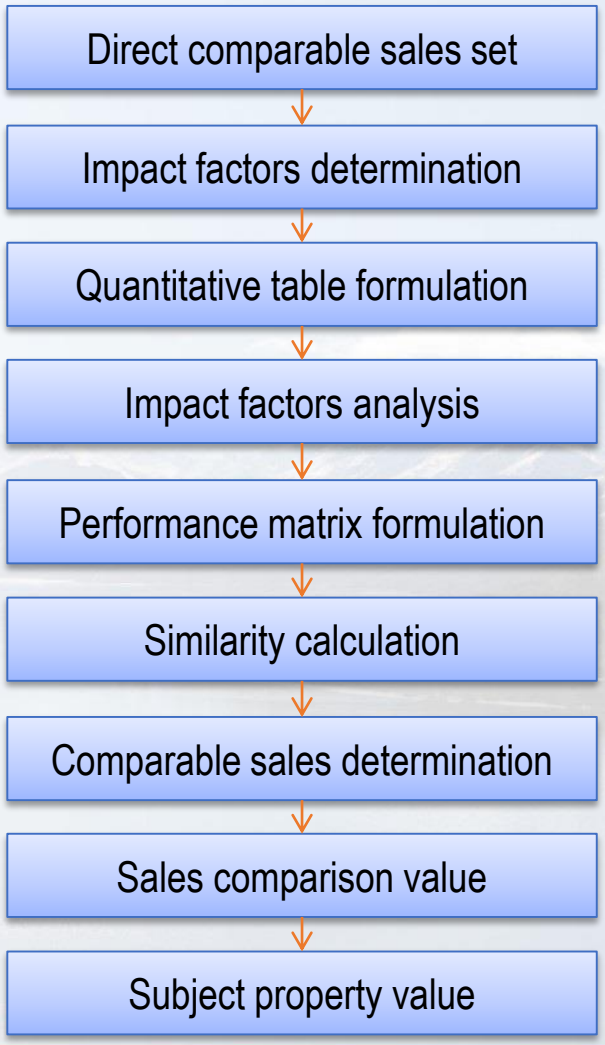
Recovery from disaster

- **The 3D GIS valuation model**



Sales Comparison Approach Improvement

- **The 3D GIS valuation model**



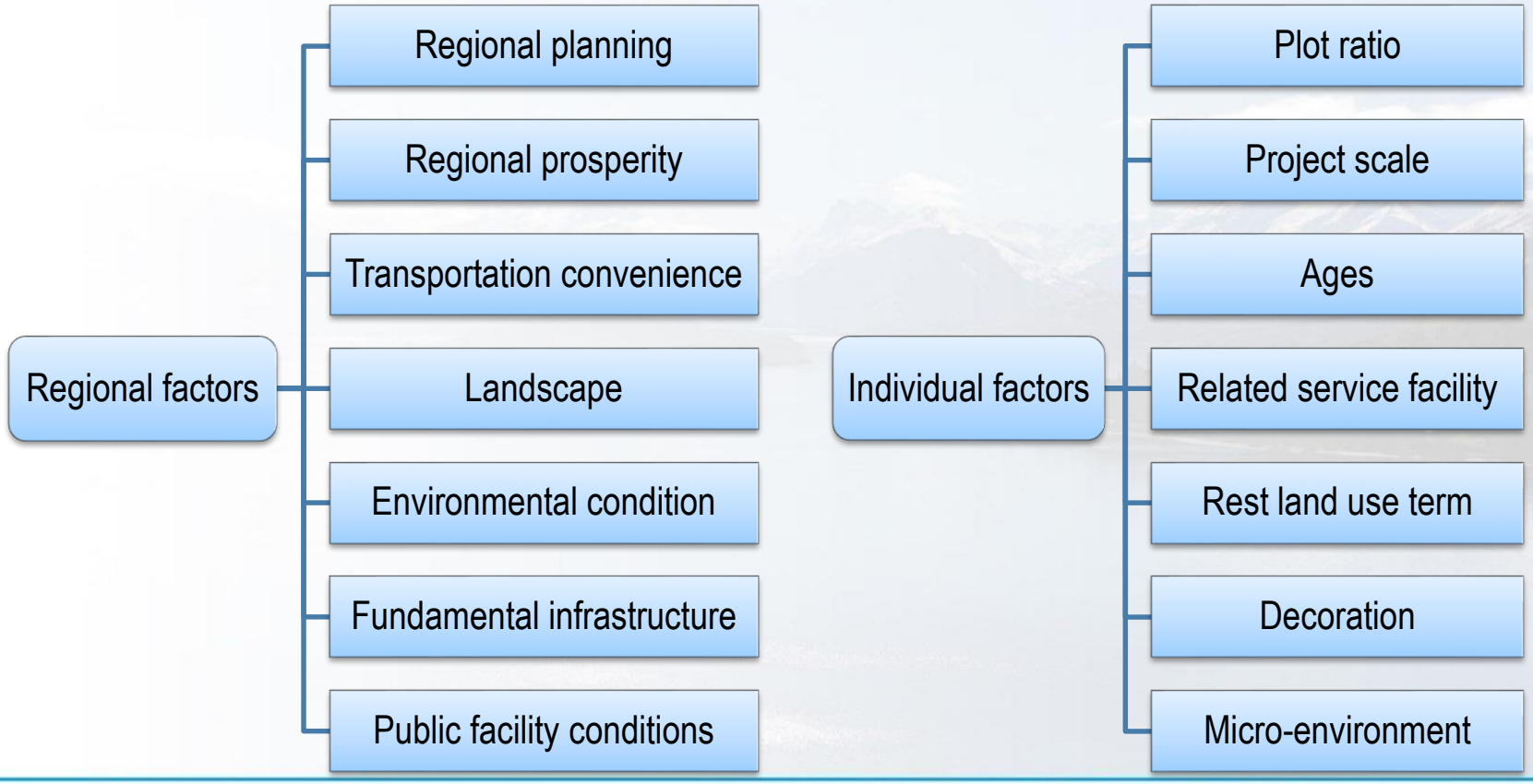
- **Refer to:**

  H. YU, Y. LIU and C. ZHANG (2014) Using 3D Geographic Information System to Improve Sales Comparison Approach for Real Estate Valuation. XXV FIG Congress, Kuala Lumpur, Malaysia

Sales Comparison Approach Improvement

Recovery from disaster

- **The 3D GIS valuation model**
  - Impact factors determination



Sales Comparison Approach Improvement

- **The 3D GIS valuation model**
  - Quantitative table formulation based on BIM
    - generated according to the national standard or code

Daylight Quantitative Classification Table

Classification grade	Description (average value of daylight factor c)
0	$c < 1\%$
1	$1\% \leq c < 2\%$
2	$2\% \leq c < 3\%$
3	$3\% \leq c < 4\%$
4	$c \geq 4\%$

Sales Comparison Approach Improvement

- **The 3D GIS valuation model**
  - Impact factors analysis

Residential	Impact factors	Descriptions	Analysis methods
Regional factors	Regional planning	Urban master planning & detailed planning etc.	Spatial query, spatial overlay
	Regional prosperity	Distance to multilevel business area	Spatial measurement, network analysis
	Transportation convenience	The number and distance of public transportation facilities (e.g. bus stop, subway stations, etc.) and road network service capabilities	Spatial measurement, network analysis, road network accessibility analysis, spatial statistics
	Landscape	The view of quality and distance to ocean, lake, mountain, green, forest park or golf course etc.	Visibility analysis, spatial measurement, spatial statistics
	Environmental condition	The air condition, noise, pollution, waste yard, incineration plant, power station, high-voltage power lines, etc. and the sunshine time	Spatial query, noise propagation analysis, pollutants diffusion analysis, visibility analysis, spatial statistics, BIM sunlight duration analysis, BIM community ventilation analysis
	Fundamental infrastructure	The surrounded fundamental infrastructure, such as, water, electricity, gas, communications, cable, internet, wireless local area network, etc.	Spatial query, spatial statistics
	Public facility conditions	The distance to public facilities such as school, park, sport center, hospital, bank, ATM, supermarket, shopping mall, convenience store, theatre, etc.	Spatial query, spatial statistics

Sales Comparison Approach Improvement

- **The 3D GIS valuation model**
  - Impact factors analysis
    - Individual factors:
      - for micro-environment: BIM indoor daylight analysis and BIM indoor ventilation analysis

Sales Comparison Approach Improvement

- **The 3D GIS valuation model**
  - Impact factors analysis
    - BIM sunlight duration analysis: to simulate the sun movement and result in a grid with sunlight hours on the surface of buildings
    - BIM indoor/outdoor ventilation analysis: based on CFD analysis model, and 3D community building models to simulate the indoor/surrounding environment ventilation
    - BIM indoor daylight analysis: based on detailed 3D building model and considering the different construction materials to calculate the daylight factor under different sunlight conditions

Case study

- **3DGIS based single property valuation system (3DGISSPV)**

BIM software supported by 斯维尔 TH SWARE

TH-BQ 2013 : for bill quantity calculation of construction works

TH-VENT 2014 : for indoor/outdoor ventilation analysis

TH-SUN 2014: for sunlight duration analysis

TH-DALI 2014: for daylight factor analysis

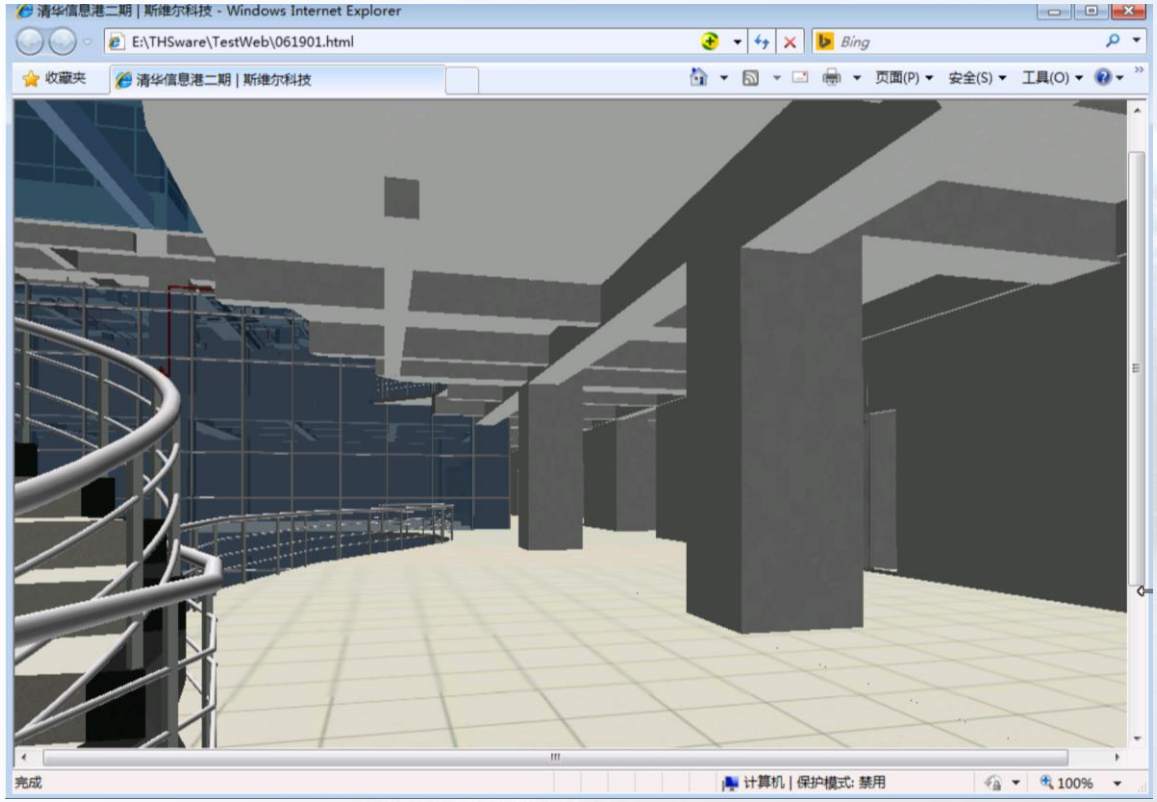
Case study

Recovery from disaster

- **BIM data loaded in 3DGISSPV system**

Case study

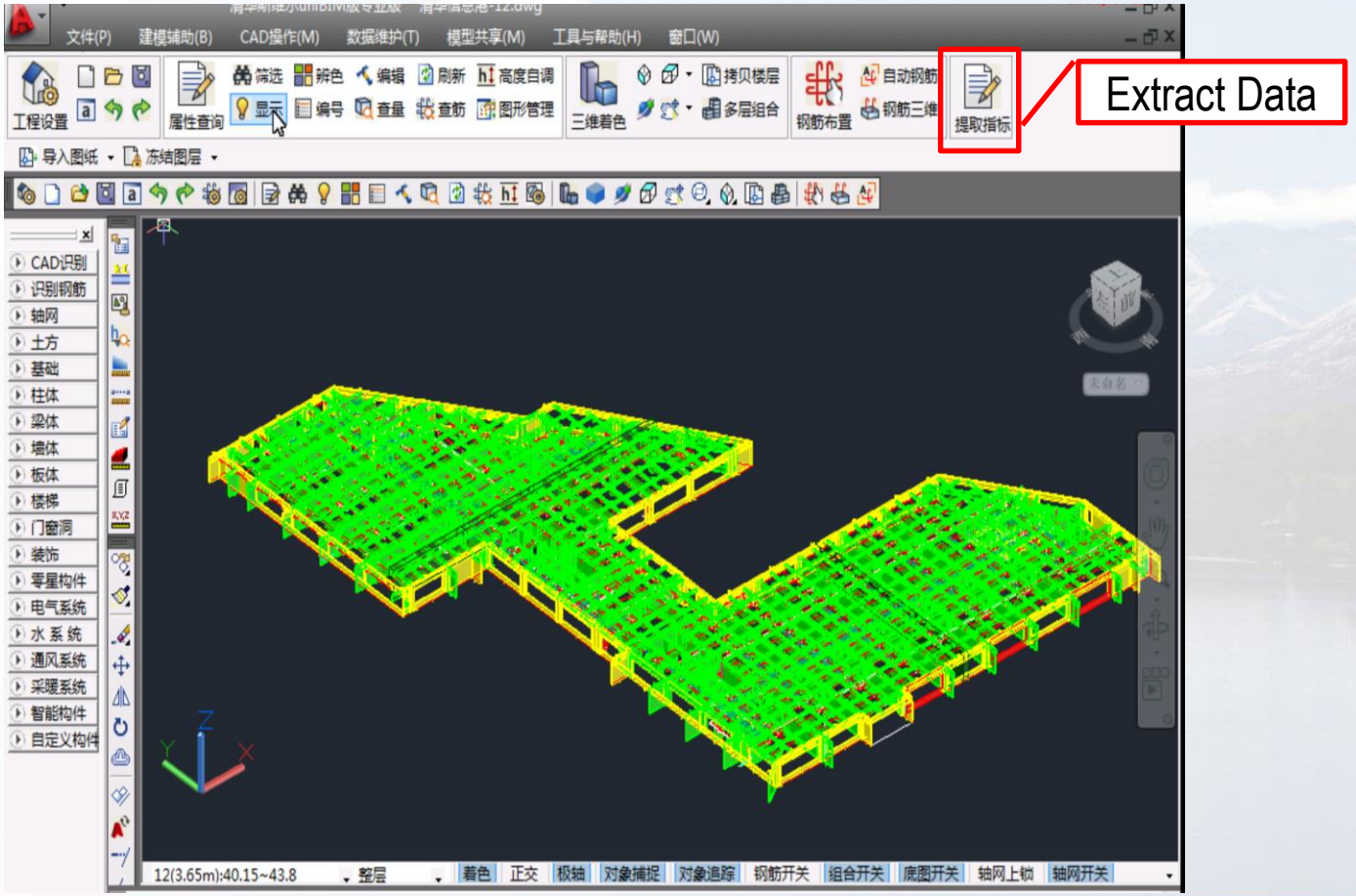
- **Inside navigation of BIM building**



Case study

Recovery from disaster

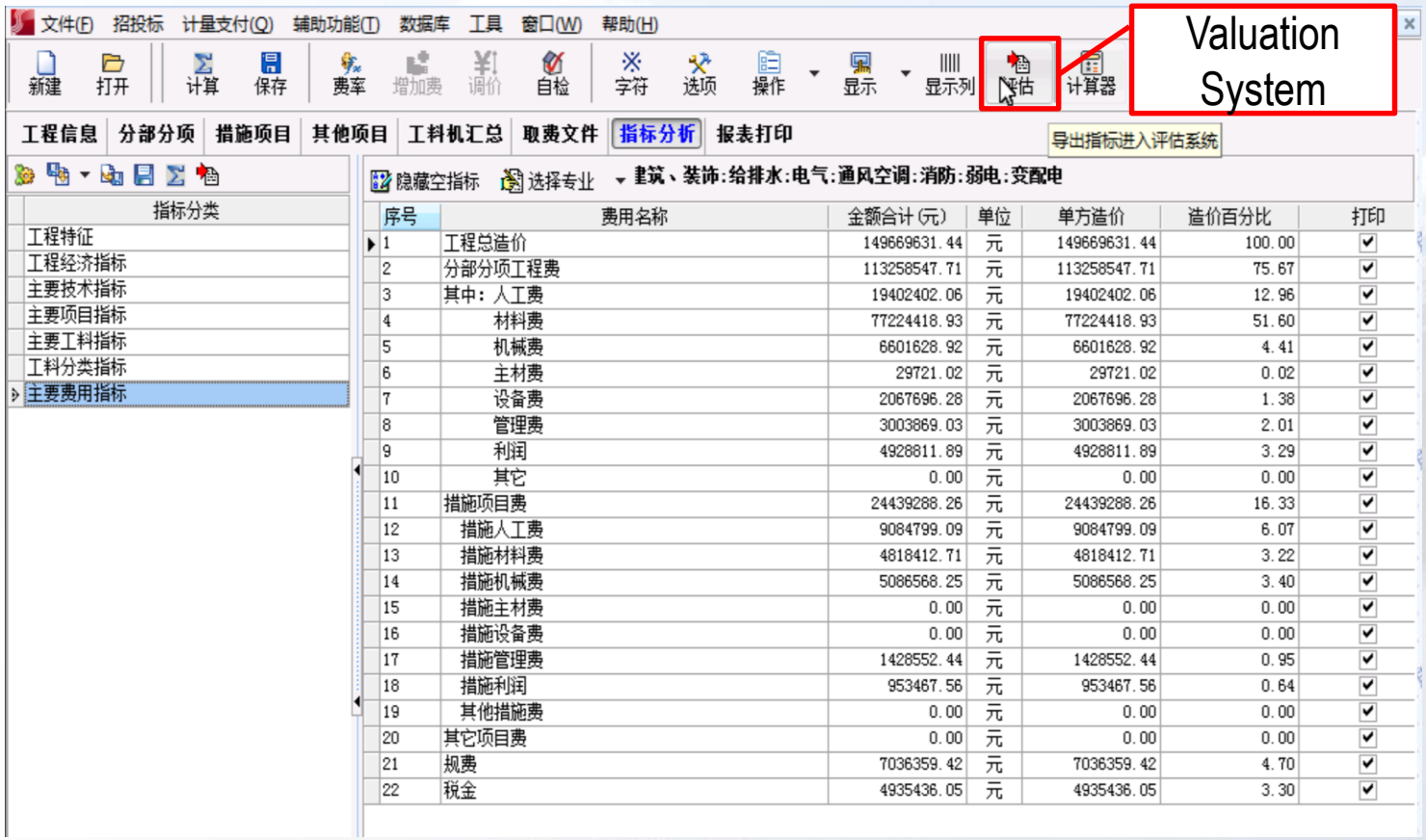
- **Detailed BIM data view in TH SWARE**



Case study

Recovery from disaster

- **Detailed BIM data view in TH SWARE**

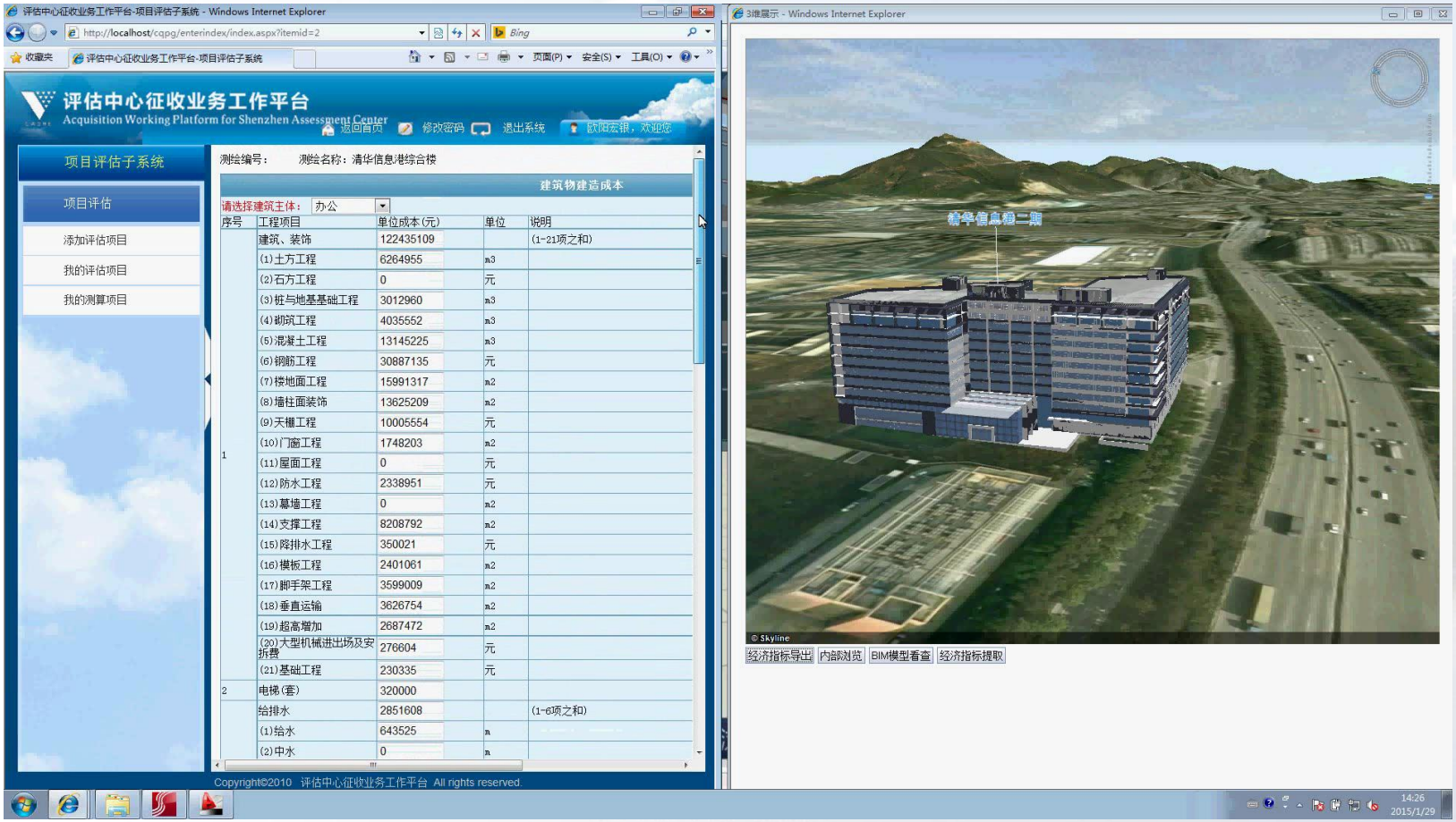


序号	费用名称	金额合计(元)	单位	单方造价	造价百分比	打印
1	工程总造价	149669631.44	元	149669631.44	100.00	☑
2	分部分项工程费	113258547.71	元	113258547.71	75.67	☑
3	其中：人工费	19402402.06	元	19402402.06	12.96	☑
4	材料费	77224418.93	元	77224418.93	51.60	☑
5	机械费	6601628.92	元	6601628.92	4.41	☑
6	主材费	29721.02	元	29721.02	0.02	☑
7	设备费	2067696.28	元	2067696.28	1.38	☑
8	管理费	3003869.03	元	3003869.03	2.01	☑
9	利润	4928811.89	元	4928811.89	3.29	☑
10	其它	0.00	元	0.00	0.00	☑
11	措施项目费	24439288.26	元	24439288.26	16.33	☑
12	措施人工费	9084799.09	元	9084799.09	6.07	☑
13	措施材料费	4818412.71	元	4818412.71	3.22	☑
14	措施机械费	5086568.25	元	5086568.25	3.40	☑
15	措施主材费	0.00	元	0.00	0.00	☑
16	措施设备费	0.00	元	0.00	0.00	☑
17	措施管理费	1428552.44	元	1428552.44	0.95	☑
18	措施利润	953467.56	元	953467.56	0.64	☑
19	其他措施费	0.00	元	0.00	0.00	☑
20	其它项目费	0.00	元	0.00	0.00	☑
21	规费	7036359.42	元	7036359.42	4.70	☑
22	税金	4935436.05	元	4935436.05	3.30	☑

Case study

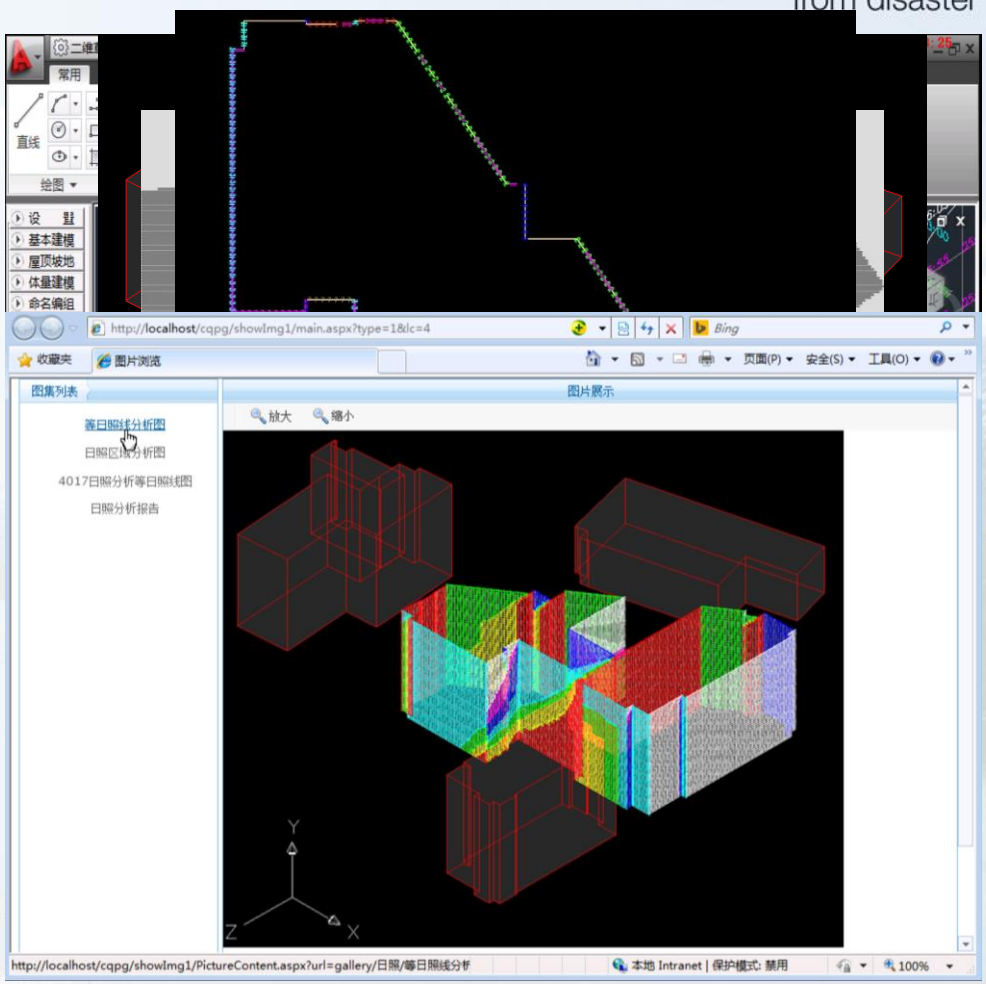
Recovery from disaster

- **BQ data extract in 3DGISSPV**



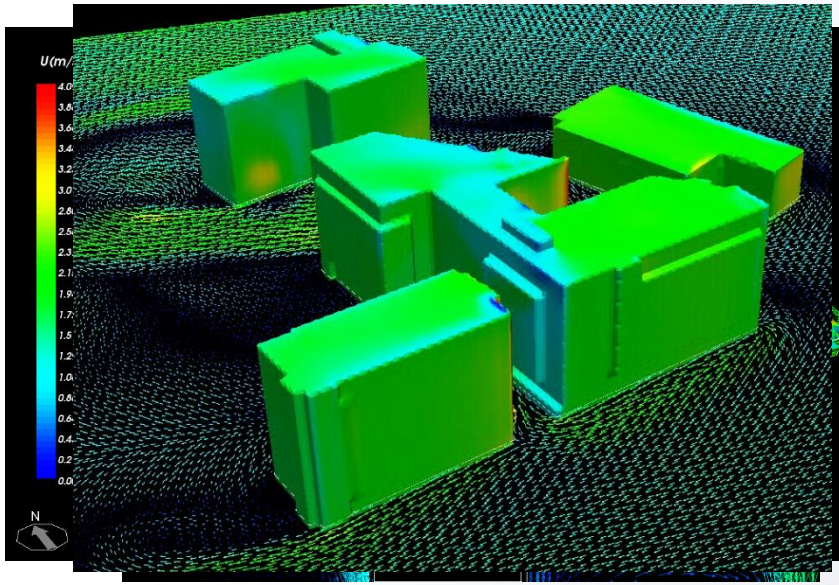
Case study

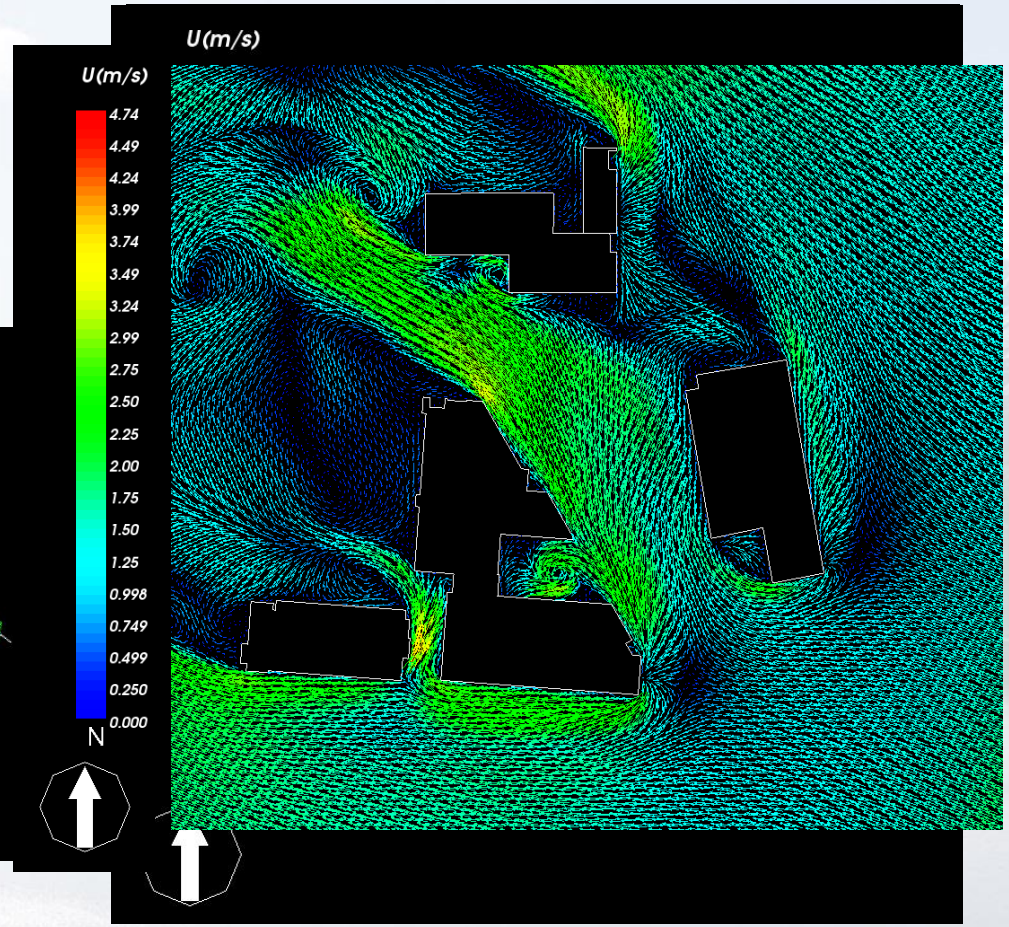
- **BIM based analysis**
  - BIM sunlight duration analysis in TH-SUM 2014
  - BIM sunlight duration analysis results in 3DGISSPV



Case study

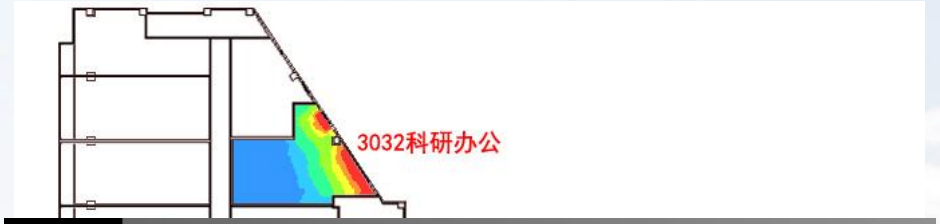
- **BIM based analysis**
  - BIM indoor/outdoor ventilation analysis in TH-VENT 2014

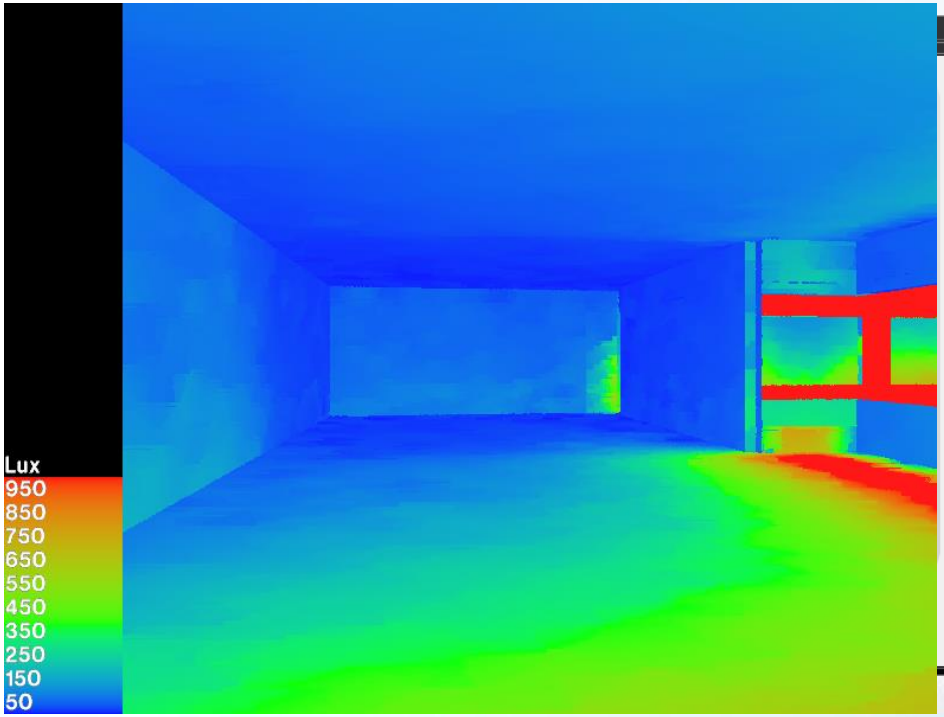


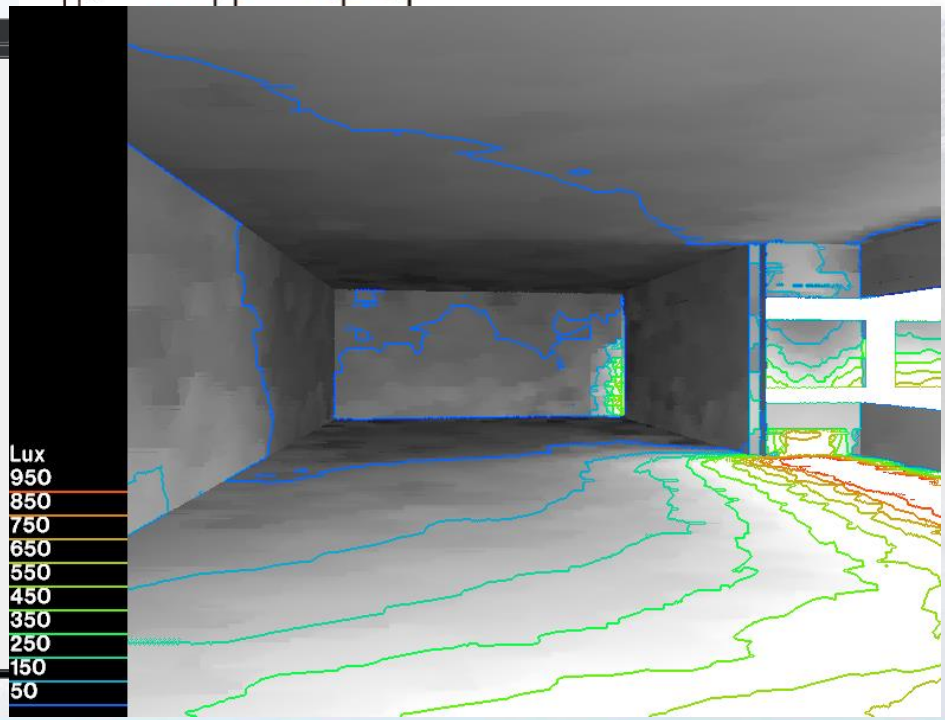


Case study

- **BIM based analysis**
  - BIM daylight factor analysis in TH-DALI 2014







Conclusions

- The purpose of this study is to provide a suitable way to enhance the valuation accuracy by integrating BIM and GIS
- It is possible to integrate BIM for real estate valuation in cost approach and provide more advanced professional analyses
- The application of 3DGISSPV system with BIM improves the working efficiency and the valuation accuracy

Thank you!

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