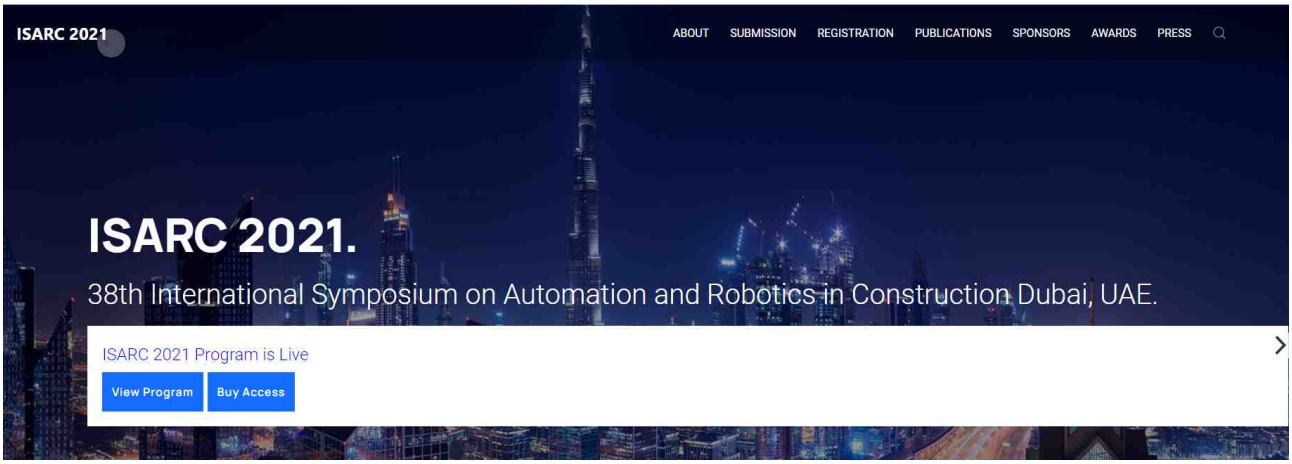


Day-1
2nd Nov

Speakers
12:00 PM - 01:00 PM
Join Now

H.E. Suhail bin Mohammed Al Mazrouei
Minister of Energy & Infrastructre

H.E. Prof. Humaid Al Nuaimi
University of Sharjah Chancellor

Network Session
01:00 PM - 02:00 PM
05:00 PM - 05:30 PM

Connect & Communicate with ISARC network

10:00 AM - 11:15 AM | 02:00 PM - 03:15 Pm | 03:15 PM - 04:30 PM | 05:30 PM - 07:00 PM | 7:00 PM - 08:15 PM

Track-A
Sensing systems & data infrastructures
SESSION: A2 / PLATFORMS AND DATA BASES
CHAIR: DANIEL HALL & MING SHAN NG
CO CHAIR: RAFEEAH AL ALI

Towards a Construction Site Control System – Task Management in Construction Operations and Intralogistics
Submission ID 153
Maximilian Schöberl
Room A2
View paper

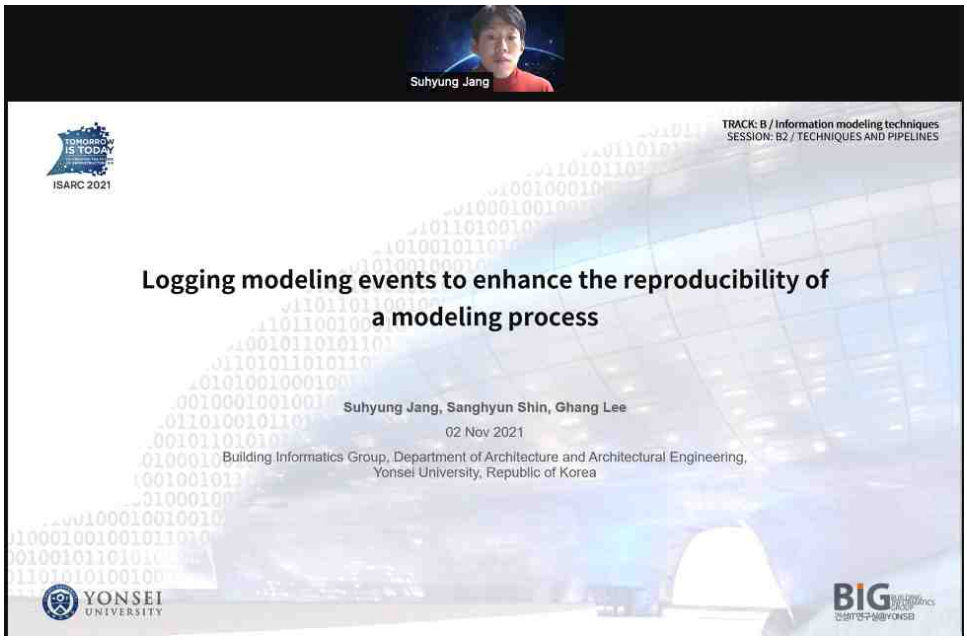
Track-B
Information modeling techniques
SESSION: B2 / TECHNIQUES AND PIPELINES
CHAIR: ENRIQUE VALERO
CO CHAIR: AMMAR SAFI

Logging modeling events to enhance the reproducibility of a modeling process
Submission ID 120
Suhyung Jang
Room B2
View paper

Track-F
Industry and short papers
SESSION: F2 /
CHAIR: RONGBO HU
CO CHAIR: CARLA SARKIS

Integrating BIM for DES-based resource scheduling
Submission ID 151
Anne Fischer
Room F2

Review of Knowledge Graphs and their Applicability to the Construction Industry



38th International Symposium on Automation and Robotics in Construction (ISARC 2021)

Logging modeling events to enhance the reproducibility of a modeling process

Suhyung Jang[a], Sanghyun Shin[a], Ghang Lee[a*]

[a] Building Informatics Group, Department of Architecture and Architectural Engineering, Yonsei University, Republic of Korea
E-mail: rgb000@yonsei.ac.kr, spicysh03126@yonsei.ac.kr, glee@yonsei.ac.kr
*Corresponding author

Abstract

This study was aimed at developing a building information modeling (BIM) process logger that can capture modeling process information as an event log file. BIM log mining is a research area that focuses on utilizing a massive amount of data created from BIM software usage. Several studies have monitored, analyzed, improved, and predicted modeling process based on BIM log mining. However, the BIM logs recorded using current BIM authoring tools do not offer explicit information about modeling commands and object-related parameters. The BIM logger proposed in the current work was developed using the application programming interface (API) of BIM authoring software to create an enhanced log file that can represent the modeling process. The reproducibility of the modeling process in the log file created using the developed logger was evaluated via quantitative and qualitative methods.

Keywords

Building Information Modeling (BIM); BIM Log Mining; Modeling Process Representation; Data Enhancement

BIM usage data in a BIM authoring tool.

BIM log mining is a young discipline in a research area that focuses on utilizing the event logs created from the BIM usage process. Extensive research has been conducted to perform BIM log mining for various purposes, such as design pattern analysis, design productivity analysis, social network analysis, modeling process visualization, and modeling command prediction.

The data maturity of BIM logs, however, has not been questioned in most previous research [3–11], even though it very much affects the results of analyses in event log mining. The quality of an event log varies according to the purpose of the analysis [12]. For reliable and precise modeling process analysis, the modeling information in BIM event logs needs to be self-descriptive to the level at which it can reproduce the process [1]. During a literature review, we verified that the modeling process data created in the current BIM log file is not explicit enough to reproduce the modeling process for process analysis [13]. In this regard, we focused on increasing the process reproducibility of the modeling log using a custom-developed BIM logger.

<첨부 – 학회발표자료>

ISARC 2021

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Suhyung Jang, Sanghyun Shin, Ghang Lee

02 Nov 2021

Building Informatics Group, Department of Architecture and Architectural Engineering,
Yonsei University, Republic of Korea

YONSEI UNIVERSITY

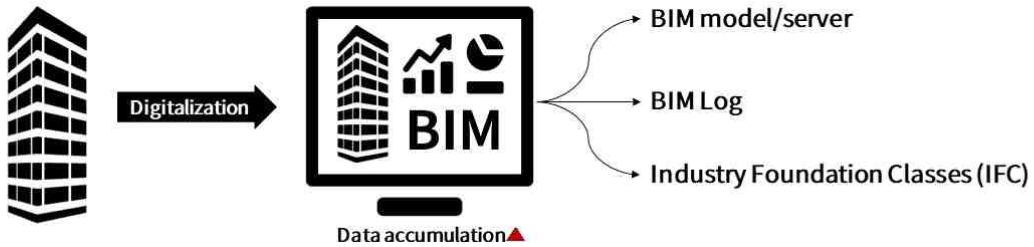
BIG BUILDING INFORMATICS GROUP 건설IT연구실@YONSEI

Motivation

TRACK: B / Information modeling techniques
SESSION: B2 / TECHNIQUES AND PIPELINES

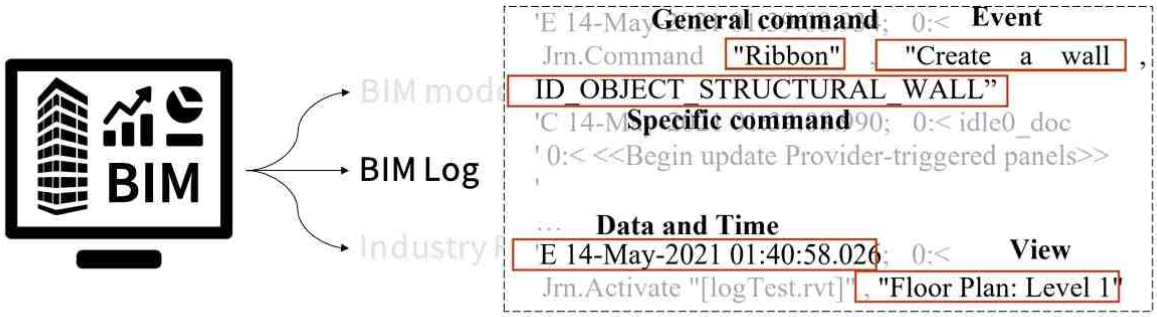
"Can we reproduce a BIM model from a BIM log like the Excel Macro?"

Motivation



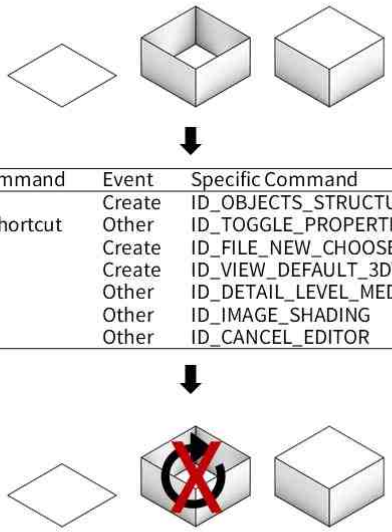
A **massive BIM data** created from **BIM software** can be utilized to **monitor, analyze, improve, and optimize** process in **AEC industry**

Motivation



BIM logs automatically record **BIM usage data** in a BIM authoring tool.
BIM logs includes **BIM usage event(command/error/message), time of the event occurrence**, and other data

Motivation



General Command	Event	Specific Command
Ribbon	Create	ID_OBJECTS_STRUCTURAL_WALL
KeyboardShortcut	Other	ID_TOGGLE_PROPERTIES_PALETTE
Ribbon	Create	ID_FILE_NEW_CHOOSE_TEMPLATE
Ribbon	Create	ID_VIEW_DEFAULT_3DVIEW
Internal	Other	ID_DETAIL_LEVEL_MEDIUM
Internal	Other	ID_IMAGE_SHADING
AccelKey	Other	ID_CANCEL_EDITOR

Research Question: Can we reproduce a BIM model from a BIM log like the Excel Macro?

Current BIM log: The geometric attributes of the modeled object cannot be verified, and the object affected by the event is not specified.

Research Objective: To enhance the modeling information in BIM log to where we can reproduce the original modeling process from the BIM log.

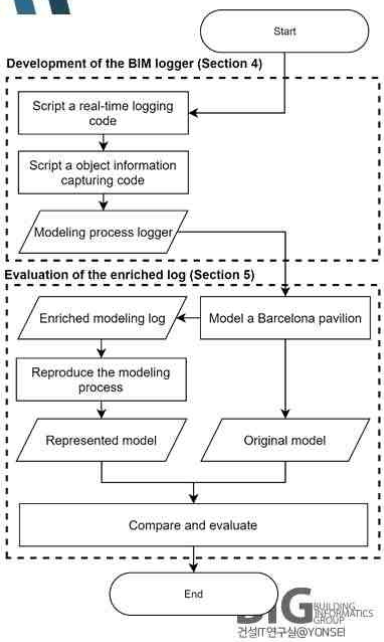
Methodology

Step1

- **Development of the BIM logger**
  - Extraction of modeling commands
  - Extraction of object information capturing (GUID, parameter)
  - Log file creation

Step2

- **Evaluation of the enhanced log**
  - Model a case (Barcelona pavilion)
  - Logging by BIM logger developed
  - Reproducing the modeling process using enriched BIM log



Custom BIM logger

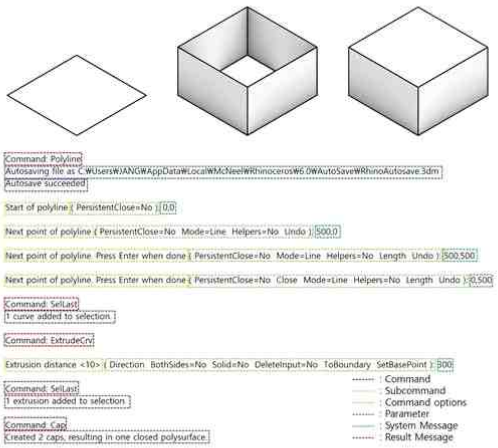


Figure 3. A modeling process and the modeling history of the process

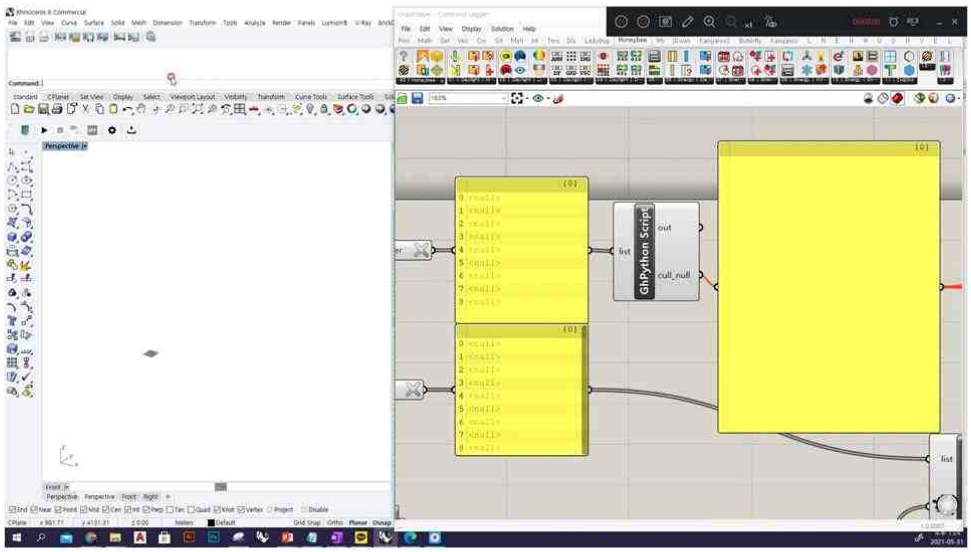
Input: modeling history
Output: modeling log

log_ord_list: list of event log orders
cmd_list: list of commands
time_list: list of timestamp
guid_list: list of GUID
cmd_ord_list: list of command orders
prm_list: list of parameters

for i in modeling history **do**
  cmh EQUALS i;
  log_ord EQUALS *log_ord* plus 1;
  if the first word of string *cmh* is "Command" **then**
    cmd EQUALS string after ": " ;
    cmd_ord EQUALS *cmd_ord* plus 1;
  else if the string *cmh* is not command related message **then**
    go to next *i*;
  end if
  if the second last word of *cmh* includes ": " **then**
    parameter EQUALS string after ": ";
  else
    parameter EQUALS "-";
  end if
  time EQUALS current time;
  guid EQUALS current object GUID;
  APPEND *log_ord* to *log_ord_list;*
  APPEND *cmd* to *cmd_list;*
  APPEND *time* to *time_list;*
  APPEND *guid* to *guid_list;*
  APPEND *cmd_ord* to *cmd_ord_list;*
  APPEND *parameter* to *prm_list;*
end for
modeling log EQUALS [*log_ord_list, time_list, guid_list, cmd_list, cmd_ord_list, prm_list*]
return modeling log

Figure 4. Pseudo code of the modeling logger

Enhanced BIM logger prototype



Enhanced BIM log

GUID	Command	Command Order	Parameter
08c83585-f792-4d43-a594-17d2ba855bea	Polyline	0	1
08c83585-f792-4d43-a594-17d2ba855bea	SelLast	1	-
5d01173f-2f3e-4ff8-9943-eb7b9c91d945	ExtrudeCrv	2	-
5d01173f-2f3e-4ff8-9943-eb7b9c91d945	ExtrudeCrv	2	-1200
5d01173f-2f3e-4ff8-9943-eb7b9c91d945	SelLast	3	-
5d01173f-2f3e-4ff8-9943-eb7b9c91d945	Cap	4	-
9e7b8788-0dab-4c69-86b0-571820582c0d	Polyline	5	-
9e7b8788-0dab-4c69-86b0-571820582c0d	Polyline	5	0/0

Table 2. Modeling information from the enhanced modeling log

Evaluation – Level of Reproducibility(LOR)

$$IoU_i = V_{Inter_i} / V_{Uni_i} \quad (1)$$

$$LOR = \frac{\sum_{n=1}^{i} X_i * IoU_i}{i} * 100\ (\%) \quad (2)$$

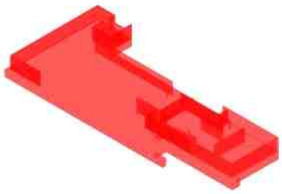
(1) Intersection of union (IoU) is a commonly used metric for measuring the overlap between two modeled objects by volumes
(2) Level of reproducibility (LOR) is an averaged percentage of IoU

Evaluation - Results

27 objects

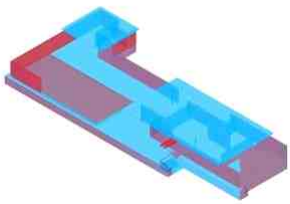
(a)
Original Model

24 objects
(with 3 non-value objects)



(b)
Represented Model

21 objects reproduced
LOR = 64.08%



(c)
Evaluation of LOR

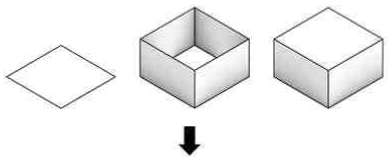
Conclusion and Future Work

Conclusion

-The enhanced log is eligible for reproducing the original modeling process
-Enhancing modeling information to the BIM log can reduce the gap between real-life modeling process and logged modeling process

Future work

-A more comprehensive BIM logger can be developed to collect not only geometric attributes but also non-modeling events and non-geometric features
-Application of enhanced logs in analysis of modeling processes (Data-driven analysis)



Log order	Time	GUID	Command	Command Order	Parameter
0	2021-05-30 14:51	08c83585-f792-4d43-a594-17d2ba855bea	Polyline	0	-
1	2021-05-30 14:51	08c83585-f792-4d43-a594-17d2ba855bea	Polyline	0	1
2	2021-05-30 14:51	08c83585-f792-4d43-a594-17d2ba855bea	Polyline	0	28000/-500
3	2021-05-30 14:52	08c83585-f792-4d43-a594-17d2ba855bea	Polyline	0	28000/200