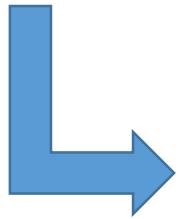


# Information Systems as Representations: A Review of the Theory and Evidence



## Thoughts on Representation, Transformation, and IS Research

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2 March 2021

University of Oslo  
Department of Informatics

Thanks for having me in Oslo. Hope to see you at the University of Queensland!



# A few words with my MISQ hat on...

- Submissions very strong
  - ~ 1000 submissions pa; ~20% growth Jan-Feb 2021 compared to Jan-Feb 2020
- Scandinavian tradition important to MISQ and the IS field
- Some 'local' board members
  - Eric Monteiro (SE), Chee-Wee Tan (SE), Mari-Klara Stein (AE)
- March 2021 issue available in the AIS e-library; editorials free online:
  - Editorial vision: <https://misq.org/misq/downloads/download/editorial/718/>
  - Theory intro: <https://misq.org/misq/downloads/download/editorial/719/>
- **Please submit your best work – all IS topics and paradigms welcome**

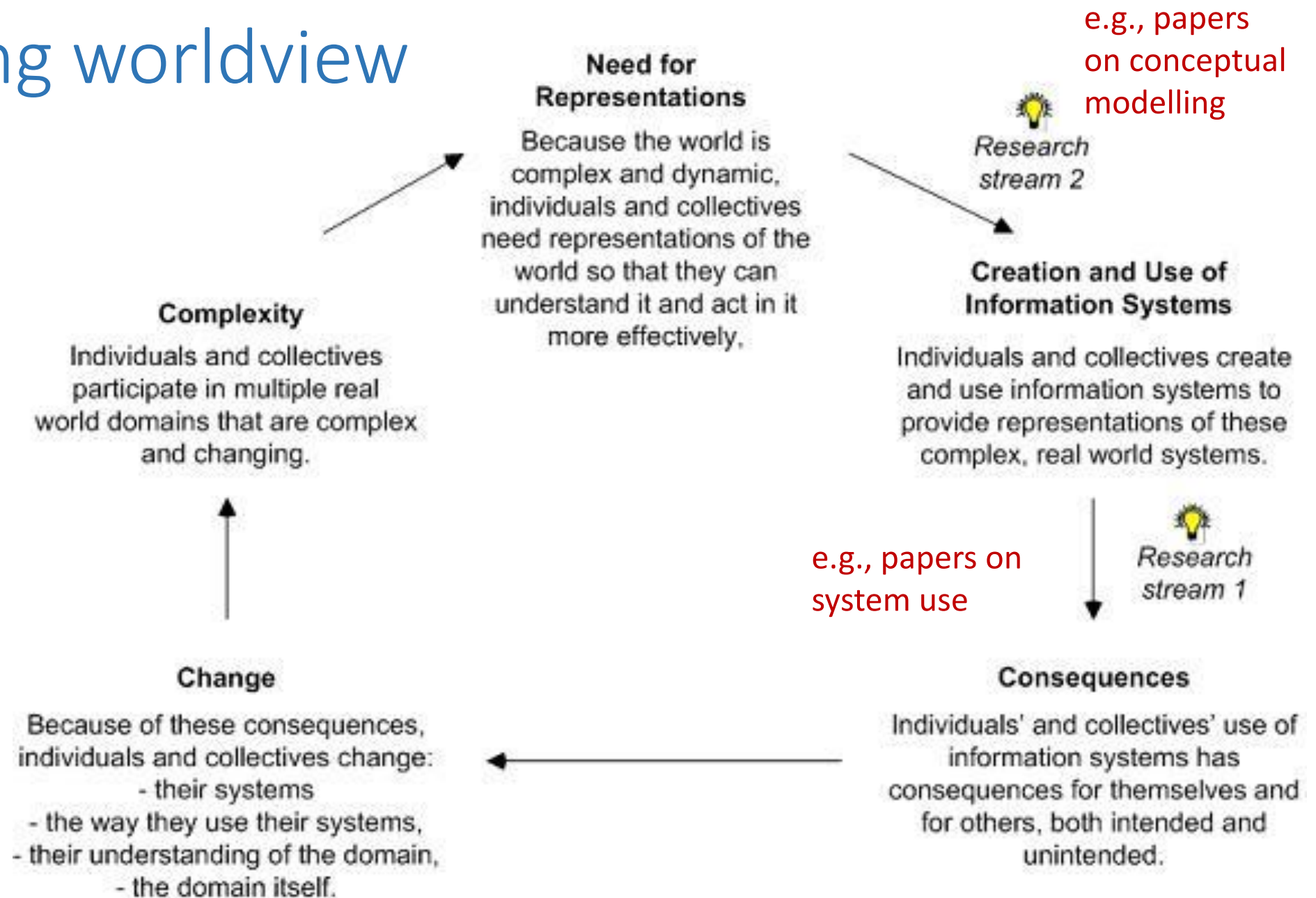
# Agenda

- A research program involving representation and transformation
- Representation
  - Current work – road ahead
- Transformation
  - Current work – road ahead
- Linking representation and transformation
  - Ideas, questions
- Open discussion

Research program involving representation  
and transformation

# Longstanding worldview

ABJ Website  
~2003-2004



# Some example papers

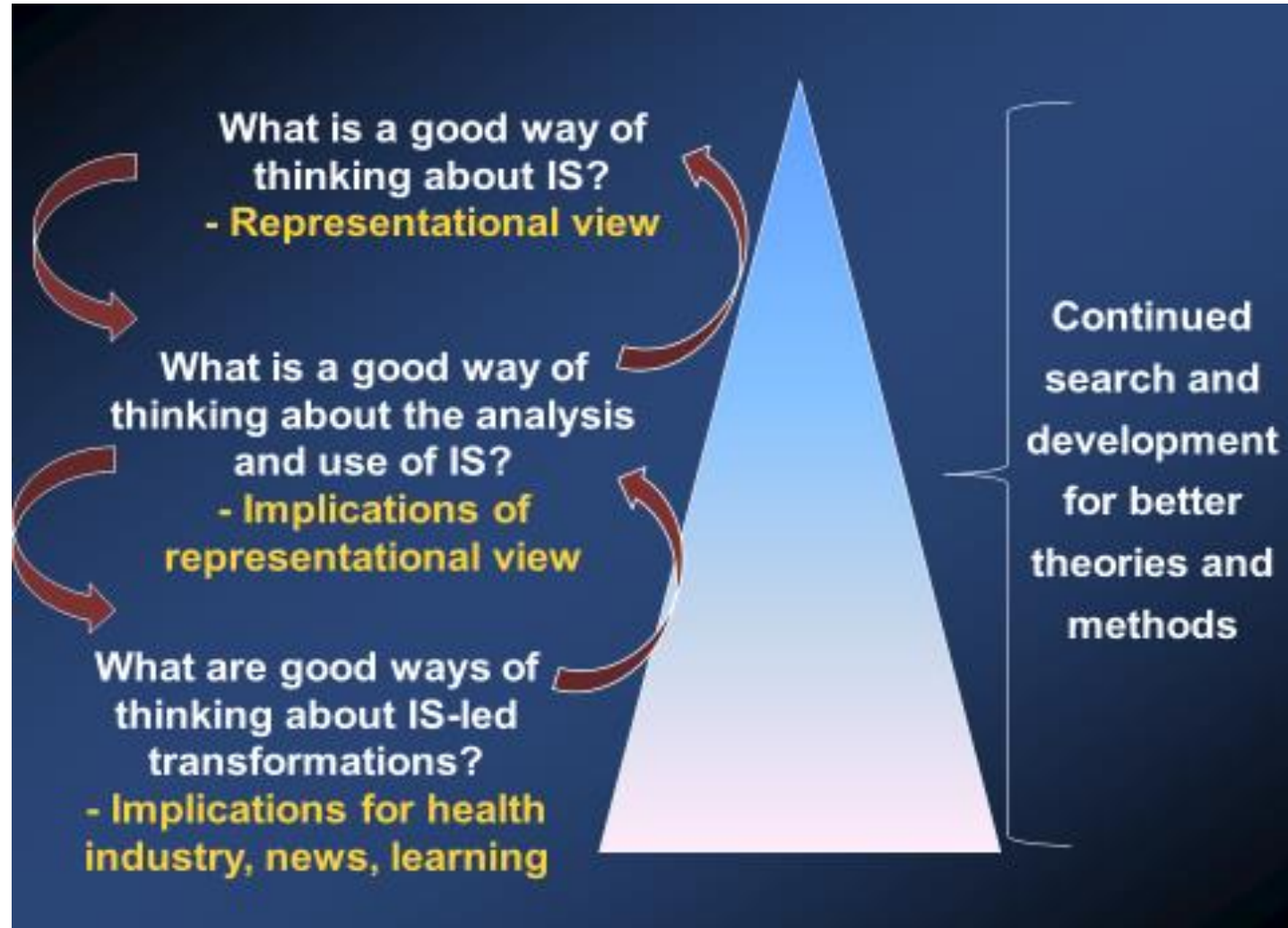
- Papers on conceptual modelling (representational view):
    - Burton-Jones and Meso 2006, Burton-Jones et al. JAIS 2009, Bera et al. 2011 MISQ, Bera et al. 2014 ISR, Clarke et a. 2016 ISR
  - Papers on system use:
    - Representation view not present:
      - Burton-Jones & Straub ISR 2006, Burton-Jones & Gallivan MISQ 2007, Burton-Jones MISQ 2009
    - Representation view present:
      - Burton-Jones and Grange ISR 2013 – top-down, Burton-Jones and Volkoff ISR 2017 – bottom-up
- “As our model shows, data-related issues (such as accuracy and consistency) and practice issues (such as reflection-in-action) are not just important independently; they are inexorably intertwined.”

# Research Program

ABJ Website  
~2009

Later published in:

Burton-Jones, A., et al. IT Use: Notes on a Journey from Use to Effective Use," in: *The Routledge Companion to Management Information Systems*, R. Galliers and M.-K. Stein (eds.), Routledge, Abingdon, Oxon, 2018, pp. 152-165.





# Transformation

Haven't yet managed to study links between representation and transformation

- A new area for me....
- Example papers emerging from a large digital health case study (Jan 2015-ongoing):
  - Linked transformations:
    - Eden, R., Burton-Jones, A., et al. "Digital Transformation Requires Workforce Transformation," *MISQ-E*, 2019
  - Institutional theory:
    - Burton-Jones, A., Akhlaghpour, S., et al. "Changing the Conversation on Evaluating Digital Transformation in Healthcare: Insights from an Institutional Analysis," *I&O*, 2020
  - Alignment:
    - Burton-Jones, A., Gilchrist, A., et al. "Improving Social Alignment During Digital Transformation," *CACM*, 2020
  - Governance:
    - Wang, G. and Burton-Jones, A. "Governing Digital Transformation: A New Perspective," *ICIS*, 2020.

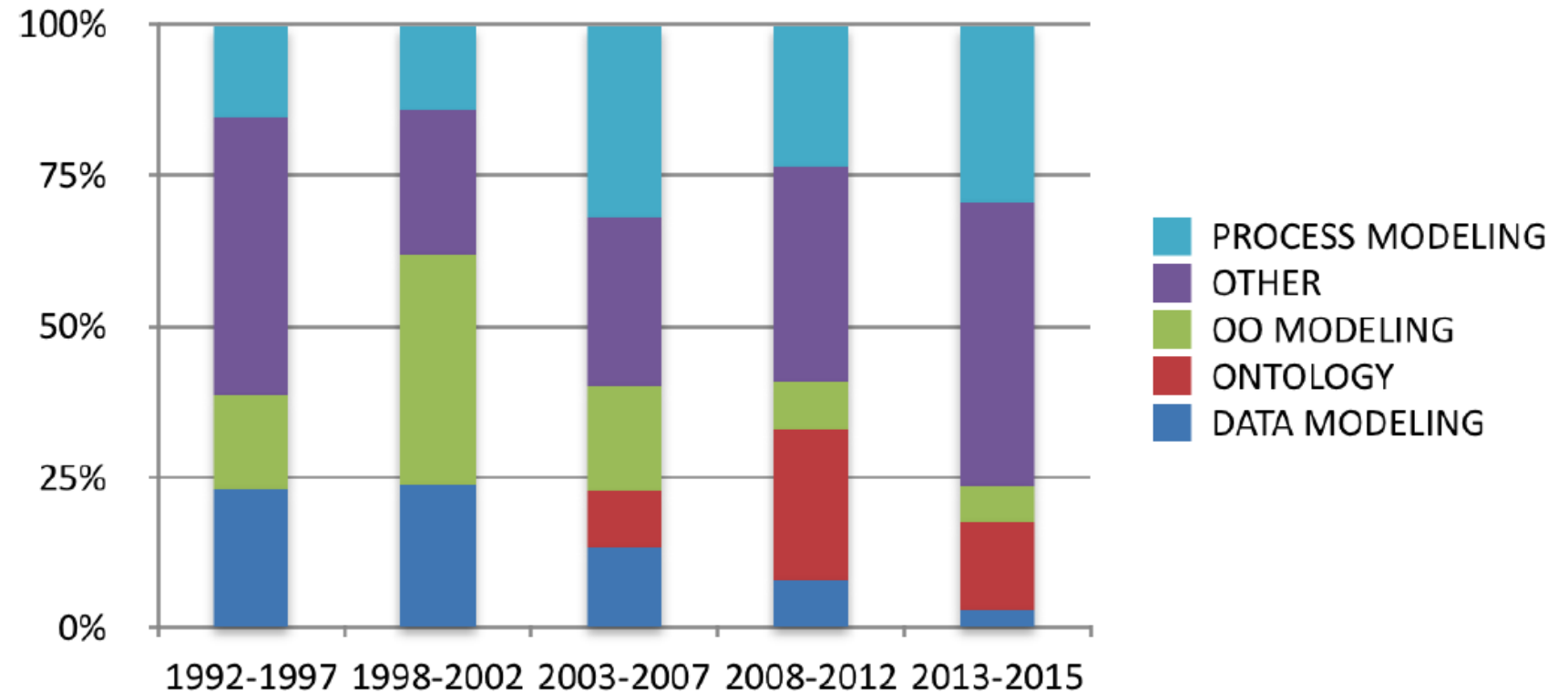
Representation – current work and road ahead

# Representation theory – introduction

- **Starting point** (Weber 1987, Wand and Weber 1990, 1993, 1995):
  - A foundation for a theory of IS design
  - Mix of explanatory and predictive theory, and prescriptive theory:
    - Explain some of the phenomena we see associated with conceptual modelling (e.g., artifacts used, errors observed, efforts expended)
    - Heuristics for how can we facilitate more effective design (e.g., methods, training).
  - Difficult to publish; main uptake through students at UBC and UQ
  - Mainly influential in conceptual modelling research and limited to formal methods and lab experiments

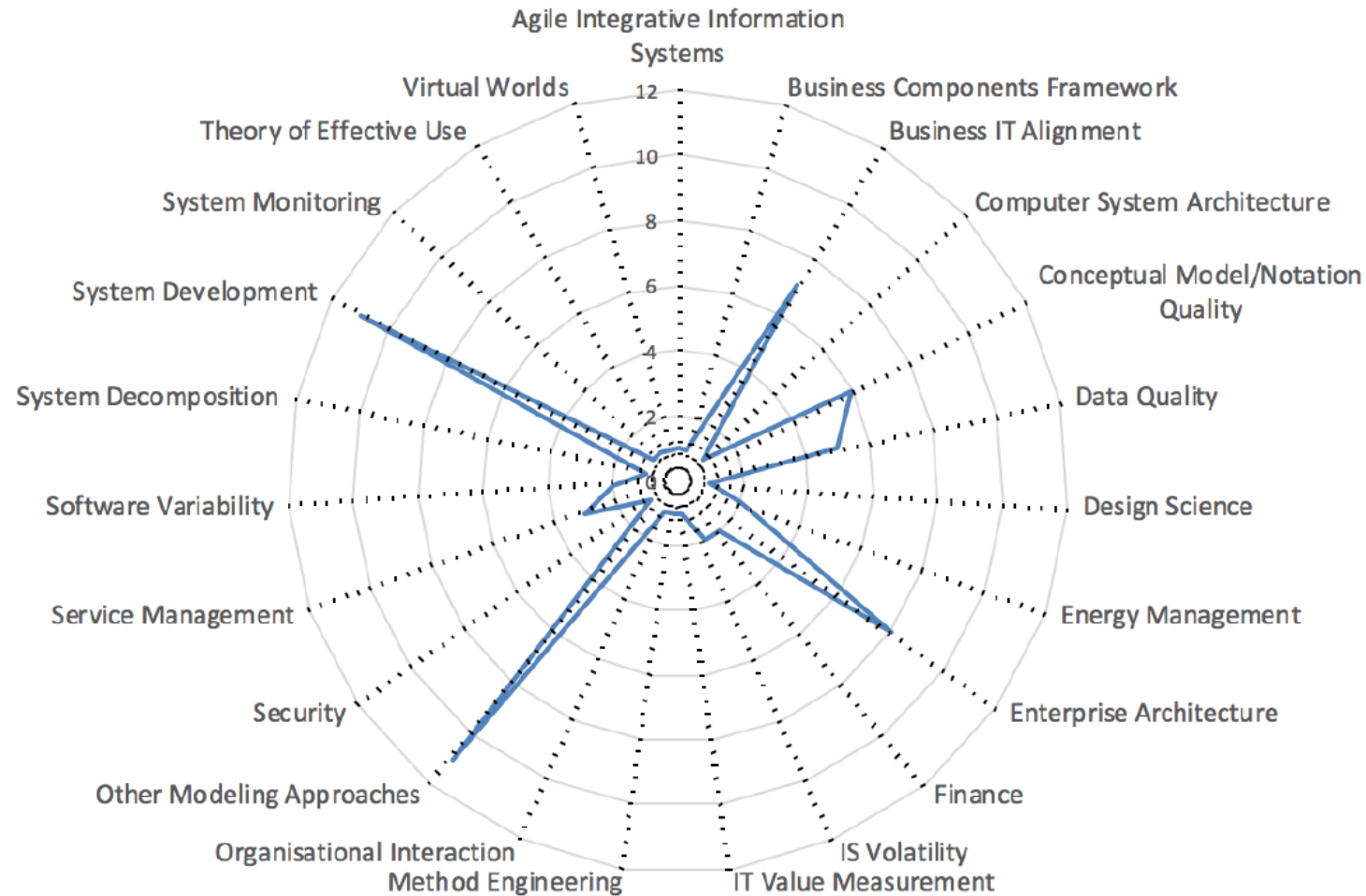
Some historical forebears in Scandinavian research: Langefors, Bubenko, Nijssen, Lytinen, Ågerfalk

# Representation theory – main applications



**Figure 2. Types of Applications per Time Period**

# Representation theory – main applications



**Figure 3. Areas of RM Application Outside the Main Areas**

# Representation theory – basic points

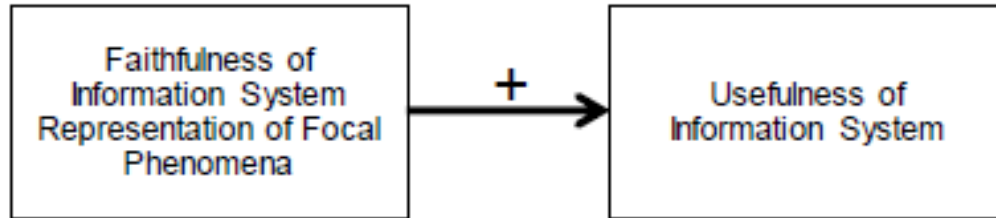


Figure A1. Impact of Representational Faithfulness on the Usefulness of an IS

“Just as the theory of the firm states that this is the reason why firms are formed, representation theory states that information systems are used because they serve as efficient vehicles for representing domains.”  
Burton-Jones and Grange 2013.

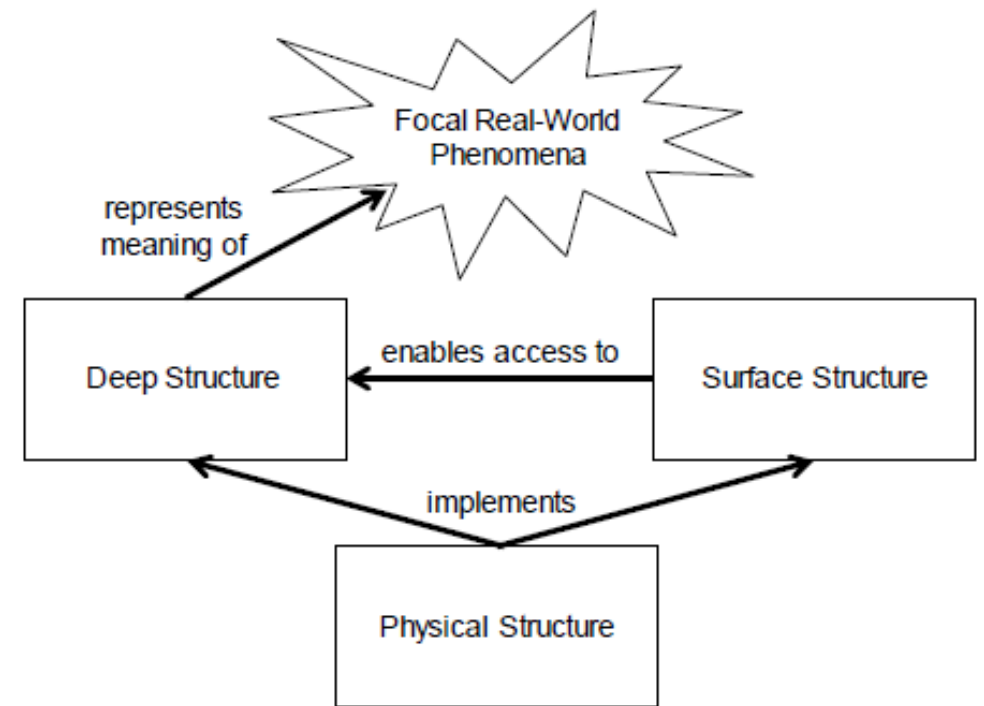
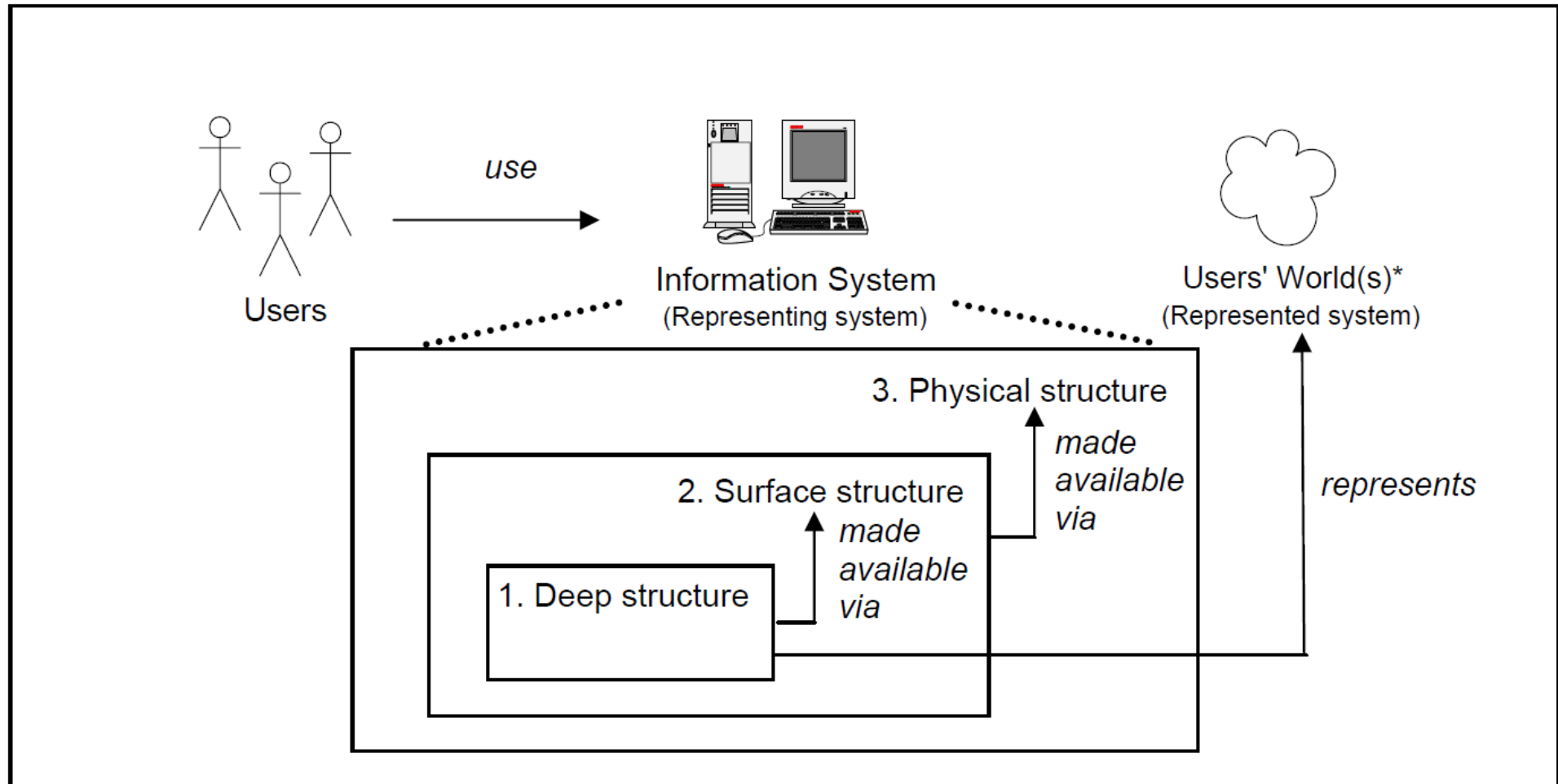


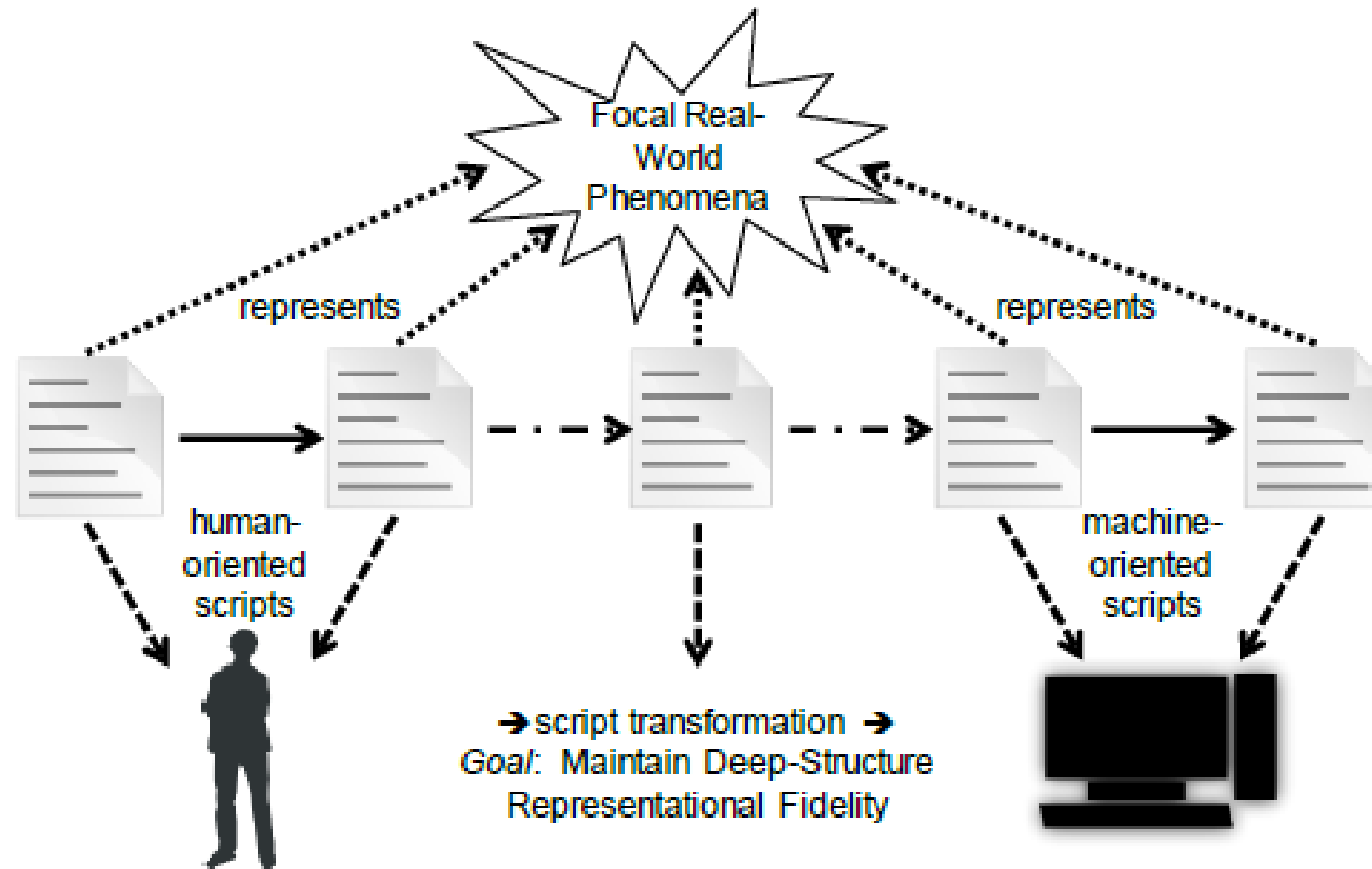
Figure A2. Three Structures of an IS

# Representation theory – basic points



**Figure 1: Information Systems: Deep, Surface, and Physical Structures**

# Representation theory – basic points



**Figure A3. Transforming Human-Oriented Representations of Focal Real-World Phenomena to Machine-Oriented Representations**



# Representation theory – basic points

- Three predictive research models derived from representation theory
  - **Representation model** -- most applications of the theory
    - Used to study the completeness and clarity of conceptual modelling grammars and scripts
  - **State-tracking model** – almost no applications of the theory
    - Used to study the extent to which an IS can serve as an effective state-tracking mechanism
  - **Good decomposition model** – a few applications of the theory
    - Used to study whether a good representation of the world can be maintained as we decompose our understanding of it for purposes of understanding and implementation
- See examples in Burton-Jones et al. MISQ 2017, Recker et al. JAIS 2019

# Representation theory – new models

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**Table 6** Summary of the Deductions We Made from Representation Theory

Deduction	Basis	Implication for our theory
1. Achieving effective use is an ongoing, error prone process	The underlying assumptions of critical realism and teleology	Led us to choose the structure of our overall framework (Figure 3)
2. Effective use must involve accessing the representations of a system via its surface and physical structure	The assumption that the purpose of using an information system is to get access to its representations	Led us to propose transparent interaction as a dimension of effective use
3. Effective use must involve obtaining faithful representations	The assumption that more faithful representations of a domain are desired	Led us to propose representational fidelity as a dimension of effective use
4. Effective use must involve some sort of action on the basis of representations	The assumption that faithful representations are desired because they enable people to act	Led us to propose informed action as a dimension of effective use
5. Learning the components of an IS can improve how well a person can access its representations through its other structures	The assumption that an IS comprises a complex set of structures, and the truism that complex structures invariably require learning	Led us to propose learning as a driver of transparent interaction
6. A user can improve his or her access to representations and their fidelity by conducting adaptations	The assumption that representations of an IS are fallible and must be accessed via a complex set of structures, and the truism that ISs are inherently malleable	Led us to propose adaptation as a driver of transparent interaction and representational fidelity
7. A user must learn the domain and how faithfully the IS represents it to know what to access, and how to adapt and leverage it	The assumption that representations of an IS are fallible and that more faithful representations provide a better basis for action	Led us to propose adaptation and learning as dual drivers of representational fidelity, and learning as an enabler of informed action

# Representation theory – criticisms (many!)

- See Table B5 in Recker et al. 2019, pp. 776-778
- Most common criticism relates to choice of ontological benchmark (e.g., Bunge):
  - Representation theory makes predictions about what can occur when there are failures in representing the real world
  - To make these predictions concrete, researchers have chosen an ‘ontology’ to help them explain what is ‘in’ the world to model. Immediately invites criticism.
- Another common criticism and potential misunderstanding:
  - Early Wittgenstein – picture theory
  - Late Wittgenstein – language games

# Lessons learned about theory from our reviews

- From theory as an intellectual product to an intellectual conversation
  - Hard to pin down what the theory really was
- From theory as purely desk work to theory as reflective practice
  - Too much desk work, not enough reflective practice
- From theory as purely representational to performative
  - What representational theories are used by designers, vendors, users in practice; how do they have pervasive influence in the infrastructures, systems, and practices we see?
- More on these dimensions in “Next Gen” theory MISQ Editorial  
<https://misq.org/misq/downloads/download/editorial/719/>

# For more details on gaps and road ahead

- Many opportunities outlined in:
  - Burton-Jones, A., Recker, J., Indulska, M., Green, P., and Weber, R. "Assessing Representation Theory with a Framework for Pursuing Success and Failure," *MISQ*, 2017, pp. 1307-1333
  - Recker, J., Indulska, M., Green, P., Burton-Jones, A., and Weber, R. "Information Systems as Representations: A Critical Review of the Theory and Evidence," *JAIS*, 2019, pp. 735-786.
  - Also see: Recker et al. "From Representation to Mediation: A New Agenda for Conceptual Modeling Research in a Digital World," *MISQ* 2021, <https://aisel.aisnet.org/misq/vol45/iss1/10/>
- Main interest for me:
  - Representation work; data work (Monteiro, Grisot, Da Cunha, others...)

Transformation – current work and road ahead

Linking Representation and Transformation

# New literature on digital transformation

- Burgeoning literature in IS and other fields
- Is it an old topic or a new one?
  - Transformation in roles (Barley), practices (Orlikowski), discourse (Barrett)
  - Transformation in identity (Wessel)
- My approach has been bottom-up:
  - Linked transformations (MISQ-E)
  - Institutional theory (I&O)
  - Alignment (CACM)
  - Governance and governing (ICIS)

# Attempts and ideas for linking representation with transformation

- These two topics are most likely linked in numerous ways, but we don't know how yet
- Some options:
  - Transformations in the high-level representation schemes affect the organizational transformation (even if that was not their purpose)
  - Transformation in the local representation scheme is intended to influence the organizational transformation
  - The transformation is represented in various ways
  - Representation work underpins the transformation



# Attempts and ideas – Appendix of Recker et al. 2019

- What is the representation of the “problem” in the problem-oriented medical record? (per Weed 1968) At multiple levels of analysis?

The diagram consists of a table with three columns under the heading 'Categories of Affordances' and three rows under the heading 'Criteria for Effective Use'. An oval containing the text 'Specific affordances and how to actualize them to achieve criterion' has an arrow pointing to the intersection of the 'Transparent Interaction' row and the 'Snapshot Affordances' column.

		Categories of Affordances		
		Snapshot Affordances	Temporal Affordances	System Affordances
Criteria for Effective Use	Transparent Interaction			
	Representational Fidelity			
	Informed Action			

Figure A7. A Combined Approach to Studying Effective IS Use

Wrap-up

# Conclusions

- Representation and transformation are core IS topics
  - Always have been, always will be
- They must be linked in some way
  - Interestingly, that link is not a core topic in our field
- Why?
- If it is important, how could we study it?

Comments/questions/suggestions?

<https://misquarterly.github.io>



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