

# Using log data – Related challenges, desiderata, and motivation for this workshop

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# Overview

- What was the main takeaway from Dublin?
- What are log data useful for?
- How to reason from log data?
- What are the main topics focused in the workshop?
- What other session formats are used?



# The current workshop continues the idea of a previous event

- 16th – 17th May 2019,  
Dublin, Ireland
- Organized by Educational  
Research Centre (Dublin,  
Ireland) and Educational  
Testing Service (Princeton,  
NJ, USA)



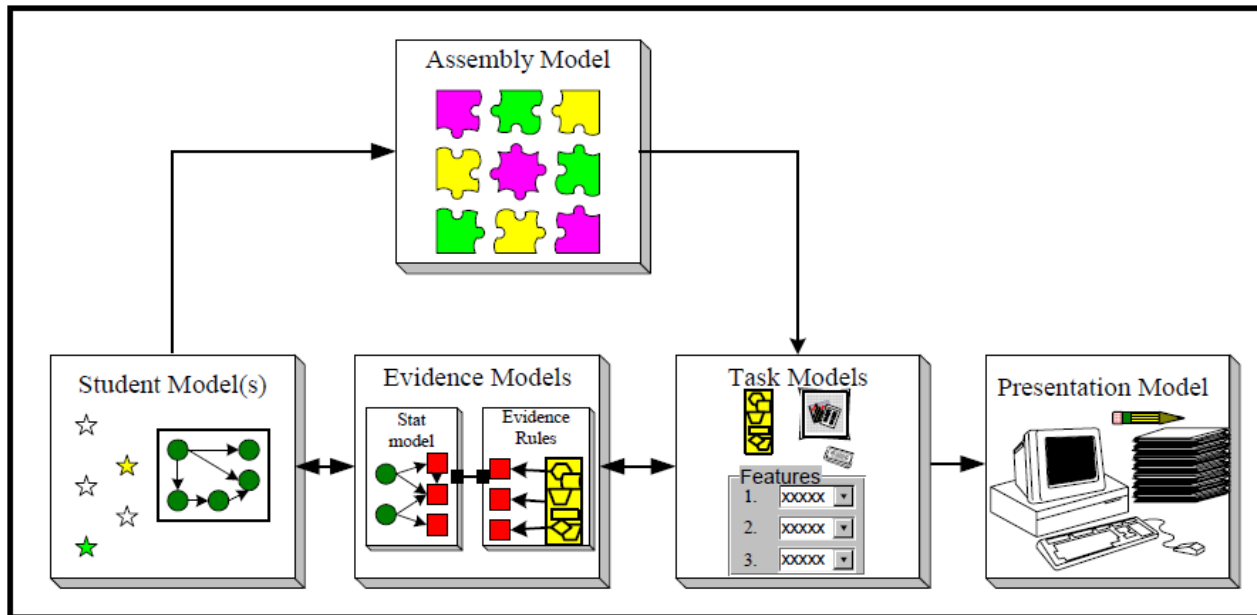
Stephen Provasnik's (NCES) main takeaway in Dublin was:

Ultimately process data are a proxy for cognitive processes



# Process data as an opportunity

- Many uses of process data in educational and psychological assessment
- Evidence-centred design (ECD) framework by Mislevy et al. (2003) can be used to identify potential uses (Goldhammer et al., in press)

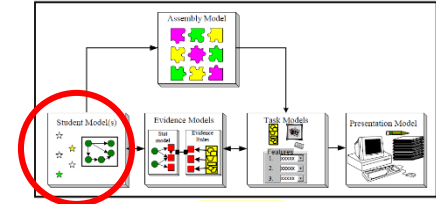


Mislevy et al. (2003, p.5)



# Use of process data

## – Student model

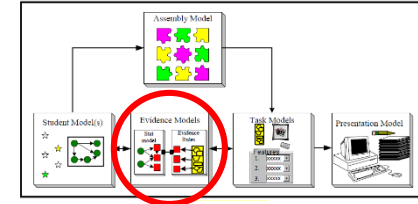


- Measuring constructs representing **attributes of the work process** (i.e., individual differences in how respondents approached or completed the tasks)
  - (Domain-specific) **speed** when completing cognitive tasks (Goldhammer & Klein Entink, 2011; van der Linden, 2007)
  - **Strategy use** when solving problems (Greiff et al., 2016)
  - **Planning** when solving a complex problem (Eichmann et al., 2019)
  - **Sourcing** when reading multiple documents (Hahnel et al., 2019)



# Use of process data

## – Evidence model

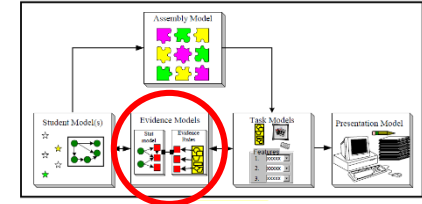


- Deriving **process indicators** from log data
  - Indicators of test-taking engagement based on response time (Wise & Kong, 2005)
- Complementing evidence rules for **product indicators**
  - **Partial credit** scoring of the work product depending on whether actions contributing to the correct outcome were carried out (e.g., PISA 2012 CPS) (OECD, 2013)
  - Coding of **missing** responses (e.g., in PIAAC responses without interaction and time on task <5 seconds were coded as “Not reached/not attempted”) (OECD, 2013)
  - Detecting **data fabrication** in PIAAC (Yamamoto & Lennon, 2018)



# Use of process data

## – Evidence model



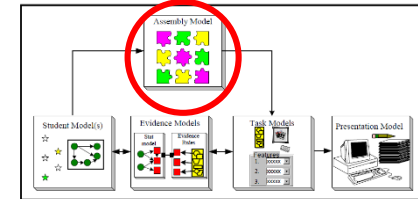
- Multiple process indicators can identify a **latent variable** representing a process-related construct (e.g., planning, speed, test-taking engagement)
- More precise and unbiased estimation of a **product-related (ability) construct**
  - Joint modeling by two-dimensional ability-speed measurement models (Bolsinova & Tijmstra, 2018; Klein Entink, et al., 2009)
  - Modelling the missing data mechanism (Pohl, et al., 2019)
- Investigating the **comparability** between modes (Kroehne et al., 2019)





# Use of process data

## – Assembly model



- Timing information can be used to optimize test design/item selection
  - more **efficient measurement** (van der Linden, 2008)
  - **controlling the speededness** of different test forms in adaptive testing (van der Linden, 2005)
- **Triggering interventions** if the response behavior is not in line with the instruction
  - Omitting responses: Feedback to individual test-taker via prompts so that he or she can adapt (Buerger et al., 2019)
  - Disengaged responding: Feedback to proctor via a dashboard so that he or she can intervene if needed (Wise et al., 2019)

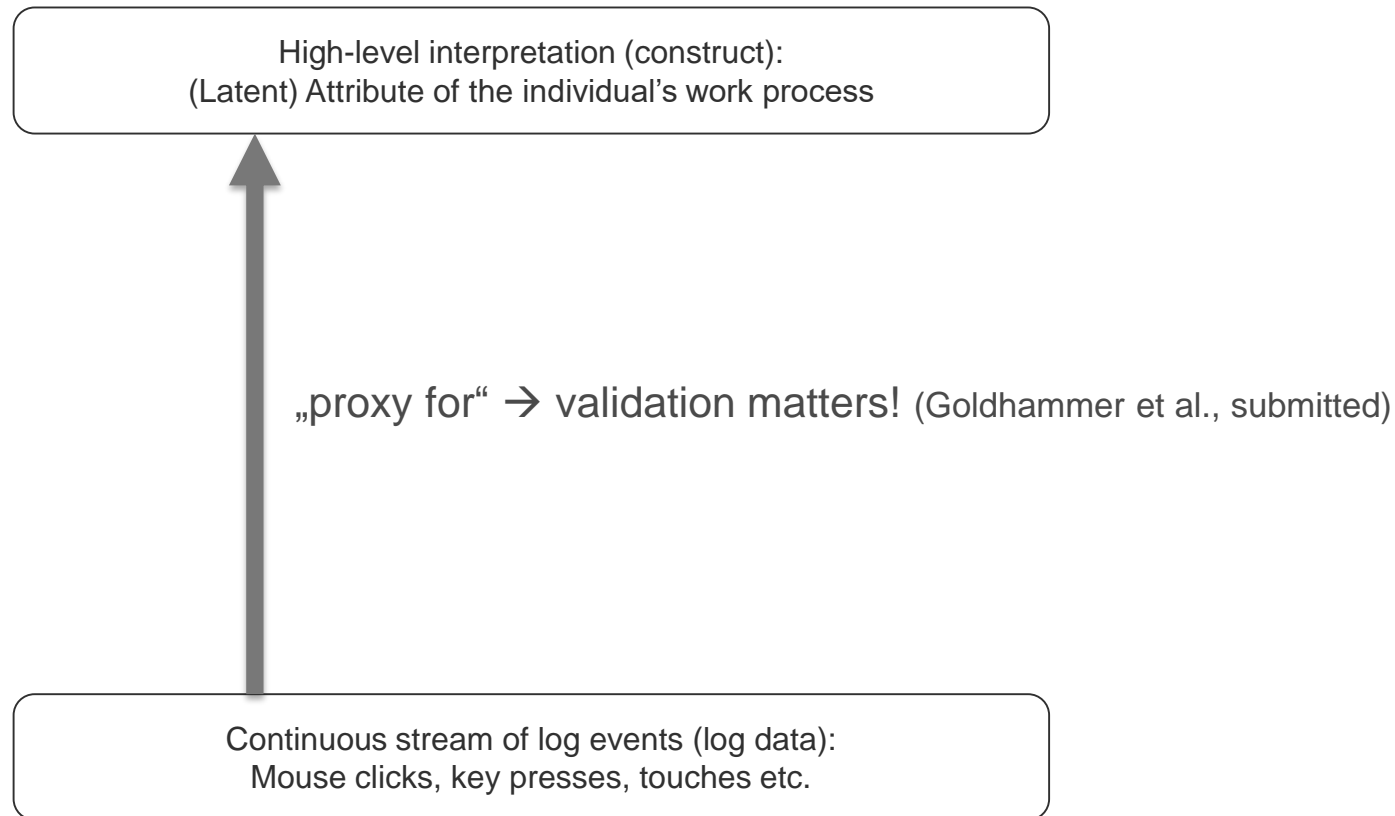


Stephen's main takeaway was:

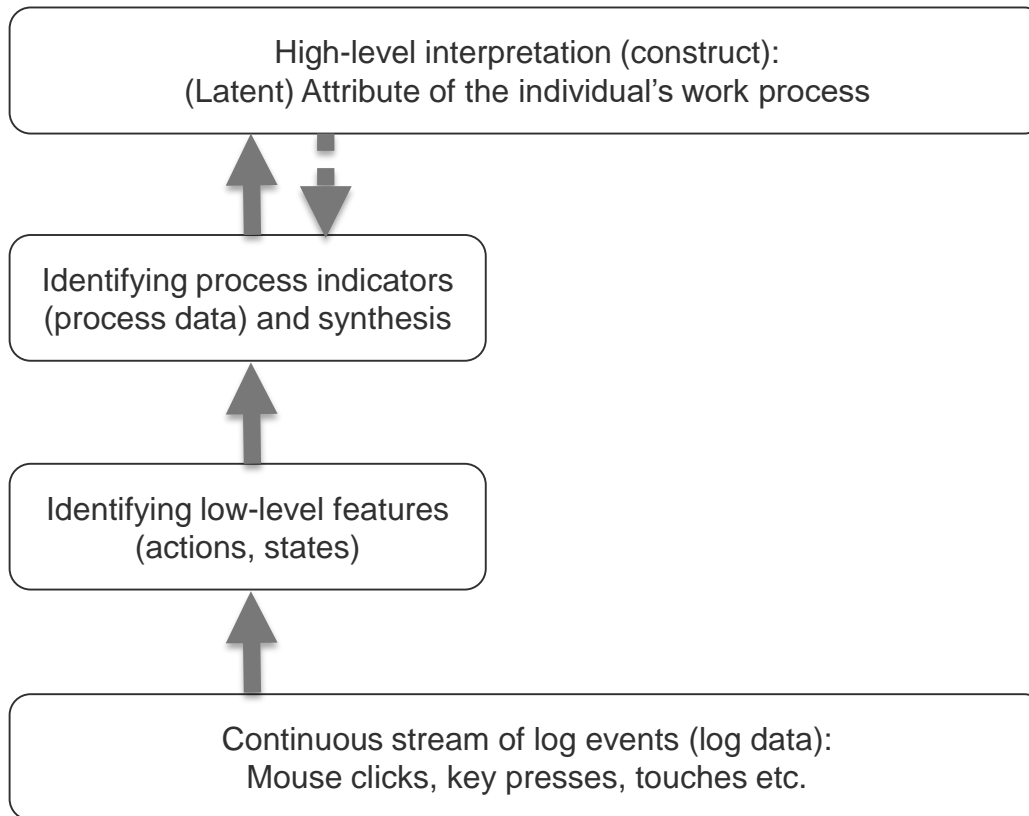
Ultimately process data are a proxy for cognitive processes



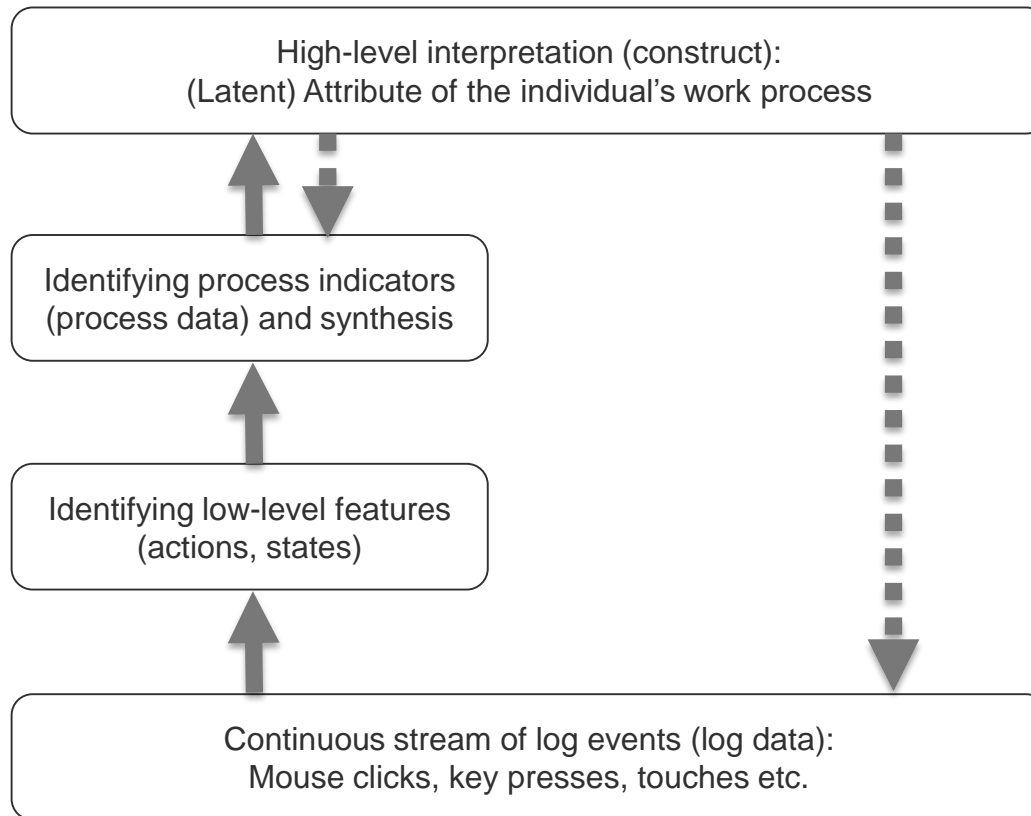
# Reasoning from evidence



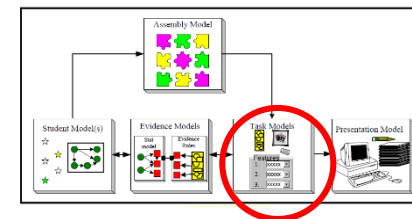
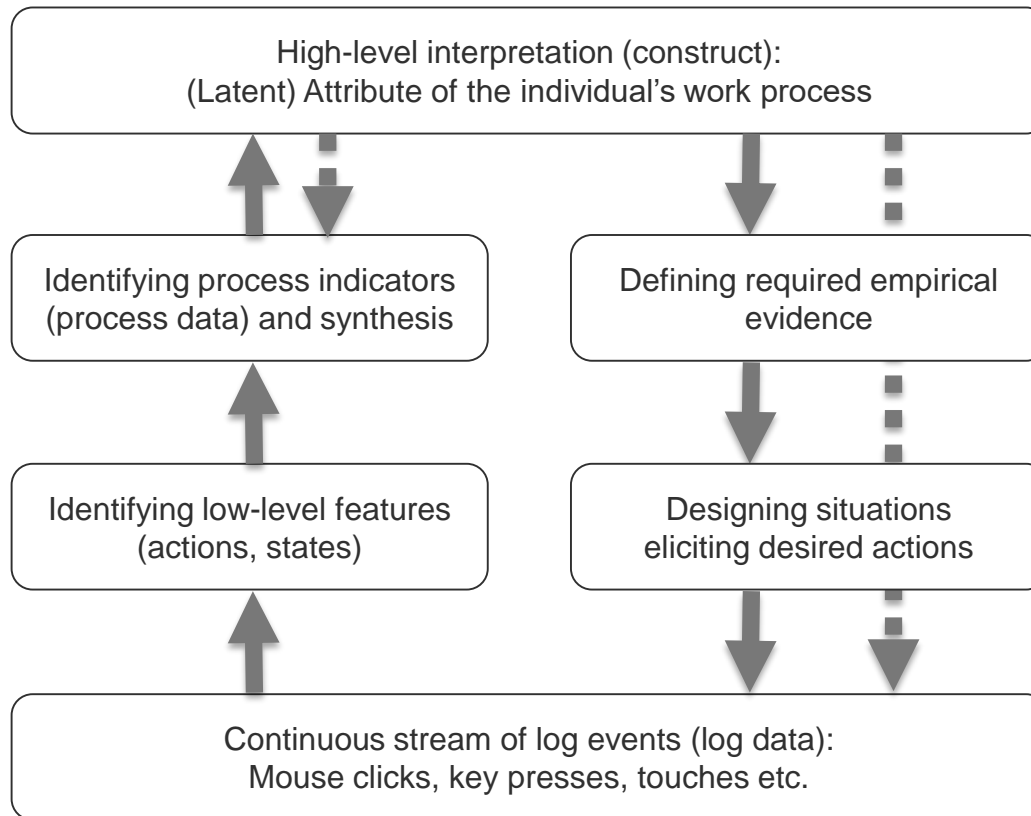
# Reasoning from evidence



# Reasoning from evidence

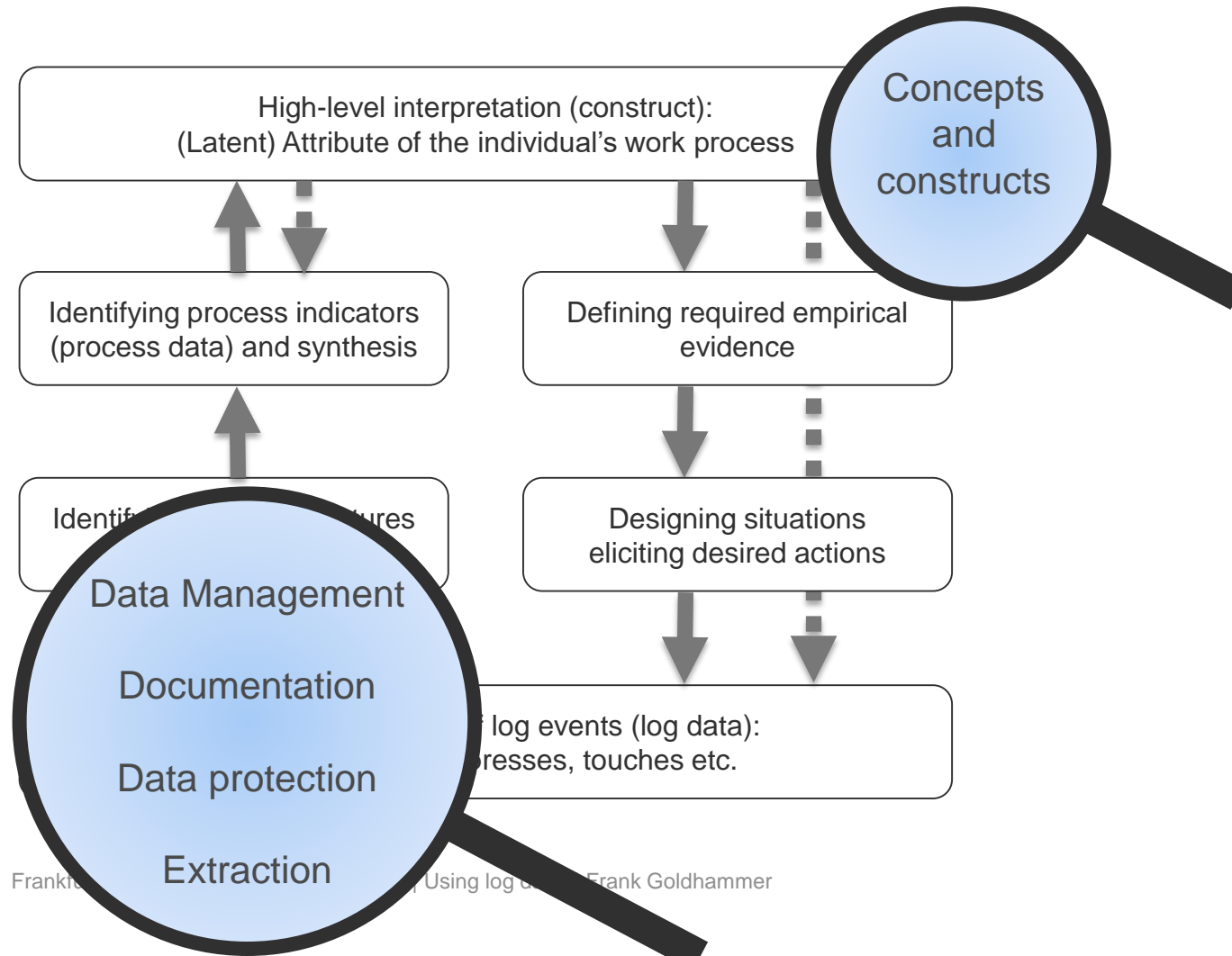


# Reasoning from evidence



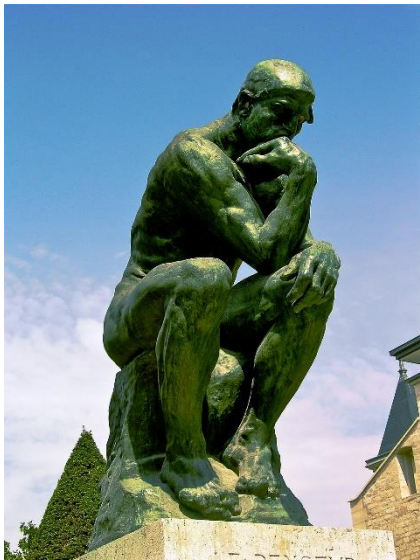
(Goldhammer et al., submitted)

# Topics focussed in the workshop

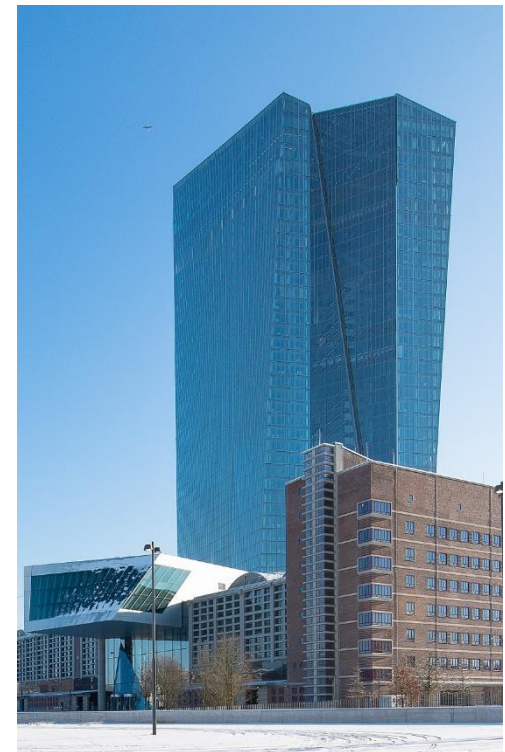


# Topics focussed in the workshop

- What have **building knowledge** (using log data) and **building a tower** in common?



,The thinker' (A. Rodin)



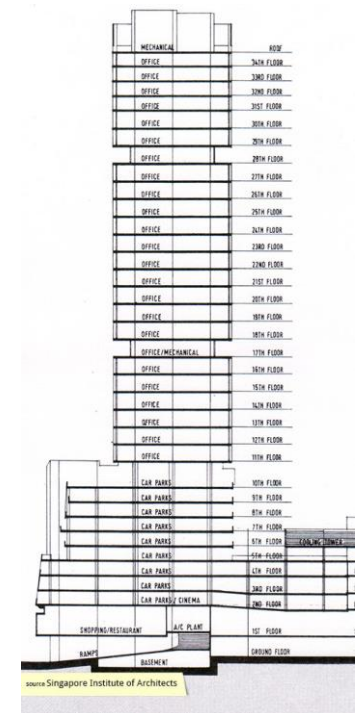
European Central Bank  
(Frankfurt)





# Concepts and constructs

- Importance of theories or process models
  - To define process-related constructs
  - To relate behavioral actions identified by log events to latent attributes of the work process
- Lectures related to the domains of
  - Problem Solving (*Samuel Greiff*)
  - Test-taking disengagement (*Steve Wise*)
  - Digital reading (*Johannes Naumann*)



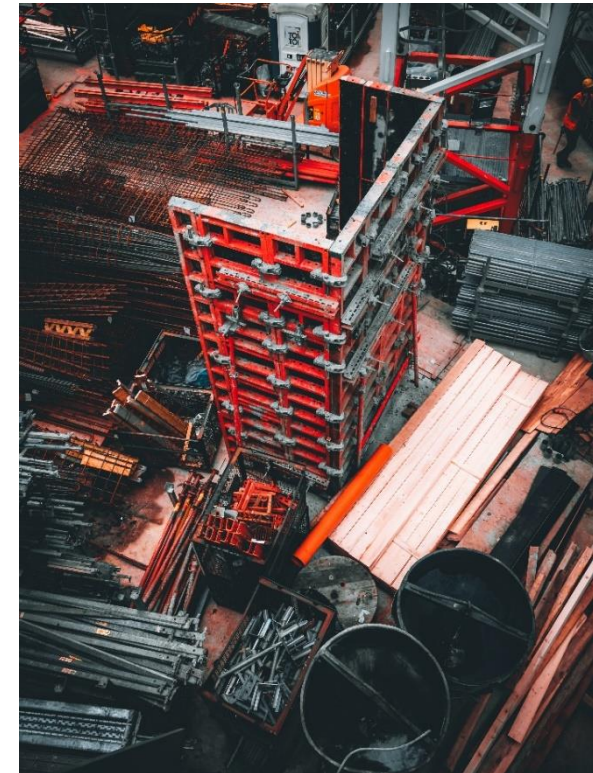
Concept of a tower

[https://commons.wikimedia.org/wiki/File:Section\\_plan\\_of\\_Shaw\\_Tower.jpg](https://commons.wikimedia.org/wiki/File:Section_plan_of_Shaw_Tower.jpg)



# Data management

- Importance of pre-processing log data
  - Cleaning
  - Transformation to data sets and storage
  - Checking correctness
- Impulse talk and small group work:  
Data management  
(*Heiko Sibberns, Ulf Kröhne*)



Storage for construction materials

# Log data and items documentation

- Importance of documentation
  - To know the meaning and properties of log events
  - To understand how log events represent actions within an item
  - To be able to reproduce research work (open science)
- Impulse talk and small group work:  
Log data and items documentation  
(*Qiwei Britt He*)

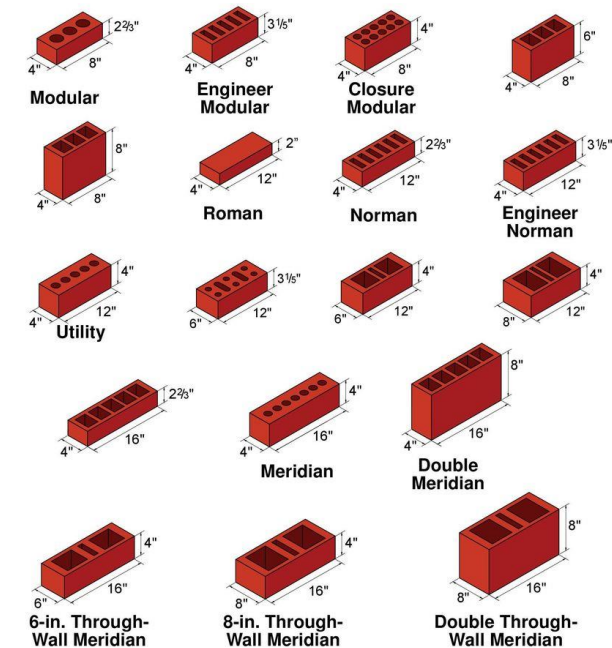


Figure 2  
Modular Brick Sizes (Nominal Dimensions)

Technical data sheet for bricks  
(Brick Industry Association, 2009, p. 3)



# Data protection and anonymization

- Importance of data protection and anonymization
  - To adhere to data protection rules
  - To prevent the conclusion on a specific person
  - To gain acceptance
- Impulse talk and plenary discussion:  
Data protection and anonymization from a learning analytics perspective  
(*Hendrik Drachsler*)



Construction regulations

# Extraction approaches and tools

- Importance of tools to support
  - Pre-processing of log data
  - Extraction of low-level features
  - Creation of process indicators
  - etc.
- Lectures on extraction approaches
  - R package LOGAN (*Ronny Scherer*)
  - glassPy Data Analytics (*Jiangang Hao*)
  - Big data analysis (*Saskia Keskpaik*)
  - PIAAC LogDataAnalyzer (*Carolin Hahnel*)
  - Tools for analyzing log file data (*Ulf Kröhne*)



Rope saw for cutting marble

# Opening and closing keynotes

- Some Notes on Process Data Analysis using TIMSS Problem Solving and Inquiry (PSI) Items (*Matthias von Davier*)
- Using Paradata to Evaluate Online Performance (*Frauke Kreuter*)
- Using Computer-Based Process Data to Improve Assessment Validity: Challenges and Opportunities (*Stephen Sireci*)



# Small group work

- How does it work?
  - Impulse talk provides input (plenary session)
  - Then, participants are randomly split into two small groups
  - In each group, the moderator will stimulate the discussion by guiding questions
  - All participants are invited to contribute to the discussion based on their experience with log data
  - The rapporteur will collect the key points from the group and share them with all the participants (plenary session)



## Social event (Tonight)

- Jazz performance by Stefanie Hoevel (vocals, piano) Martin Lejeune (guitar)
- In the atrium of the DIPF building





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# Hands-on training (Friday)

- Tutor: *Ulf Kröhne*
- Topics:
  - Preparation of log data
  - Extraction of process indicators
  - Theoretical and empirical foundation
- Data: Log data from TIMSS
- Software: R (logFSM and others)



**Thank you for joining and contributing  
to the workshop!**

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