Scientific Research in Information Systems: A Beginner's Guide (2nd edition)

Teaching Materials

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Overview

Content
Part 1: Basic Principles of Research
Part 2: Conducting Research
Part 3: Publishing Research

Chapter 5:
Research Methods

Quantitative Methods

Cornerstones of Quantitative Methods (1)

- Procedures that feature research methods such as experiments or surveys and which are characterized by an emphasis on quantitative data (think of these procedures as having a focus on “numbers”).
- Quantitative data are types of data whose value is measured in the form of numbers, with a unique numerical value associated with each data record.
- Quantitative methods emphasize state-of-the-art analysis of such data to create **valid** and **reliable** general claims.

Cornerstones of Quantitative Methods (2)

- Quantitative methods emphasize (post-) positivist philosophy.
  - Positivist researchers generally assume that reality is objectively given and can be discovered by a researcher and described by measurable properties independent of the observer (researcher) and his or her instruments.
  - Interpretive researchers, on the other hand, start out with the assumption that access to reality (given or socially constructed) is only through social constructions such as language, consciousness, and shared meanings
- Ontologically, quantitative research is based on the idea that scientific theories can be proposed that can be falsified by comparing theory to carefully collected empirical data. The world has an objective reality that can be captured and translated into testable hypotheses, usually in the form of statistical or other numerical analyses
- Example: Einstein’s theory of relativity really became trusted when in 1919, Eddington’s eclipse observation showed that Einstein’s predictions were correct and Newton’s predictions incorrect.

The hypothetico-deductive model to science

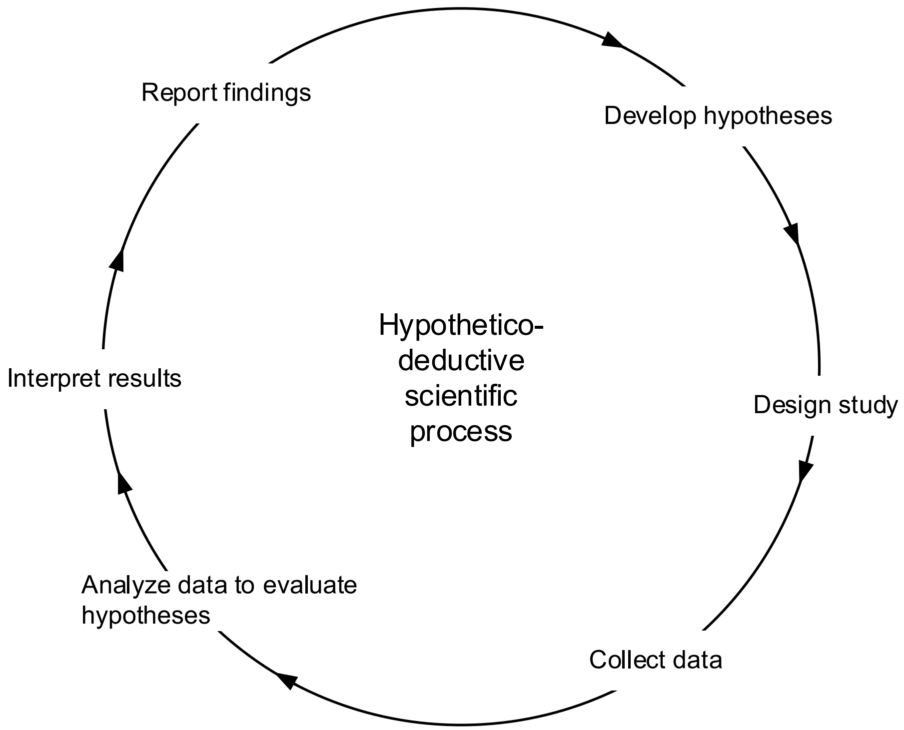
1. Researchers posit a new theory in the form of one or more hypotheses (e.g., an alternative hypothesis that people with small hands type faster), expressed in contrast to a null hypothesis of no effect (e.g., people with small hands do not type faster).

2. They design an empirical study to obtain data (e.g., measures of typing speed and hand size).

3. They collect the data from a sample (e.g., a group of students or knowledge workers).

4. They test their hypotheses, by analyzing the gathered data and calculating one or another test statistic (e.g., a t-test comparing typing speed of those with large hands to those with small hands). They calculate a probability, the p-value, under the assumptions of a specified statistical model, that a particular test statistic (e.g., the average typing speed) would be equal to or more extreme than its observed value. Through this test, they examine in the data whether the null hypothesis holds true in the population (e.g., people with small and large hands type at the same speed). This prediction is called a null hypothesis because it typically assumes the absence of an effect (i.e., no difference in typing speed). The p-value—the probability of finding a difference in typing speed in our sample, assuming that there is no difference in the population—is then usually compared to certain thresholds (typically 0.05 or 0.01) known as the alpha protection level.

5. They interpret the results from the statistical tests. If the null hypothesis is rejected, researchers typically construe this result as denoting “accept” or “support” for their stated alternative hypothesis (that people with small hands indeed type faster).



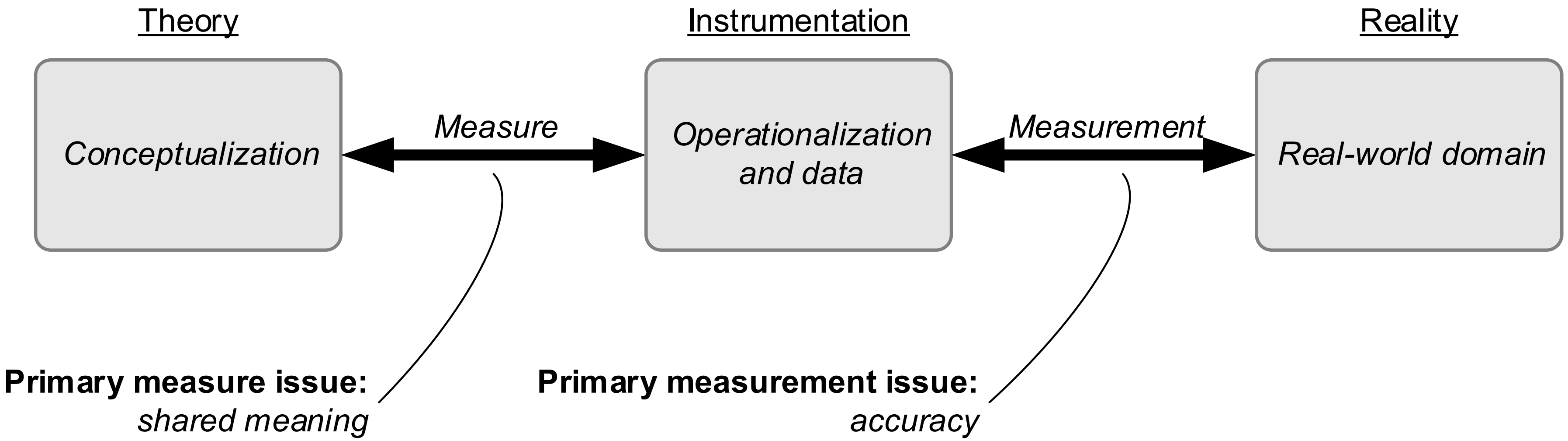
Mertens, W., & Recker, J. (2020). New Guidelines for Null Hypothesis Significance Testing in Hypothetico-Deductive IS Research. *Journal of the Association for Information Systems, 21(4), 1072-1102.*

Fundamentals of Quantitative Methods

- The Importance of Measurement

- Quantitative methods depend heavily on exact measurement. measurement provides the fundamental connection between empirical observation and the theoretical and mathematical expression of quantitative relationships

Measures and measurement



Burton-Jones, A., and Lee, A. S. 2017. "Thinking About Measures and Measurement in Positivist Research: A Proposal for Refocusing on Fundamentals," *Information Systems Research (28:3), pp. 451-467.*

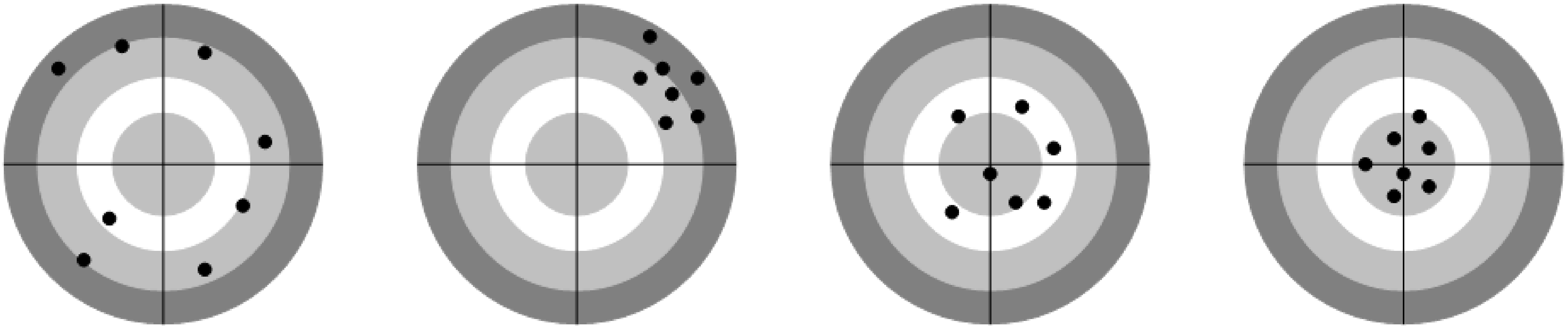
Two requirements of measures and measurement

- The variables that are chosen as operationalizations must also guarantee that data can be collected from the selected empirical referents accurately (i.e., consistently and precisely). This step concerns the **reliability** of measurement.

- The variables that are chosen as operationalizations to measure a theoretical construct must share its meaning (in all its complexity if possible). This step concerns the **validity** of the measures.

Burton-Jones, A., and Lee, A. S. 2017. "Thinking About Measures and Measurement in Positivist Research: A Proposal for Refocusing on Fundamentals," *Information Systems Research (28:3), pp. 451-467.*

Reliability and Validity



Neither **reliable** nor **valid** | **Reliable** but not **valid** | **Valid** but not **reliable** | Both **reliable** and **valid**

Validity

- Validity describes whether the operationalizations and the collected data share the true meaning of the constructs researchers set out to measure.
- Can be assess theoretically and/or empirically.

Types of Validity

- Content validity
  - refers to the extent to which a researcher's conceptualization of a construct is reflected in her operationalization of it, that is, how well a set of measures match with and capture the relevant content domain of a theoretical construct.
  - Content validity is important because researchers have many choices in creating ways to measure a construct. Did they choose wisely so that the measures they use capture the essence of the construct? They could, of course, err on the side of inclusion or exclusion.
  - Assessments may include an expert panel that peruse a rating scheme and/or a qualitative assessment technique such as the Q-sort method.

Types of Validity

- Construct validity
  - is an issue of operationalization and measurement between constructs. The baseline issue here is whether different theoretical constructs are separable from each other.
  - Convergent validity: Items or phrases in the instrumentation are not related in the way they should be or they are not related in the ways they should not be.
  - Discriminant validity: Items or phrases in the instrumentation do not segregate or differ from each other as they should.
  - Nomological validity: assesses whether measurements and data about different constructs correlate in a way that matches how previous literature predicted the causal (or nomological) relationships of the underlying theoretical constructs.
  - Construct validity is typically assessed empirically through statistical, correlational logic.

Types of Validity

- Internal validity
  - assesses whether alternative explanations of the dependent variable(s) exist that have not been ruled out.
  - Factors:
    - temporal precedence of IVs before DVs
    - Covariation
    - ruling out rival hypotheses
  - Typically assessed through the inclusion of statistical control variables such as firm size, experience, gender, etc.

Types of Validity

- Other types of validity
  - Manipulation validity
    - used in experiments to assess whether an experimental group (but not the control group) is faithfully manipulated and we can thus trust that any observed group differences are in fact attributable to the experimental manipulation.
  - Statistical conclusion validity
    - assesses the appropriate use of statistics to infer whether the presumed independent and dependent variables co-vary as predicted
  - Predictive validity
    - assesses the extent to which a measure successfully predicts a future outcome that is theoretically expected
  - Ecological validity
    - assesses the ability to generalize study findings to real-world settings

Reliability

- describes the extent to which a measurement variable or set of variables is consistent in what it is intended to measure.
- important to the scientific principles of replicability because reliability implies that the operations of a study can be repeated in equal settings with the same results.
- Sources of reliability problems often stem from a reliance on overly subjective observations and data collections.

Types of Reliability

- Internal consistency
  - measures whether several measurement items that propose to measure the same general construct produce similar scores.
  - The most common test is through Cronbach’s (1951) alpha.

Types of Reliability

- Interrater reliability
  - is important when several subjects, researchers, raters, or judges code the same data
  - When a range of individuals (multiple study subjects or multiple researchers, for example) all rate the same observation and we look to get consistent, consensual results
  - Cohen’s (1960) coefficient Kappa is the most commonly used test.

Types of Reliability

- Other types of reliability
  - unidimensional reliability, composite reliability, split-half reliability, or test-retest reliability
  - See optional reading

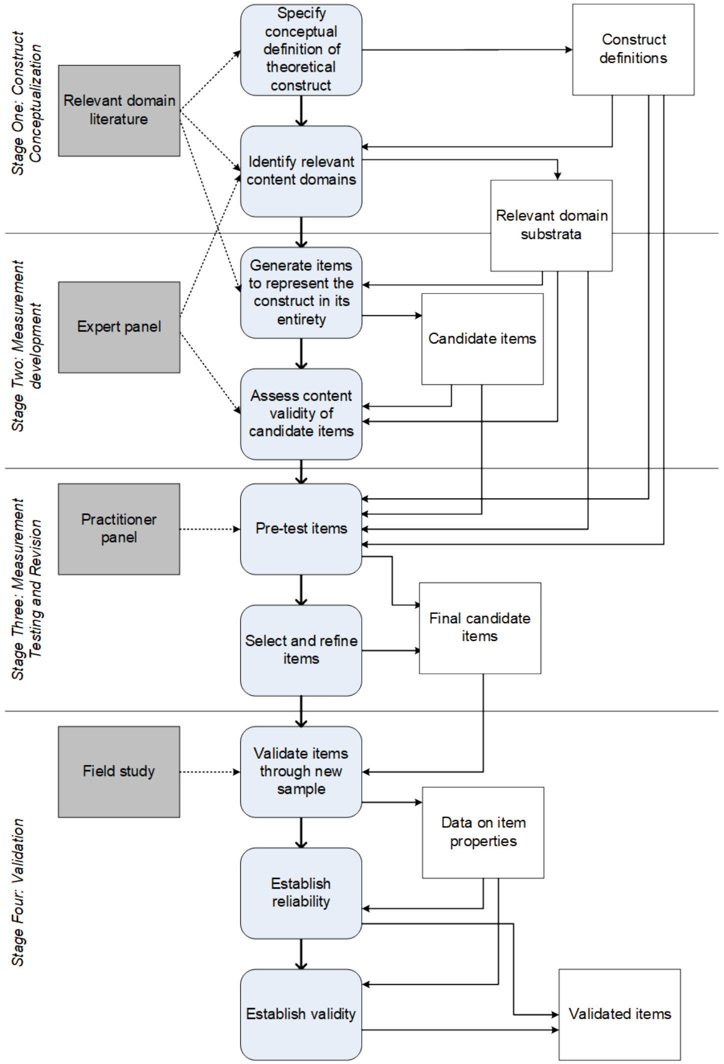
Straub, D. W., Boudreau, M.-C., & Gefen, D. (2004). Validation Guidelines for IS Positivist Research. *Communications of the Association for Information Systems, 13(24), 380-427.*

Developing and Assessing Measures and Measurements

- Establishing reliability and validity of measures and measurement is a demanding and resource-intensive task.
- The first rule should always be to identify and re-use where possible, existing measures and measurements that have already been developed and assessed.
- Examples:
  - the Handbook of Management Scales (https://en.wikibooks.org/wiki/Handbook_of_Management_Scales)
  - the Inter-Nomological Network (https://inn.theorizeit.org/)

Procedure for Developing and Assessing New Measures and Measurements

1. Define the conceptual domain of a construct
2. generate pools of candidate measurement items are for each construct
3. Purify the list of candidate items through testing and revisions
4. obtain statistical evidence for reliability and validity of the measures and measurements



Types of Quantitative Methods

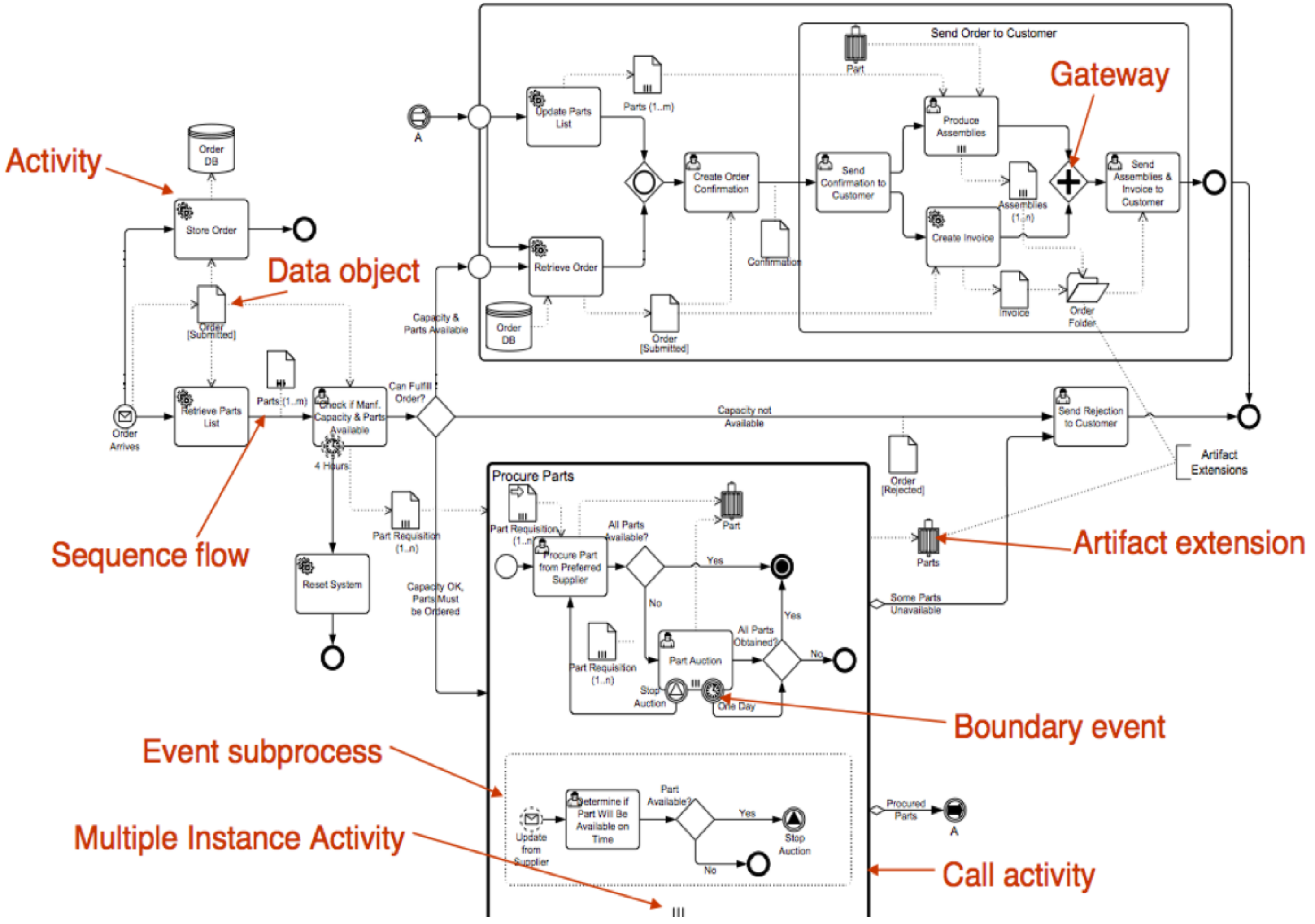
General QtPR Research Approaches

Descriptive research	Correlational research	Quasi-experimental research	True experimental research
describes the current status of some identified variables to provide systematic information about some phenomena.	identifies and interprets relationship patterns between variables but does not establish causal mechanisms for the observed patterns.	attempts to establish cause-effect relationships between non-equivalent groups. Statistical tests of equivalency are used to rule out confounds.	establishes cause-effect relationships between variables by manipulating randomly assigned groups to determine the effect of treatments on dependent variables.

Descriptive/correlational quantiative research: Survey

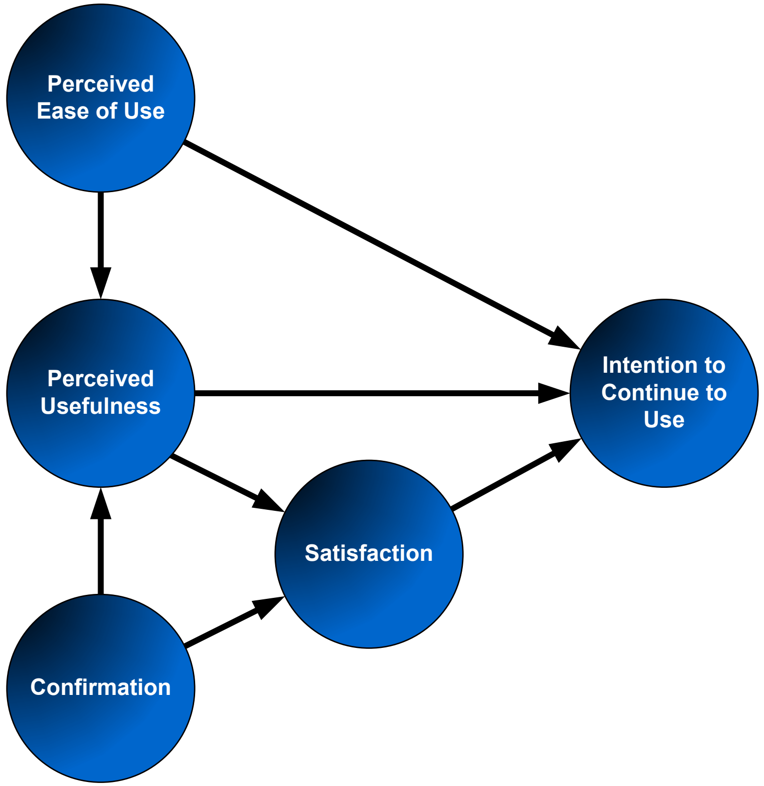
- A non-experimental, observational research method that does not involve controlling or manipulating independent variables.
- to gather information about the characteristics, actions, perceptions, attitudes, or opinions of a large group of units of observations (such as individuals, groups, or organizations), referred to as a “population”.
- involve collecting data about a population from a random sample of that population through questionnaire-type instruments that can be distributed and completed via mail, online, telephone, or, less frequently, through structured interviews.
- Traditionally, the dominant technique for data collection in IS.
- Are preferable when
  - the central questions of interest about a phenomenon are “what is happening?” and “how and why is it happening?” and
  - when control of the independent and dependent variables is not required or not possible.
- Can be used for at least three purposes:
  - Exploration: to identify factors that appear relevant (e.g., success/failure factors)
  - Description: to ascertain facts about the situations, events, attitudes, opinions, processes, or behaviors that are occurring in a population. (e.g., typical political polls)
  - Explanation: to test theory and hypothetical causal relationships between theoretical constructs (the most common form)

Example: Survey research



Hypotheses

- Three determinants of continuance
  - whether users form a positive belief about the actual use of a technique, viz., whether they find it useful and easy to use in actual process modelling practice, and
  - whether users are able to confirm (or disconfirm) initial expectations from the pre-usage phase about a technique.



Recker, J. (2010). Explaining Usage of Process Modeling Grammars: Comparing Three Theoretical Models in the Study of Two Grammars. *Information & Management, 47(5-6), 316-324.*

Measurement development

Instructions

In the following, you will be given four definitions (of construct deficit, redundancy, overload, and excess) and for each definition a number of items contained in a table.

It is asked of you to *assess* these items, independently from each other, as to how well they *fit* the content of the given definition, in the sense how appropriate they are for being used as a measurement item (using a Likert-scale) for the given definition. The assessment should be done using a scale from 1 (fits extremely poorly) to 7 (fits extremely well).

Consider the following example: it was found that with respect to the definition of perceived usefulness ("the degree to which a person believes that using a particular system would enhance his or her job performance"), the item "Using the system increases my work productivity" *fits* the definition in the sense that it is appropriate for measuring an individual's perception of the usefulness of a system using a 7-point scale with the endpoints "I strongly disagree" and "I strongly agree".

The same principle applies to this test. To better understand this test, consider the following example that is based on the works of Davis (1986, 1989) and considers various aspects of the usefulness of an IT system. Note here that the rankings are given for illustration purposes only and do not necessarily reflect an appropriate judgement.

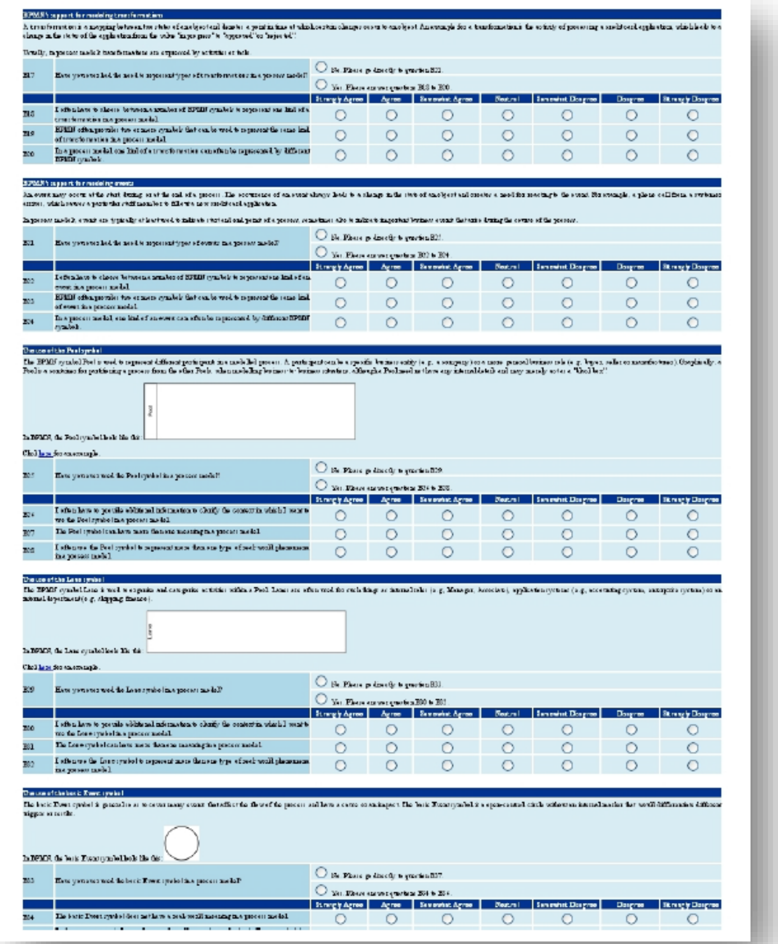
Definition:

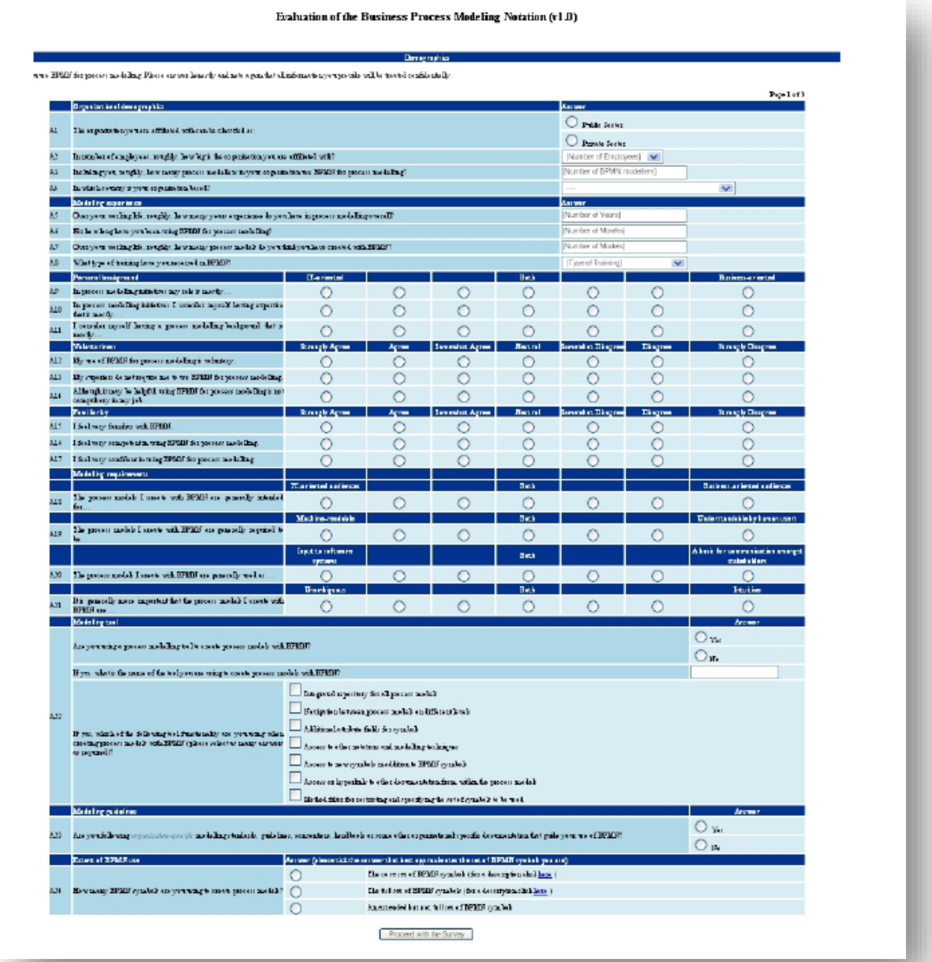
Perceived usefulness of an IT system is the degree to which a person believes that using the system would enhance his or her job performance.

Items:

Item Description	Rank
Using an IT system improves my job performance	6
An IT system supports critical aspects of my job	5
Using an IT system saves me time	4
Using an IT system enables me to accomplish tasks more quickly	7
Using an IT system improves the quality of the work I do	3

The Instrument

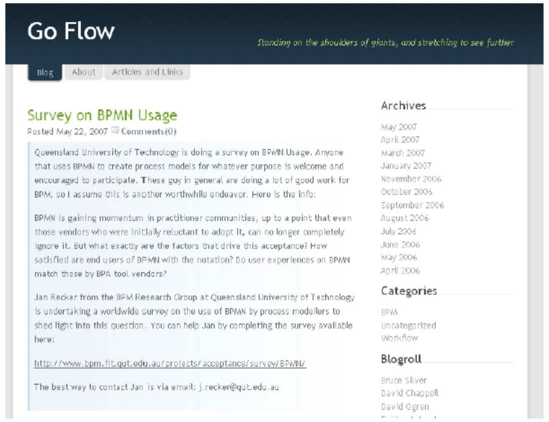




Survey administration

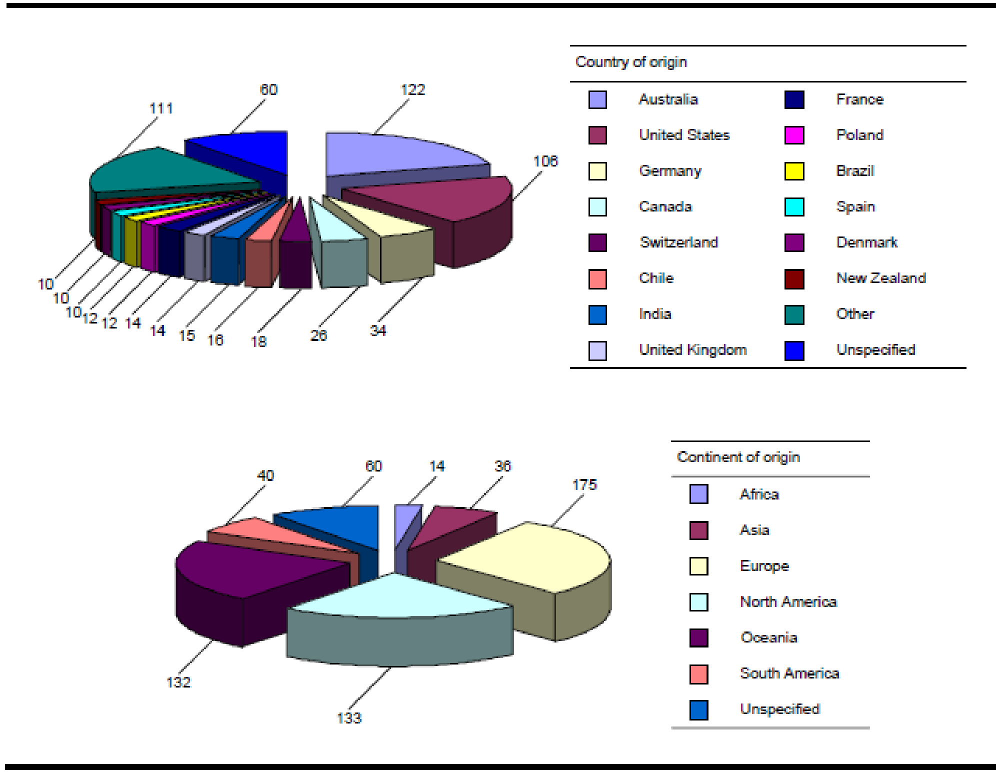
- Population: all process and systems analysts
- Sample: convenience sample (all I could get)
- Administration: Web-based survey
- Sample size: about 600 if I remember correctly.

App. C.14: Survey announcement through BPTrends



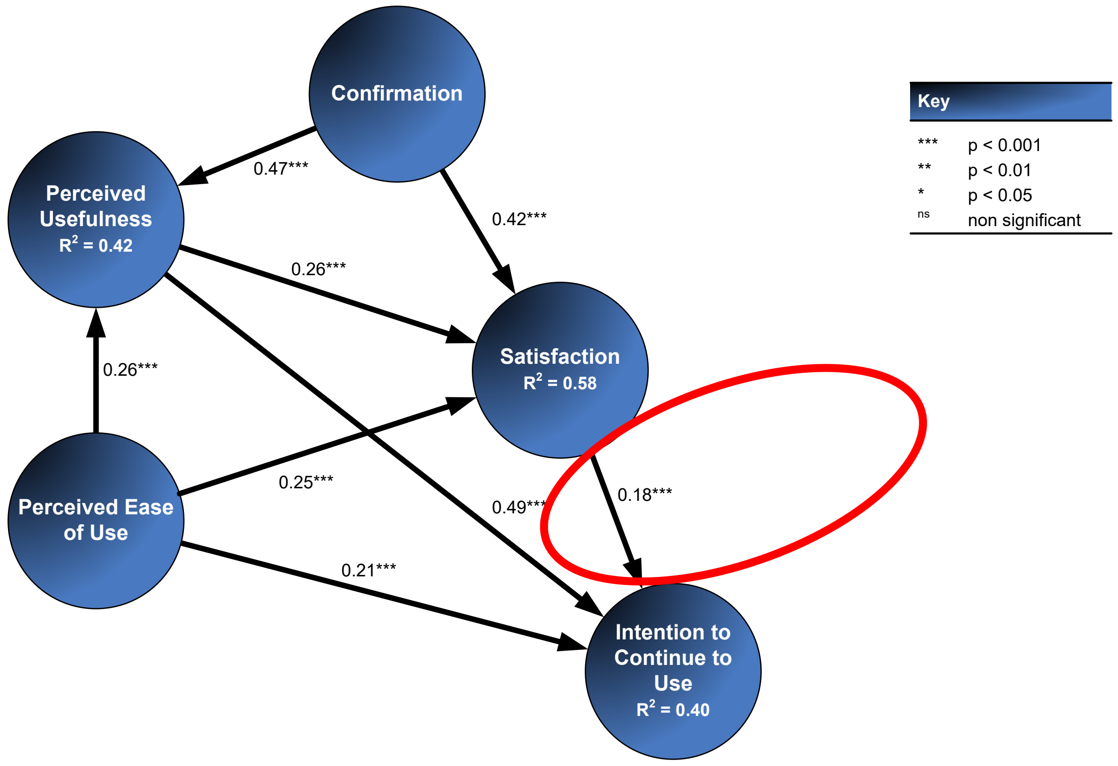
App. C.16: Survey announcement through Go Flow blog

Results: Demographics



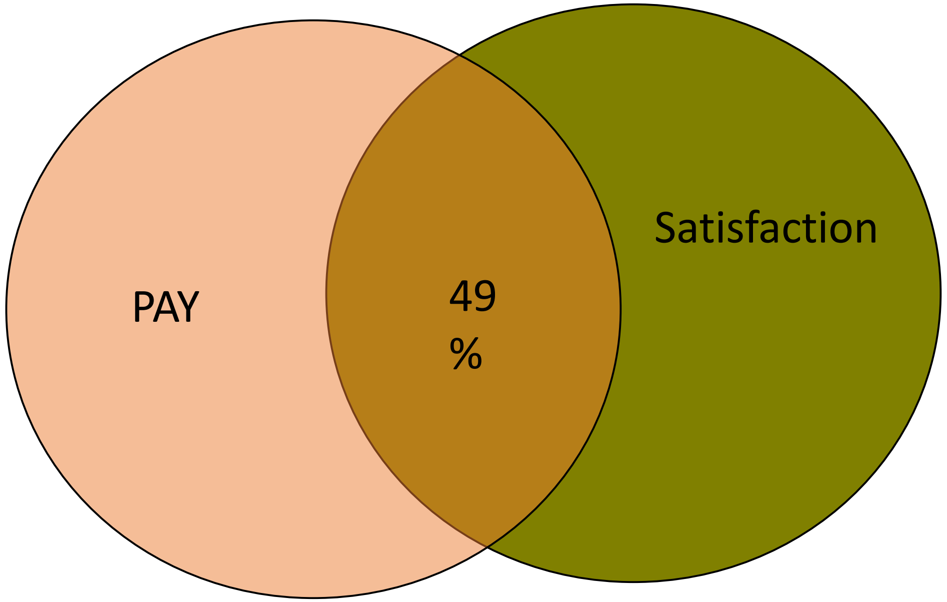
Aspect	Values	Frequency	Percentage
Organisational demographics			
Type	Public sector	186	.315
	Private sector	344	.583
	Unspecified	60	.102
Size	Less than 100	158	.268
	Between 100 and 1000	134	.227
	More than 1000	238	.403
Size of modelling team	Less than 10	380	.644
	Between 10 and 50	128	.217
	More than 50	22	.038
	Unspecified	60	.102
Personal demographics			
Continent of origin	Africa	14	.024
	Asia	36	.061
	Europe	175	.297
	North America	133	.225
	Oceania	132	.224
	South America	40	.068
	Unspecified	60	.102
Type of training	Formal/certified BPMN course	56	.095
	Internal/in-house BPMN course	30	.051
	University BPMN course	24	.041
	On the job training	78	.132
	Learnt the technique myself	212	.359
	Read the specification	116	.197
	Other	14	.024
	Unspecified	60	.102
Guidelines in use	Yes	236	.400
	No	294	.498
	Unspecified	60	.102
Set of BPMN constructs in use	Core set	192	.325
	Extended but not full set	200	.234
	Full set	138	.339
	Unspecified	60	.102

Statistical results about the hypotheses



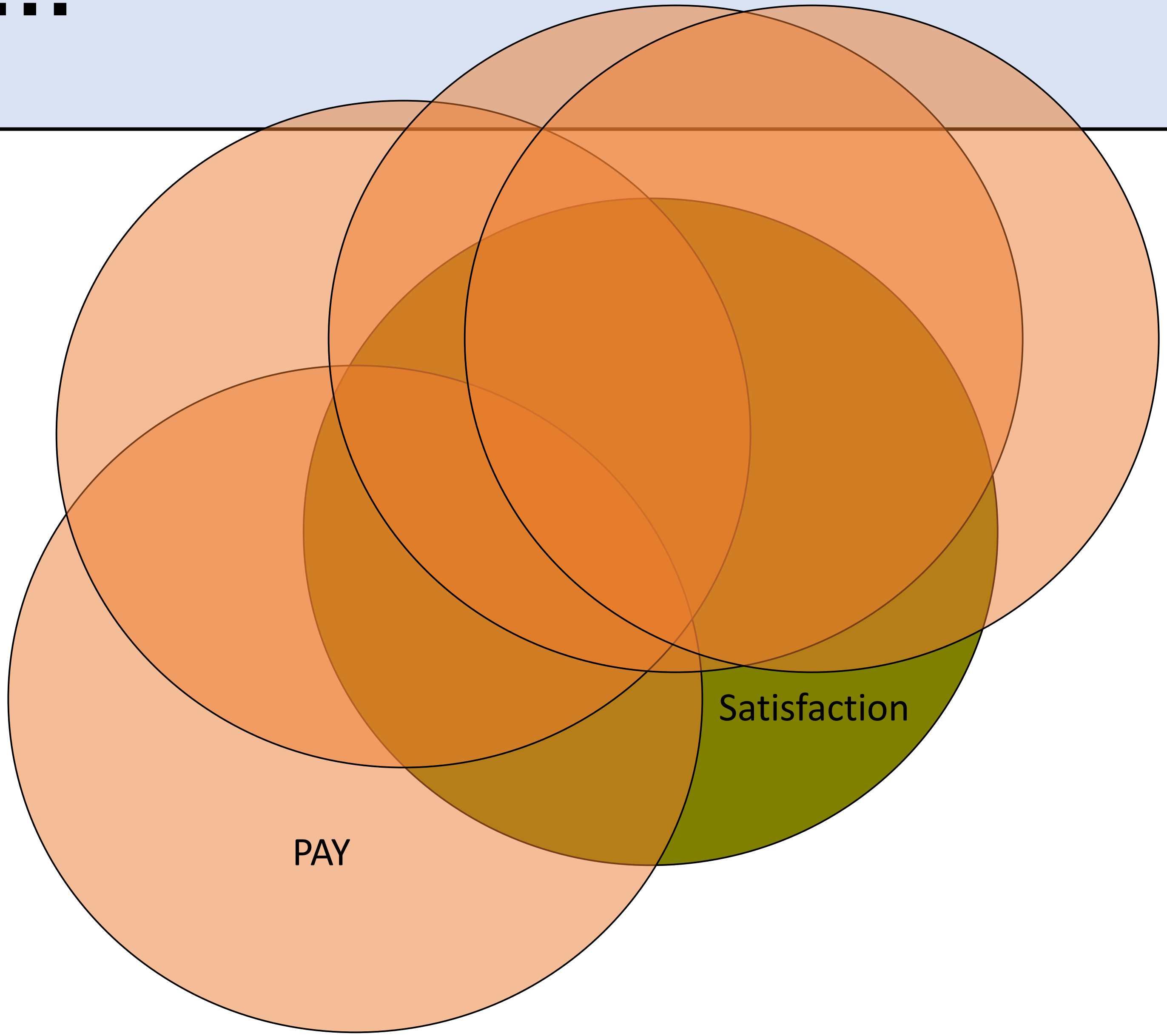
Interlude – shared variance

- R2 describes how much variance in the levels of the dependent variable is explained through the variance in the levels of the independent variable(s).



The Problem is…

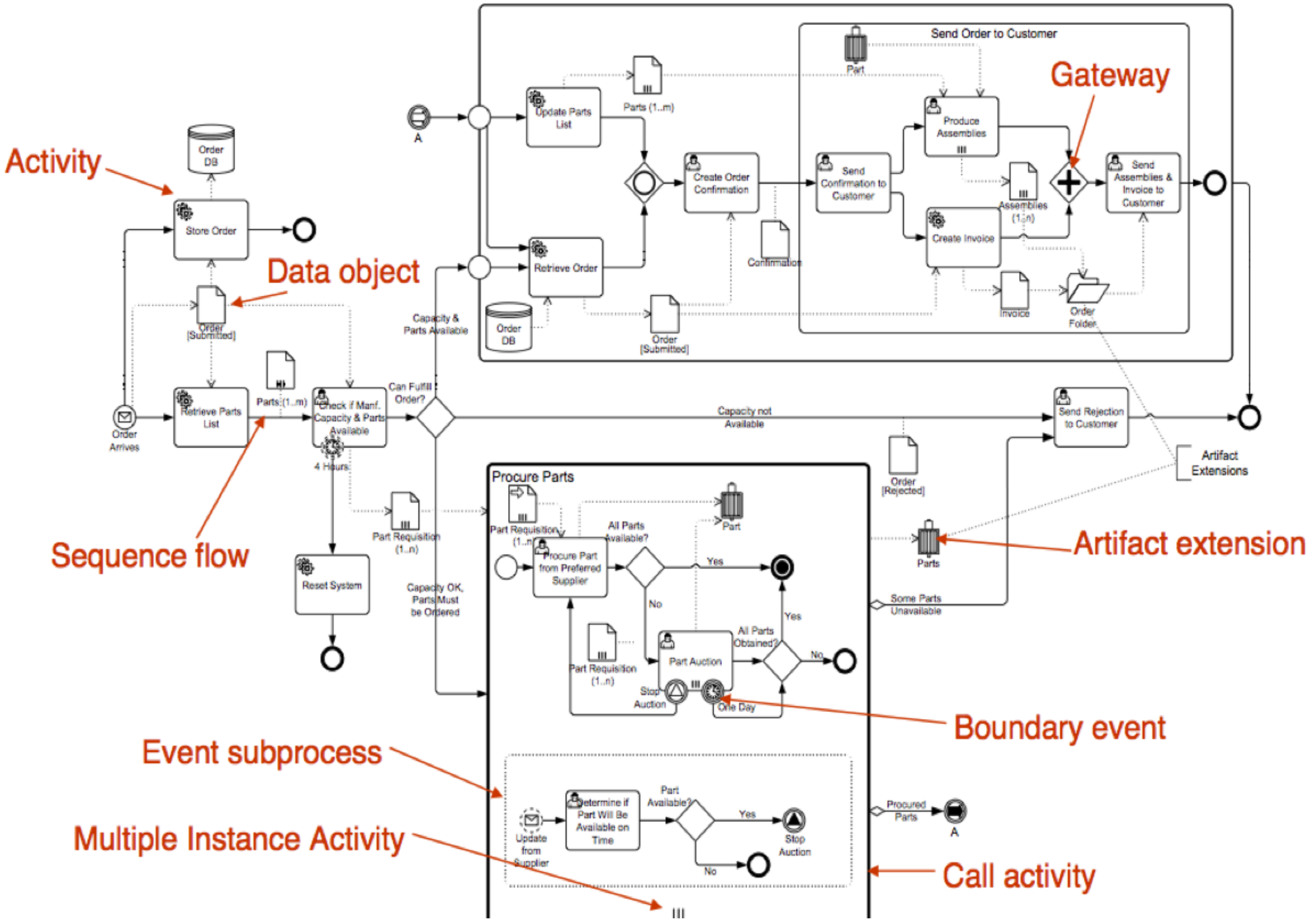
- Reality is much more complex than our sets of 1,2,3,... explanatory variables.
- Remember:
  Our measures
  always, invariably,
  contain **error**.



Guidelines for survey research

1. Carry out careful development and assessment of measures and measurements.
2. Pre- and pilot-test your survey instrument.
3. Disclose your sampling strategy.
4. Report a profile of the sample framework.
5. Include your instruments in your reports.
6. Report your response rate.
7. Establish validity and reliability.
8. Follow the latest guidelines for data analysis.

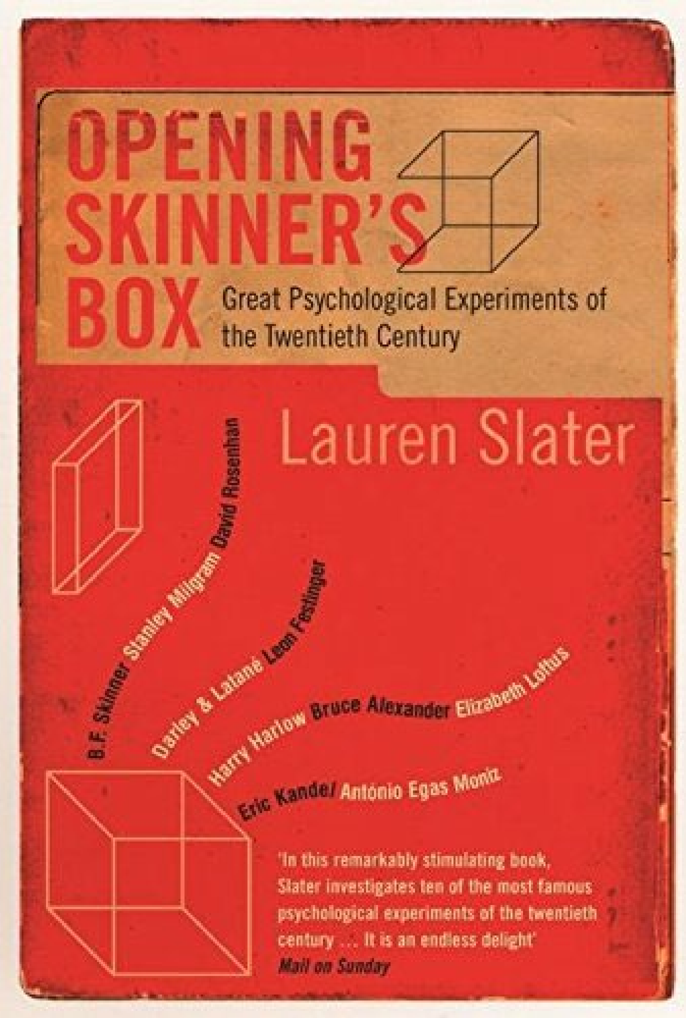
Example: experimental research



Experimental research

- Quantitative methods specifically intended to examine cause-and-effect relationships.
- used to examine such relationships by imposing a **treatment** on one group of respondents (the treatment group) but not on another group (the control group) while **maintaining control** over potential confounding factors.
- Treatment: a manipulation that an experimenter administers to the treatment group so the experimenter can observe a response.
- Primary advantage: Internal validity
- Primary disadvantage: ecological validity
- Often considered “the gold standard”.
- Can take place in the laboratory (**lab experiment**) or in reality (**field experiment**)

Example: Skinner‘s Box



Basic experimental concepts

- Treatment manipulation
  - the control for the cause in cause-effect relationships by identifying the type and number of **stimulus levels** (provision versus non-provision, low/medium/high levels of stimulus, and so forth).
  - Experimental designs typically involve a phase prior to treatment manipulation called **pre-test measures**, and usually a phase after treatment manipulation called **post-test measures**.

Basic experimental concepts

- Experimental controls
  - mechanisms employed to ensure that the responses observed are due to the treatments and not because of confounding factors (e.g., placebo effect)
  - also used in experiments to rule out rival theories, that is, alternative explanations.

Basic experimental concepts

- Randomization
  - the process of selecting a sample from a population in such a way that personal characteristics and predispositions do not interfere with the treatment or the response to the treatment.
  - Through matched allocation (expensive and difficult) or random assignment (key for true experiments)
- Quasi-experiments lack random assignment of subjects to groups and hence are experiments with non-equivalent groups (e.g., males versus females)

True-Experimental Designs

True Experimental Designs

Two-group Post-test-only Design

R	T	O_{post}	(Treatment group)
R		O_{post}	(Control group)

Two-group Pre-test-Post-test Design

R	O_{pre}	T	O_{post}	(Treatment group)
R	O_{pre}		O_{post}	(Control group)

Two-group Covariance Design

R	C	T	O_{post}	(Treatment group)
R	C		O_{post}	(Control group)

2x2 Mixed Factorial Design

R	T_{11}	O_{post}	(Group 1)
R	T_{12}	O_{post}	(Group 2)
R	T_{21}	O_{post}	(Group 3)
R	T_{22}	O_{post}	(Group 4)

Legend

R	Random assignment
N	Non-random assignment
C	Covariate measurement
T	Treatment administration
O_{pre}	Pre-test observation measurements
O_{post}	Post-test observation measurements

Quasi-Experimental Designs

Quasi-Experimental Designs

Non-equivalent Two-group Design

N	O_{pre}	T	O_{post}	(Treatment group)
N	O_{pre}		O_{post}	(Control group)

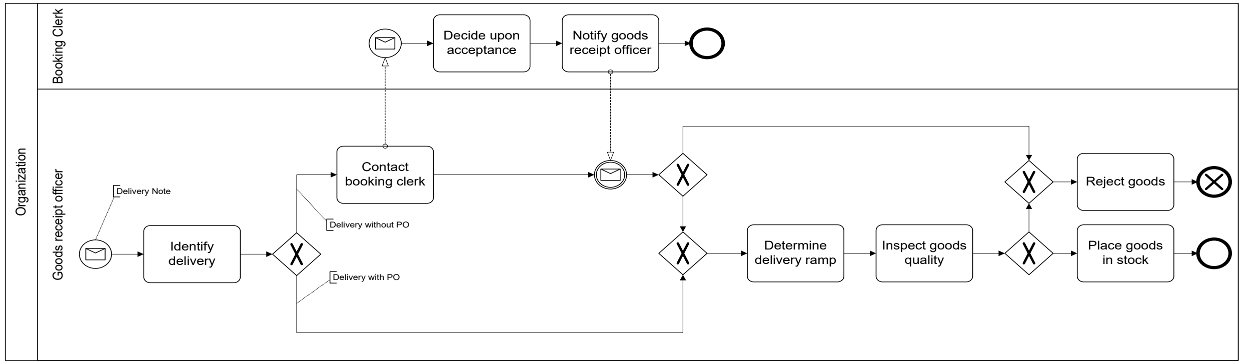
Non-equivalent Two-group Switched Replication Design

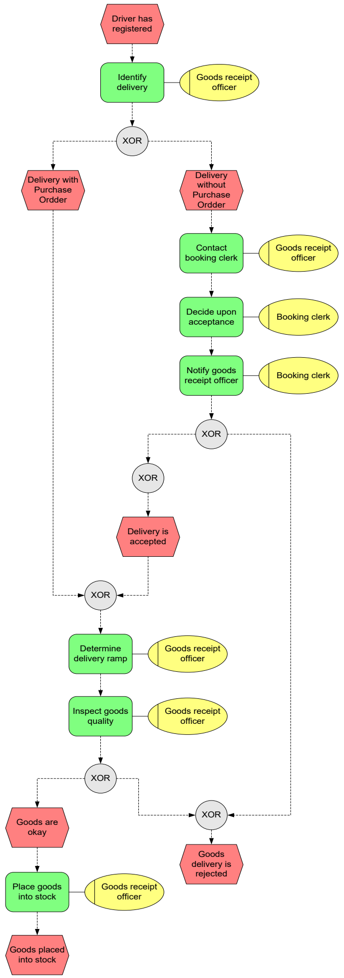
N	O_{pre}	T	O_{post1}		O_{post2}	(Treatment group)
N	O_{pre}		O_{post1}	T	O_{post2}	(Control group)

Legend

R	Random assignment
N	Non-random assignment
C	Covariate measurement
T	Treatment administration
O_{pre}	Pre-test observation measurements
O_{post}	Post-test observation measurements

Example: The impact of modeling grammar





Recker, J., & Dreiling, A. (2011). The Effects of Content Presentation Format and User Characteristics on Novice Developers’ Understanding of Process Models. *Communications of the Association for Information Systems, 28(6), 65-84.*

A Better Example

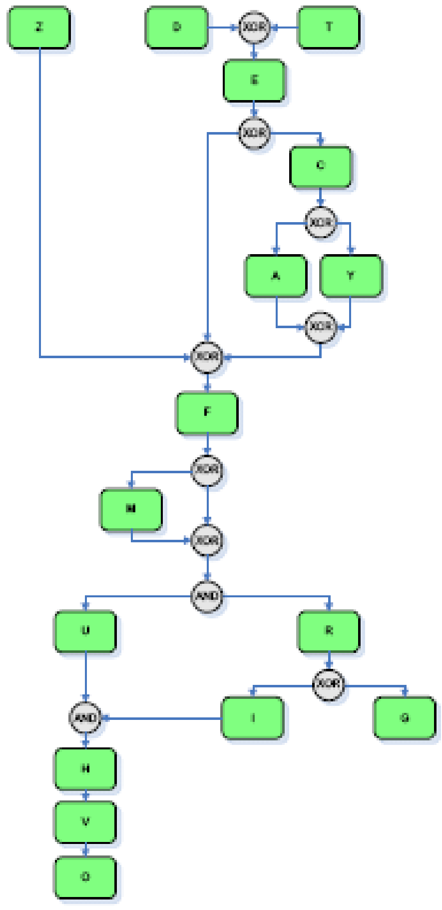


Figure 1. Model 4 with Letters

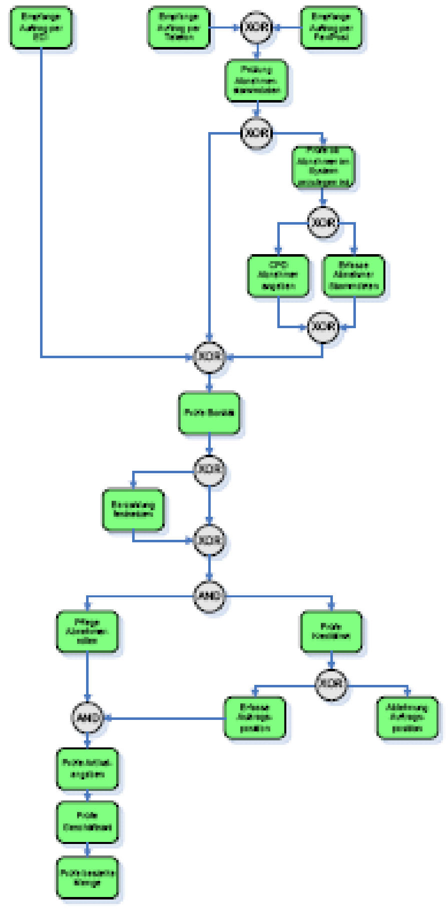


Figure 2. Model 4 with German Text

Mendling, J., Strembeck, M., & Recker, J. (2012). Factors of Process Model Comprehension — Findings from a Series of Experiments. *Decision Support Systems, 53(1), 195-206.*

Guidelines for experimental research

1. Carry out experiments only in the presence of strong theory.
2. Design your treatments carefully.
3. Perform manipulation checks.
4. Rule out alternative hypotheses..
5. Ensure ecological validity.
6. Check for the latest guidelines on experiments in the literature.

Qualitative Methods

Qualitative Research

Overview

- are strategies of empirical inquiry that investigate **phenomena within a real-life context**.
- are helpful especially when the **boundaries between phenomena and context** are not apparent, or when you want to study a particular phenomenon in depth.
- are well suited for **exploratory research** where a phenomenon is not yet fully understood, not well researched, or still emerging.
- are also ideal for studying **social, cultural, or political aspects** of a phenomenon.
- stresses on the “**why**" and “**how**" of things rather than the “what," “where" and “when" of things. It involves detailed study of a small sample or group.

Examples

- Alan Peshkin's 1986 book God's Choice: The Total World of a Fundamentalist Christian School published by the University of Chicago Press
  - Peshkin studies the culture of Bethany Baptist Academy by interviewing the students, parents, teachers, and members of the community, and spending eighteen months observing, to provide a comprehensive and in depth analysis of Christian schooling as an alternative to public education.
  - Paskin's work represents qualitative research as it is an in-depth study using tools such as observations and unstructured interviews, without any assumptions or hypothesis, and aimed at securing descriptive or non-quantifiable data on Bethany Baptist Academy specifically, without attempting to generalize the findings to other schools.

Other examples

- Victor of Aveyron
  - https://en.wikipedia.org/wiki/Victor_of_Aveyron
    - broke new ground in the education of the developmentally delayed.

- Piaget's Theory of Cognitive Development
  - http://www.edpsycinteractive.org/topics/cognition/piaget.html
    - Developed a constructivist theory of learning and instruction about the process of “coming to know” and the stages we move through as we gradually acquire this ability.

Basic tenets

- Scientific studies with procedures that feature research methods such as case study, ethnography or phenomenology and which are characterized by an emphasis on qualitative data.
- (Think of these procedures as having a focus on "**words**")
- They emphasize understanding of phenomena through direct observation, communication with participants, or analysis of texts, and may stress contextual subjective accuracy over generality.

Basic principles

- **Natural setting**: performed in the field, studying a phenomenon in the context in which it occurs.
- **Researchers as a key instrument**: researchers collect data and information themselves, often through face-to-face interactions, observing behaviours, studying documents, or interviewing participants.
- **Multiple sources of data**: researchers typically gather a variety of data of different sorts, from interviews to documents to observations and so forth.

Basic principles

- **Inductive analysis**: emphasise bottom-up analysis of data and the build-up of patterns, themes, and concepts into increasingly abstract units from the data.
- **Evolutionary design**: follow an evolutionary research process in which a research plan, a theory, data collection, or analysis can unfold and change over time as the research progresses.

Often used terms and methods

- **Interviews**: Conversations with key informants
- **Observations**: observing phenomena/behaviors directly
- **Documentation**: studying documents, plans, schemes etc
- **Triangulation**: using multiple sources of data
- **Coding**: assigning tags or labels as units of meaning to pieces or chunks of data collected
- **Memoing**: a subjective commentary or reflection about what was happening at the time or place of the data collection

Popular Qualitative Research Approaches

- Ethnographic Research
  - Example: the study of a particular culture and their understanding of the role of a particular disease in their cultural framework.
- Grounded Theory
  - an inductive type of research, based or "grounded" in the observations or data from which it was developed
- Phenomenology
  - describes the "subjective reality" of an event, as perceived by the study population; it is the study of a phenomenon.
- Critical Social Research
  - used by a researcher to understand how people communicate and develop symbolic meanings.
- Ethical Inquiry
  - an intellectual analysis of ethical problems. It includes the study of ethics as related to obligation, rights, duty, right and wrong, choice etc.

Popular Qualitative Research Approaches

- Activist Research
  - aims to raise the views of the underprivileged or "underdogs" to prominence to the elite or master classes, the latter who often control the public view or positions.
- Historical Research
  - to discuss past and present events in the context of the present condition, and allows one to reflect and provide possible answers to current issues and problems.
- Visual Ethnography
  - uses visual methods of data collection, including photo, voice, photo elicitation, collaging, drawing, and mapping.
- Autoethnography
  - the study of self: a method in which the researcher uses their personal experience to address an issue.

Qualitative versus Quantitative Methods

	Quantitative	Qualitative
Purpose	to explain & predict; to test, confirm and validate theory	to describe & explain; to explore and interpret; to generate theory
Research Process	focused; deals with known variables; uses established guidelines; static designs; context free; objective	holistic approach; unknown variables; flexible guidelines; 'emergent' design; context bound; subjective
Form of Reasoning	deductive - from general case (theory) to specific situations	inductive - from specific situation to general case
Nature of Findings	numerical data; statistics; formal and 'scientific'	narrative description; words and quotes; personal voice; literary style
Researcher Beliefs	there is at least some objective reality that can be measured	there are multiple, constructed realities that defy easy measurement or categorization
Research Literature	relatively large	relatively limited
Research Question	confirmatory or predictive	exploratory or interpretive
Research Skills	statistics and deductive reasoning, and able to write in a technical and scientific style	inductive reasoning, attentiveness to detail, and able to write in a more literary, narrative style

Recker, J. (2022). *Scientific Research in Information Systems: A Beginner's Guide (2nd ed.). Springer.*

Why and when we choose qualitative research

Research Design Decisions

Spectrum	One end of Continuum		Other End of Continuum
Method	Qualitative	vs.	Quantitative
Aim	Exploratory	vs.	Explanatory
Boundary	Case	vs.	Statistical
Setting	Field	vs.	Laboratory
Timing	Longitudinal	vs.	Cross-sectional
Outcome	Descriptive	vs.	Causal
Ambition	Understanding	vs.	Predicting

Genres of Qualitative Research

Sarker, S., Xiao, X., Beaulieu, T., and Lee, A. S. 2018. "Learning from First-Generation Qualitative Approaches in the Is Discipline: An Evolutionary View and Some Implications for Authors and Evaluators (Part 1/2)," *Journal of the Association for Information Systems (19:8), pp. 752-774.*

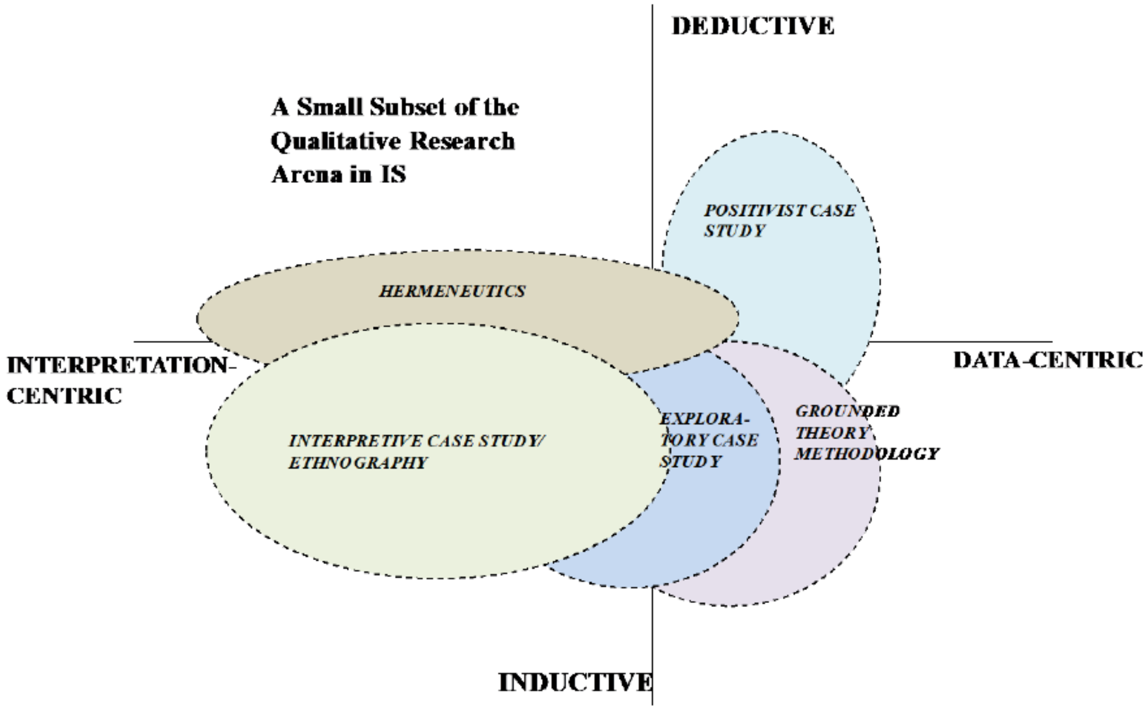


Figure 2a. A Map of First-Generation Genres in Qualitative Research

Inductive vs Deductive: Using Theory – or not

- A priori theory
  - Informs an understanding of possible answers to RQ before you do your study
  - Can be used to develop interview protocol
    - Identifies relevant concepts and relationships that you can develop questions about
  - Allows you to evaluate the theory based on the results
    - Do your interview findings resonate with the theory, confirm or disconfirm it?

- No a priori theory
  - You enter data collection with a "blank slate"
  - Avoids bias towards a certain perspective, idea or concept
  - No guidance on interview protocol focus
    - Needs to be broad, open and generative so you don't "miss anything important"
  - Can lead to the generation of entirely novel theory
  - May lead to findings that have already been explained by existing theory

Two Primary Uses of Qualitative Methods

- In exploratory research:
  to **discover**

- Example
  - Dutta, S., Zbaracki, M.J., and Bergen, M. "Pricing Process as a Capability: a Resource-based Perspective," Strategic Management Journal (24:7) 2003, pp 615-630.

- In explanatory research:
  to **test**, **explain** or **compare**

- Example
  - Markus, M.L. "Power, Politics, and MIS Implementation," Communications of the ACM (26:6) 1983, pp 430-444.

Dutta, S., Zbaracki, M.J., and Bergen, M. "Pricing Process as a Capability: a Resource-based Perspective," Strategic Management Journal (24:7) 2003, pp 615-630.

- A primarily **inductive** application of the case study method
- Analysed data from a study of the pricing process of a large manufacturing firm
- Compared the data to existing theories.
- Then developed a new theory.
- Then returned to the data to see how the emergent theory matched the data.
- Finally returned to the theory for yet another revision

Markus, M.L. "Power, Politics, and MIS Implementation," Communications of the ACM (26:6) 1983, pp 430-444.

- Compares three theories of resistance with the implementation of a computer system, using an in-depth case study to test the predictions of each theory
  - Theory 1: people resist change – people are the case of resistance
  - Theory 2: resistance is determined by the environment of the technology – technology is the case of resistance
  - Theory 3: interaction between characteristics of people and technology – both are the case of resistance
- The case data is used to contrast the explanatory and predictive power of the theories

Case study

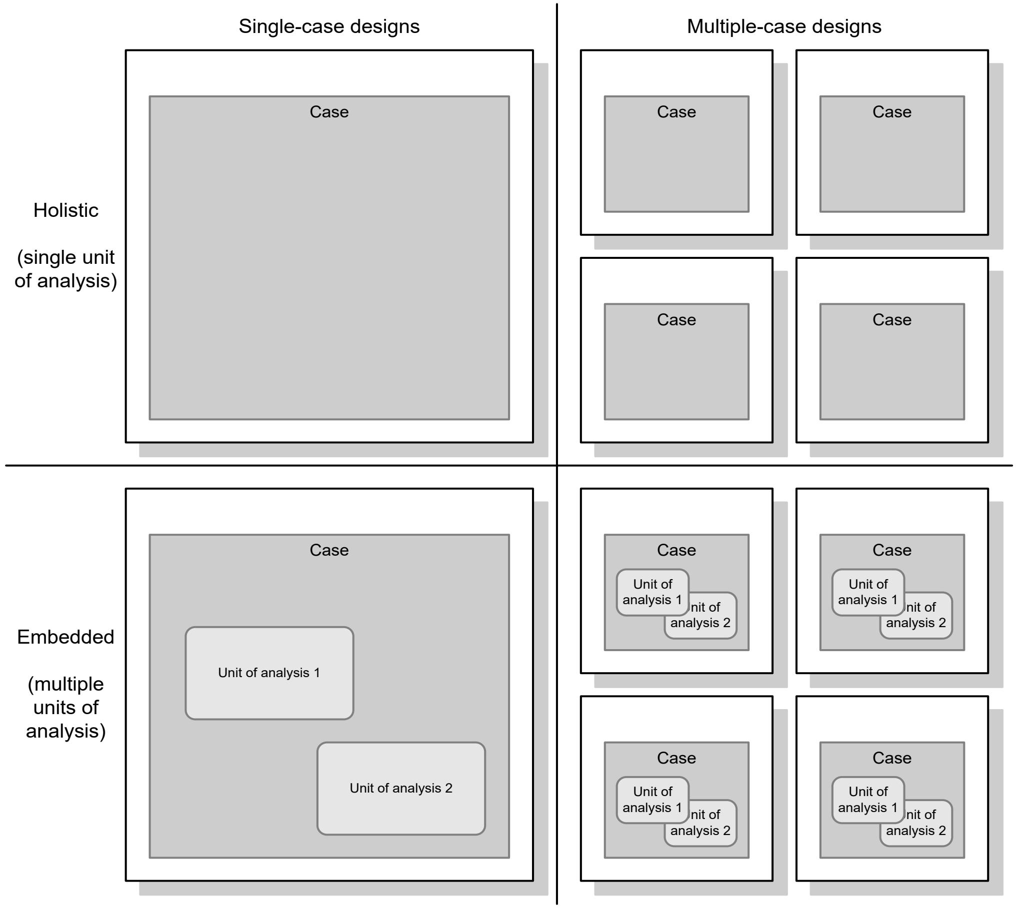
- Case study research uses empirical evidence from one or more organizations where an attempt is made to study the subject matter in context. Multiple sources of evidence are used.

Myers, M.D. *Qualitative Research in Business and Management Sage, Thousand Oaks, California, 2009.*

- Three important points:
  - In business, the **case is very often a firm or organization** even if the subject matter is not.
  - The difference to ethnography is that case study normally does not involve **participant observation** or **fieldwork.**
  - Case study research is per se **philosophically neutral.**

Qualitative Research

- Case Study Designs



Single-case Designs

- Single cases are often argued to be idiosyncratic – not affording great potential for development of abstract, generalizable theory
- However, they are still useful in many situations for purposes of knowledge contributions
- Often a particular rationale is needed for single-case designs
  - **Critical** case: case meets all conditions for testing a theory.
  - **Unique** case: case is extreme or rare.
  - **Representative** case: case is typical for everyday/commonplace situations.
  - **Revelatory** case: case presents a previously inaccessible opportunity.
  - **Longitudinal** case: case reflects the change of a subject matter over two more different points in time.

Example Single Case Study

MIS Quarterly

SPECIAL ISSUE: IS & ENVIRONMENTAL SUSTAINABILITY

SENSEMAKING AND SUSTAINABLE PRACTICING: FUNCTIONAL AFFORDANCES OF INFORMATION SYSTEMS IN GREEN TRANSFORMATIONS[1]

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This paper explores how a world-wide operating software solutions provider implemented environmentally sustainable business practices in response to emerging environmental concerns. Through an interpretive case study, we develop a theoretical framework that identifies four important functional affordances originating in information systems, which are required in environmental sustainability transformations as they create an actionable context in which (1) organizations can engage in a sensemaking process related to understanding emerging environmental requirements, and (2) individuals can implement environmentally sustainable work practices. Through our work, we provide several contributions, including a better understanding of IS-enabled

Seidel, S., Recker, J., & vom Brocke, J. (2013). Sensemaking and Sustainable Practicing: Functional Affordances of Information Systems in Green Transformations. *MIS Quarterly, 37(4), 1275-1299.*

Multiple-case Designs

- Often presents more completing evidence → research appears more robust
- Rationales for single-cases often cannot be satisfied by multiple cases
- Require more extensive resourcing and time
- Require a replication logic (a heuristic to select the additional cases):
  - **Literal**: a case where similar results are predicted
  - **Theoretical**: a case where contrasting results for anticipatable reasons are predicted

Example Multiple Case Study

DESIGNING DIGITAL MARKET OFFERINGS: HOW DIGITAL VENTURES NAVIGATE THE TENSION BETWEEN GENERATIVE DIGITAL TECHNOLOGY AND THE CURRENT ENVIRONMENT

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ABSTRACT

Digital ventures must navigate a key tension as they design new digital market offerings—that is, products or services that are embodied in digital technologies or enabled by them. On one hand, digital ventures pursue a vision that builds on what might be possible through the generative potential that digital technology offers, but on the other hand, they face an environment in the here-and-now, with existing customer preferences, extant regulations, and legacy technology. Taking a designing view, we trace how six independent digital ventures in the German financial services industry dealt with this tension as they created their digital market offerings. Our findings suggest that digital ventures enact three designing mechanisms to resolve the tension: bounding technology scope, transposing through digital objects, and probing the solution space. Through these mechanisms, digital ventures construct a buffer—one that has functional, material, and temporal dimensions—between the vision they gradually realize through their market offering and the here-and-now conditions of the environment digital ventures enter.

Keywords: digital entrepreneurship, designing, tension, digital market offering, case study

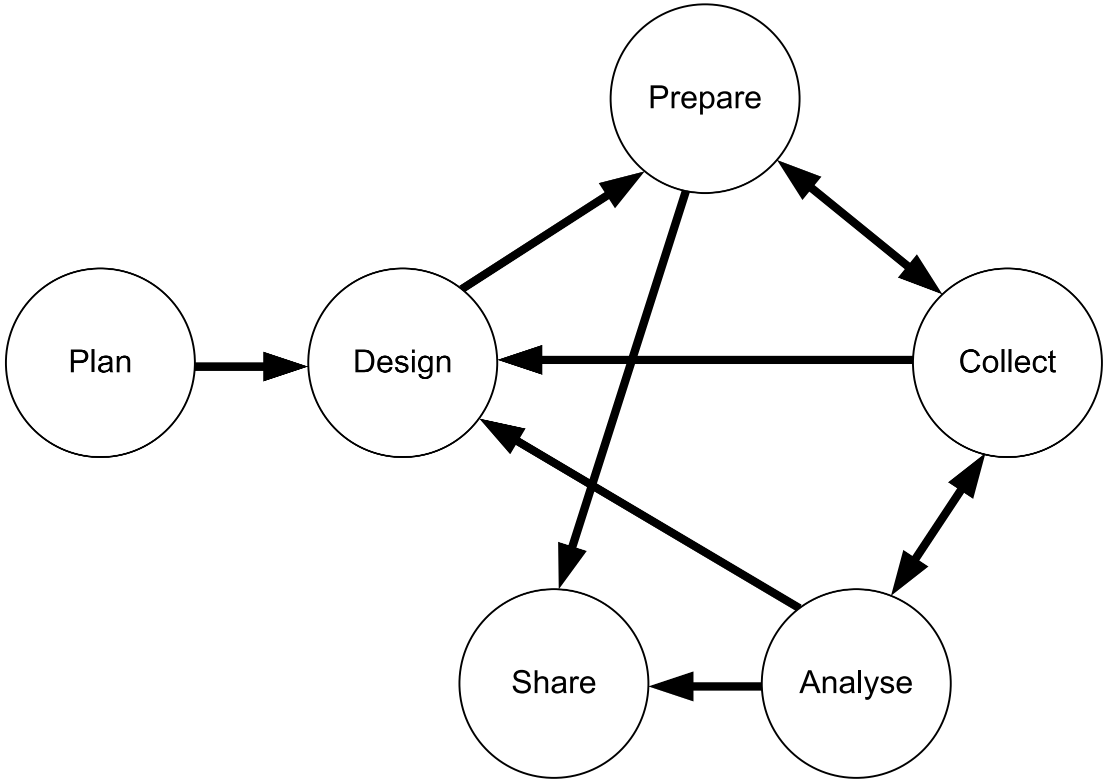
Accepted at *MIS Quarterly*
October 7, 2021

Lehmann, J., Recker, J., Yoo, Y., & Rosenkranz, C. (2022). Designing Digital Market Offerings: How Digital Ventures Navigate the Tension Between Generative Digital Technology and the Existing Environment. *MIS Quarterly*, (46:3), DOI: 10.25300/MISQ/2022/16026.

Embedded and Holistic Case Designs

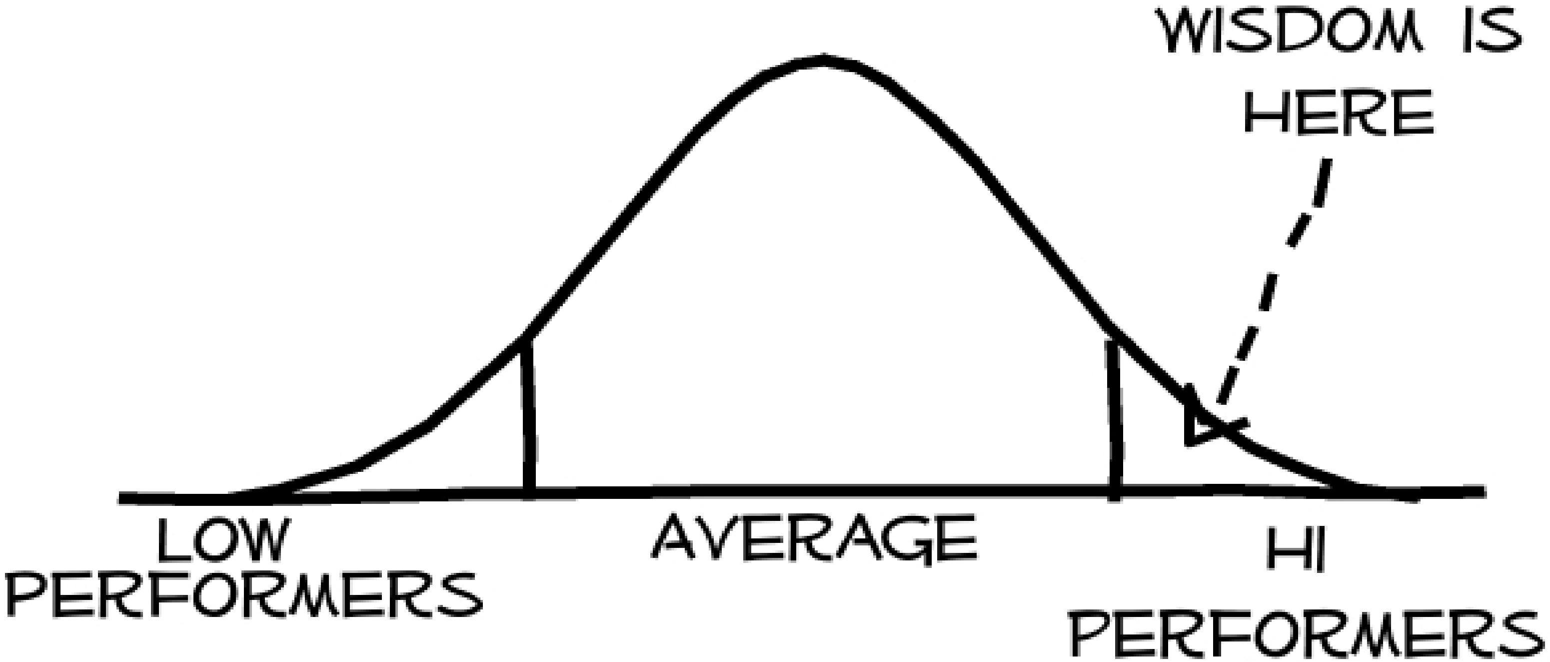
- **Embedded design** means that there is more than one unit of analysis in a study of one or several cases related to the same object of investigation.
  - allows a researcher to define an appropriate set of subunits and thereby add to the sensitivity of the investigation
- **Holistic designs** characterize case studies that investigate a phenomenon on a more global level.
  - advantageous either when no logical subunits can be identified or when the theory itself is of a holistic nature.

Qualitative Research Genres
- Case Study Procedures



- **Planning** refers to identifying the research questions and other rationale for doing a case study.
- **Designing** refers to defining the unit of analysis, the number and types of cases to be studied, and the potential use of theory or propositions to guide the study.
- **Preparing** involves taking the necessary steps to conduct high-quality data collection
- **Collecting** means executing the case study protocol(s) and gathering data, preferably from multiple sources.
- **Analysing** consists of examining, categorising, coding, tabulating, testing or otherwise combining and studying the evidence collected to draw empirically based inferences and other conclusions.
- **Sharing** refers to bringing case study results and findings to a close by identifying and addressing relevant audiences and providing them with the findings through appropriate reporting or presentation.

Example: Positive Deviance



Planning: Case Study protocols

Queensland University of Technology

<Identifying Positive Deviance in Fresh Food>

BAKERY DEPARTMENT

(In-store (Full/Maxi) and Proprietary)

Plan for case site visits

Draft 24/07/2012

Jan Recker/Thomas Kohlborn/Tyge Kummer
Queensland University of Technology

Queensland University of Technology

Draft Observation Protocol

With the aim of gaining a comprehensive and detailed picture of each of the identified stores, the following activities need to be conducted:

- Observation of / participation in the following processes
  - Supply process:
  - Production process:
  - Sales process
  - Cleaning process
  - Back office processes
- Document analysis:
  - for the above processes, any documentation that describes, prescribes, or documents the activities, roles, and used IT systems, will be useful for review in order to understand the processes in more depth. This documentation will be sourced from the internal WOWnet platform (access is already granted).

Draft Interview Protocol

Interviews are to be conducted with the following roles regarding the above processes focussed on the stated questions above:

- Store Manager
- Department Manager
- Baker (where applicable)
- Baker's assistants / team (where applicable)
- Apprentices (where applicable)
- Consumers (through survey instrument, preferably online). This work builds on previous surveys by the Woolworths' Consumer Insights team and will likely be conducted after the case visits.
- Packers (where applicable)
- Vendor representatives for proprietary bakery (where applicable)

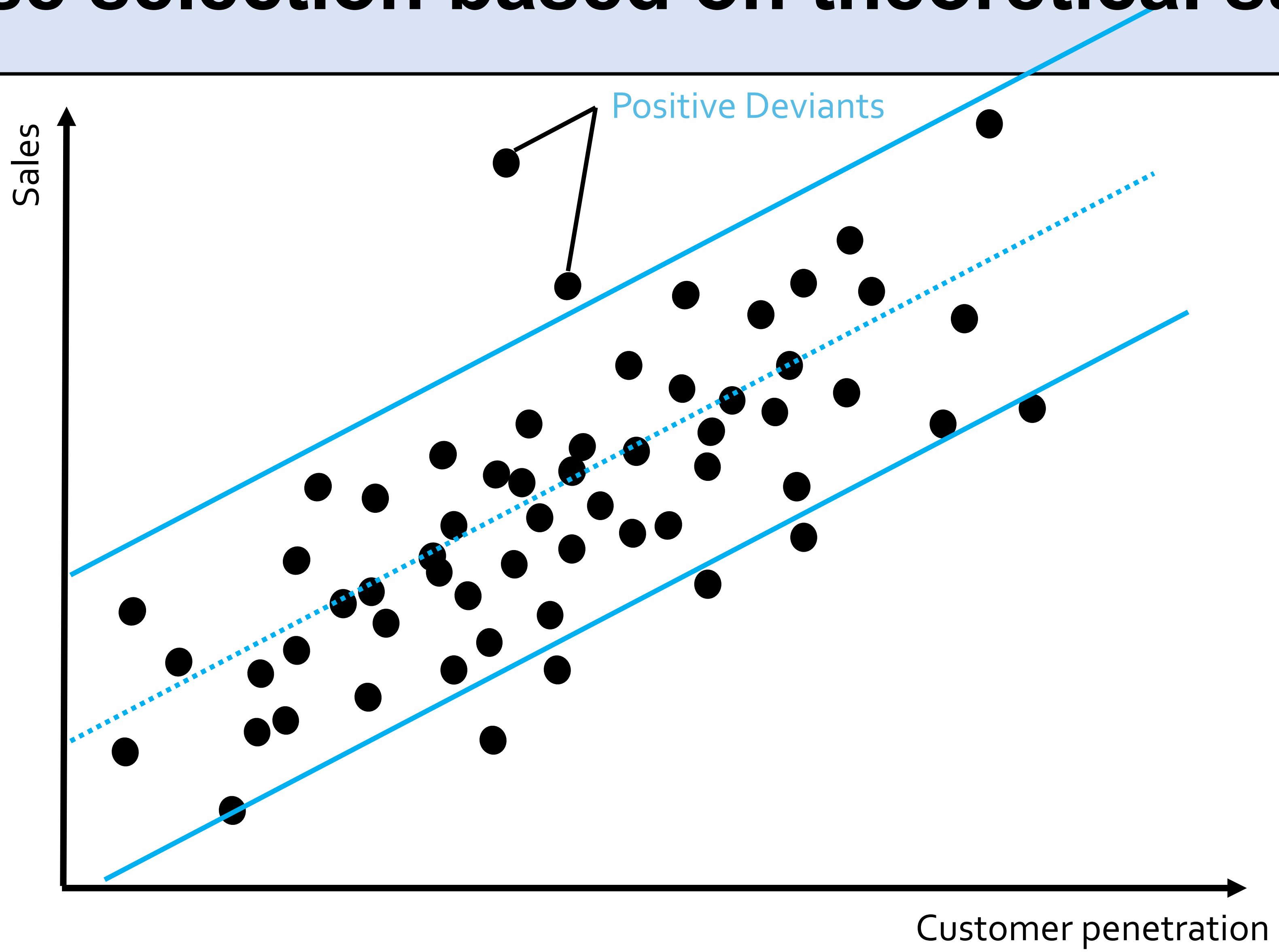
As a person fulfilling one role may be involved in more than one of the above processes, the interview questions will be adapted and shaped accordingly.

Background information relevant for all interviewees:

- What is your role/position?
- What are your duties and responsibilities?
- How long have you been working for Woolworths?
- How long have you been working in your current position in your local store?
  - Other positions?
- In which one of these processes are you involved (actively or passively)? List processes and describe them.

Adapt questions based on given answers:

Designing:
Case selection based on theoretical sampling



Designing:
Case selection based on theoretical sampling

Time plan for Site Visits

The following stores have been identified as candidates for visits.
Average store have been identified based on location (vicinity to Norwest or Brisbane CBD) plus inclusion in 99% average performance bandwidth.

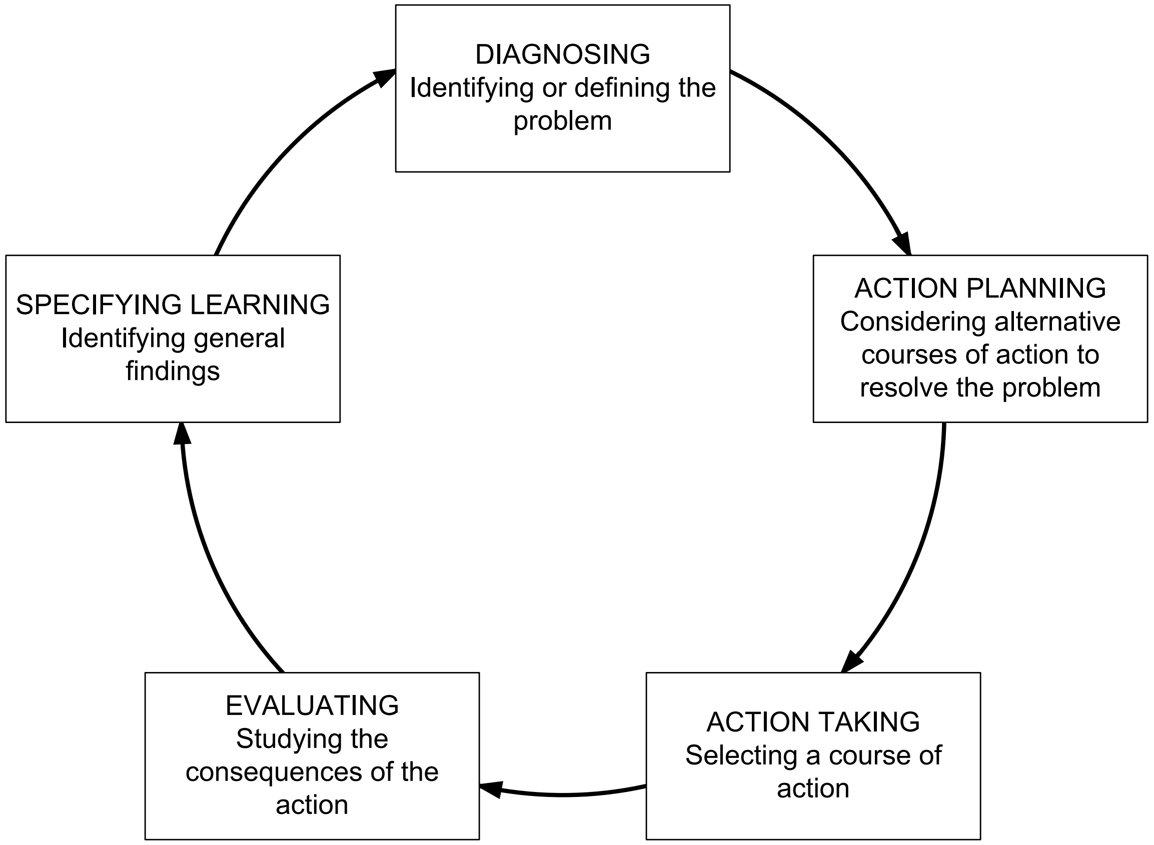
Grey highlighted names are stores that have been identified as not fully compliant with definition of positive deviance (e.g., criteria thresholds, cross-departmental validation and/or environmental scan).
It can be decided to eliminate or replace these stores.

PD Proprietary Bakery	***PD In-store Bakery (MAXI)***	***PD In-store Bakery (FULL)***	***Ave Proprietary Bakery***	***Ave In-store Bakery (FULL)***	***Ave In-store Bakery (MAXI)***
SYDNEY CBD MET CENTRE	LEURA	CAIRNS	Albany Creek	Tahmoor	Burwood Plaza
ST GEORGES TERRACE	TOWN HALL	MACKSVILLE	Ashmore	Prospect	St Ives
MAROUBRA BEACH	CULBURRA BEACH	SWANSEA	Hillsdale	Manly West	Potts Point
FELIXSTOW S		MACQUARIE FIELDS	Karalee	Stafford	Redfern
MARDEN		COLLINGWOOD PARK	Young	Morooka	
CHRISTIES BEACH S					

Specific dates will need to be negotiated between Woolworths, QUT and stores. Iit is suggested to commence with site visits from **30 July onwards**. The following table details the plan at present.

Collecting: Being In the field

Qualitative Research Genres - Action Research



- an interactive method of inquiry
- builds upon the idea of introducing changes or other sorts of interventions into a context and studying the effects of those actions
- distinctive feature of action research is the deliberate introduction of interventions by the researcher

Qualitative Research Genres - Action Research

- Advantages
  - the opportunity to contribute to both academic knowledge and to solving a real-world problem.
  - combines relevance and rigor in research.
- Disadvantages
  - doing action and research together is a challenging act for anyone, let alone an inexperienced scholar.
  - assuming a position of a value-neutral, independent observer to the extent that it allows for critical reflection and analysis, while at the same time maintaining a role as an influencer and intervener .
  - Access to participating organizations that put control to the researcher is hard to organize.

Qualitative Research Genres - Grounded Theory

- a type of qualitative research that relies on inductive generation (building) of theory based on (“grounded in”) qualitative data systematically collected and analysed about a phenomenon.
  - The main purpose of the grounded theory method is theory building, not testing.
  - Prior domain knowledge should not lead to pre-conceived hypotheses or conjectures about the research that the research then seeks to falsify or verify.
  - The research process involves the constant endeavour to jointly collect and compare data, and to constantly contrast new data to any emerging concepts and constructs of the theory being built.
  - All kinds of data are applicable, and are selected by the researcher through theoretical sampling.

Qualitative Research Genres
- Grounded Theory

- Advantages
  - tight and early immersion into data analysis – unlike, say, quantitative research where data analysis is typically conducted at a much later stage of the research process.
  - encourages systematic and detailed data analysis and the literature provides ample guidelines for conducting these steps.
- Disadvantages
  - detailed and systematic bottom-up analysis of data: It is very easy to get bogged down in data analysis on a very low level of detail
  - it is difficult to integrate data to higher levels of abstraction.
  - dependent on both excellent and rich data – collected typically before knowing what to look for
  - dependent on creative and critical thinking ability – a skill not easily learned or taught.
  - particularly challenging method especially for early career researchers.

Doing Qualitative Research

Traditional **secondary** data collection methods

- Archival analysis (review of documents or other media)
- Content from the Internet

- Traditional **primary** data collection methods
  - Interviews
  - Focus groups
  - Observations
  - Open ended surveys

Interviews for Data Collection

- A method for data collection that is
  - Targeted: the focus is directly on a selected topic,
  - Insightful: can provide causal inferences as perceived by interviewees.
  - allowing some level of control: the interviewee can use follow-up and probing questions to steer the conversation into certain areas of interest.
  - flexible and responsive: can accommodate a range of research problems and can be used to explore additional research questions if they arise.
  - allow the collection of rich and descriptive data
  - a familiar method: a conversation with a purpose

Format	Advantages	Disadvantages
Structured	Features consistency and reliability	Cannot follow emergent new lines of inquiry
Semi-structured	Combines strengths and minimizes risk	
Unstructured	Allows free talk by interviewees about what they find important	Requires interviewee to be in a free-flowing, talkative mode. If too talkative, white noise data is generated.

Interview Protocol & Questions

- Items to consider:
  - Do you have predetermined topics/concepts you wish to ask questions about?
    - Topic guide format (semi-structured) or actual questions (fully structured)?
  - How many questions will/can you ask?
    - Less is more
  - What question will you ask?
    - Type (what/how/when/why/etc.)
    - Ending (open/closed)
    - Structure (unstructured/semi-structured/structured)
    - Probes (pre-determined/emergent)

Rough Procedure for Interviewing

- Entry: opening question
- Introduction: foster conversation
- Transition: move to key questions
- Core: 2-5 key questions
- Closure: ending the conversation
  - Summative statement (“all things considered…”)
  - Validation question (“so what I think you said was …”)
  - Summary question: (“anything else you want to add?”)

Qualitative Data Analysis Techniques

- Coding
  - organizes raw data into conceptual categories, where each code is effectively a category or ‘bin’ into which a piece of data is placed
- Memoing
  - a subjective commentary or reflection on what was happening at the time or place of the data collection
- Critical incident analysis
  - identifying series of ‘events’ or ‘states’ that occur (e.g., in chronological order) and the transitions between them

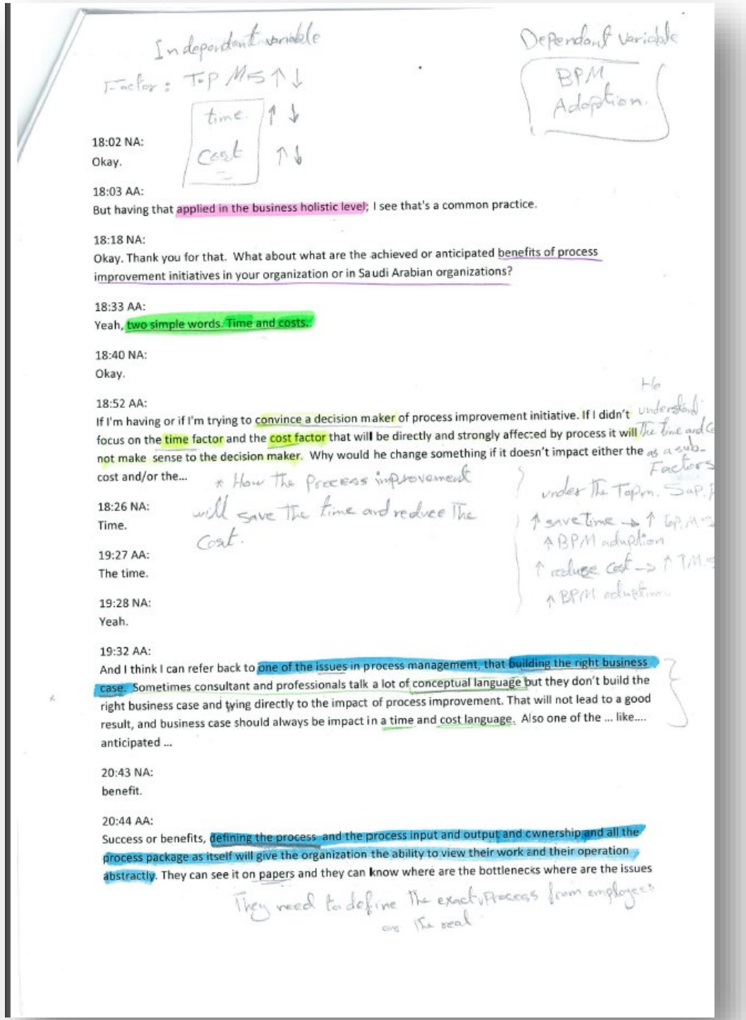
Example Coding

Coding a Page from a Sample Interview Transcript

The Process of Reconstructing Curriculum in a Rural High School Setting

Codes Here		Themes (And other Ideas) Here
	JJ: One thing, Lucy, that I've heard talked about was the fact that schools reflect the strengths of communities. What do you perceive as strengths of Greenfield as a community and how that relates to schools?	
Close-knit community	LU: Well, I think Greenfield is a fairly close-knit community. I think people are interested in what goes on. And because of that, they have a sense of ownership in the schools. We like to keep track of what our kids are doing and feel a connection to them because of that. The downside of that perhaps is that kids can feel that we are looking TOO close. But most of the time, that is the nurturing environment that we do provide an atmosphere of concern and	Potential theme: The community
Health of community or community values	care. To back up, you said the health of the community itself is reflected in schools. A lot of times communities look at schools and say they are not doing this or they aren't doing that, or we're missing something in our schools. I think perhaps we look at the school and see, this is probably a pretty conservative community overall, and look to make sure that what is being talked about in the schools really carries out the community's values. There is a	Idea: getting a good sense here for the community and its values
	little bit of an idealization I think, perhaps in terms of what we thought of "basic education." [And I think there might be a tendency to hold back a little bit too much because of that idealization of "you know, we learned the basics, the reading, the	A good quote
Change is threatening	writing and the arithmetic."] So you know, any change is threatening. And I think that goes for the community as well as what we see reflected at the school. Sometimes that can get in the way of trying to do different things. I think, again, idealization, older members of the community forget, some of the immaturity that they experienced when they were in school and forgetting that kids are kids. So there is a little bit too much of that mental attitude. But for the most part, I think there is a sense of we're all in this together, and concern for the kids.	
	JJ: In terms of looking at leadership strengths in the community, where does Greenfield set in a continuum there with planning process, understanding the need to plan, forward-thinking, visionary people. You talked about that a little bit before.	Potential theme: Leader
Visionary skills of talented People	LU: I think there are people that have wonderful visionary skills. I would say that the community as a whole would be . . . would not reflect that. I think there are people who are driving the process, but the rest of the community may be lagging behind a little bit. I think we have some incredibly talented people who become frustrated when they try to implement what they see as their . . .	Idea: returns to description of community again

Example Coding in Practice



18:02 NA:
Okay.

18:03 AA:
But having that applied in the business holistic level; I see that's a common practice.

18:18 NA:
Okay. Thank you for that. What about what are the achieved or anticipated benefits of process improvement initiatives in your organization or in Saudi Arabian organizations?

18:33 AA:
Yeah, two simple words. Time and costs.

18:40 NA:
Okay.

18:52 AA:
If I'm having or if I'm trying to convince a decision maker of process improvement initiative. If I didn't focus on the time factor and the cost factor that will be directly and strongly affected by process it will not make sense to the decision maker. Why would he change something if it doesn't impact either the cost and/or the...

18:26 NA:
Time.

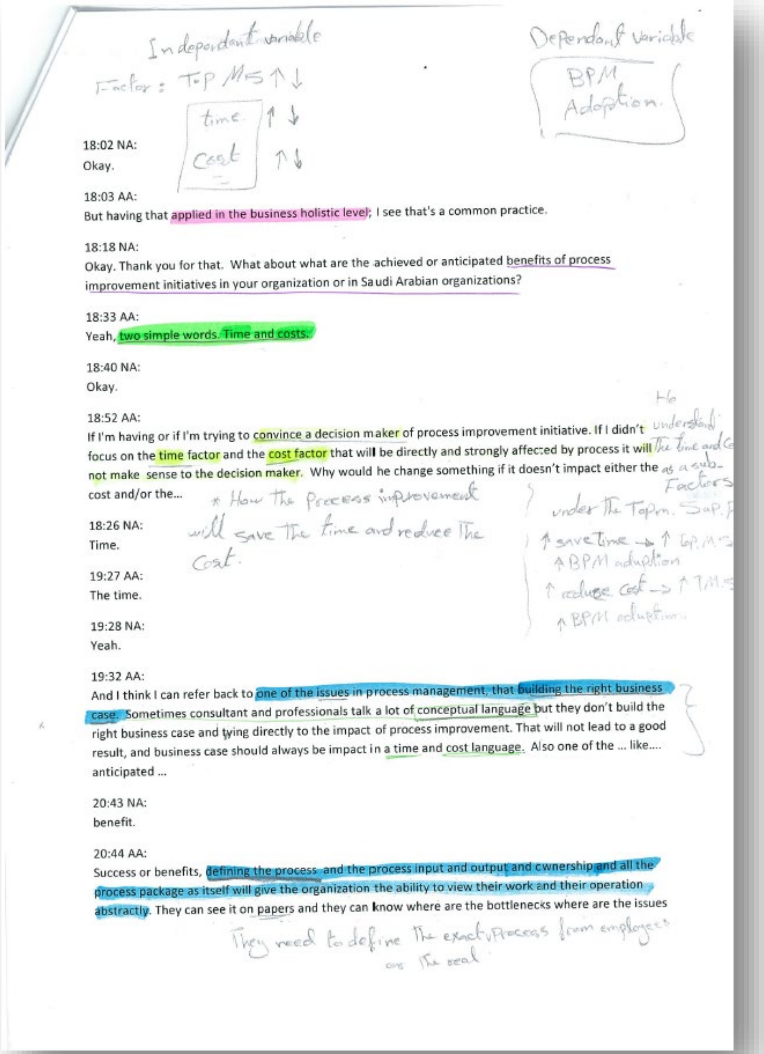
19:27 AA:
The time.

19:28 NA:
Yeah.

19:32 AA:
And I think I can refer back to one of the issues in process management, that building the right business case. Sometimes consultant and professionals talk a lot of conceptual language but they don't build the right business case and tying directly to the impact of process improvement. That will not lead to a good result, and business case should always be impact in a time and cost language. Also one of the ... like.... anticipated ...

20:43 NA:
benefit.

20:44 AA:
Success or benefits, defining the process and the process input and output and cwnership and all the process package as itself will give the organization the ability to view their work and their operation abstractly. They can see it on papers and they can know where are the bottlenecks where are the issues



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Example Memoing

MEMORANDUM

Date: 27 November 2011
To: Jan Recker
From: Niz Safrudin
Re: Observations from Interview with Adam Bennett

Purpose of Interview

*The objective of the interview was to determine how Commonwealth Bank (CBA) managed its Core Banking Modernisation as a business transformation initiative. The interview took place on 22/11/11 with **Adam Bennett**, Chief Information Officer for Retail and Business Banking of CBA. The semi-structured interview comprised of 12 questions and lasted approximately 50 minutes. While the findings are summarized in the annexed interview summary, the reflective observations are outlined below.*

Observation #1: Interview Approach

- The sequence of the interview questions proceeded in accordance with intended protocol – reflects incorporation of lessons learnt from the trial interview with Michael Genrich
- Props used worked fairly well, i.e. handouts to visualize interview questions, list of management disciplines and timeline of CBM initiative
- Interviewee appeared agitated halfway through the duration which can perhaps be mitigated with the following strategies:
  - Illustrate, on the props used, a form of (dynamic/coloured) timeline to indicate the progress of the interview thus far – this way the interviewee will be aware of how far we are into the interview, and how much more needs to be covered
  - Inform throughout the interview the first part, second part, halfway through, second last question, last question, etc.

Observation #2: Interview Questions

- 2 questions were eliminated from list (total 14):
  - i. Question 10 on who were involved in the initiative was already answered in Question 4 (sub-consciously)
  - ii. Question 13 on whether the interviewee would do the same thing & what would be done differently was not answered– need to allow interviewee to take their

BTM Research
Case Study Interview #01

Observation #3: Management Services

- Management personnel from respective management disciplines was clarified as being used as proxy for Management Services (MS)
- Another way to deduce the origin of MS is to identify the organizational structure for the initiative, and who utilizes the tools used to manage the initiative as per STS theory (components = task + actor + structure + technology)
- Management services composition was mentioned to stem from Programme Director, Dave Curran – this will be further enquired when interviewing Dave
- Findings re MS that are outlined in annexed Summary:
  - 2 new MS were added to list (Migration Management & Solution Delivery)
  - 4 MS were mentioned to require integration
  - 6 MS were mentioned to be prominent and directly involved in the initiative
  - 10 MS were mentioned to be indirect involved/influenced the initiative
- Need to clearly ascertain what constitutes as involvement "to some degree", i.e. where, when, why, how and who? This can be derived from further interviews and perusal of documentation

Observation #4: Orchestration Patterns

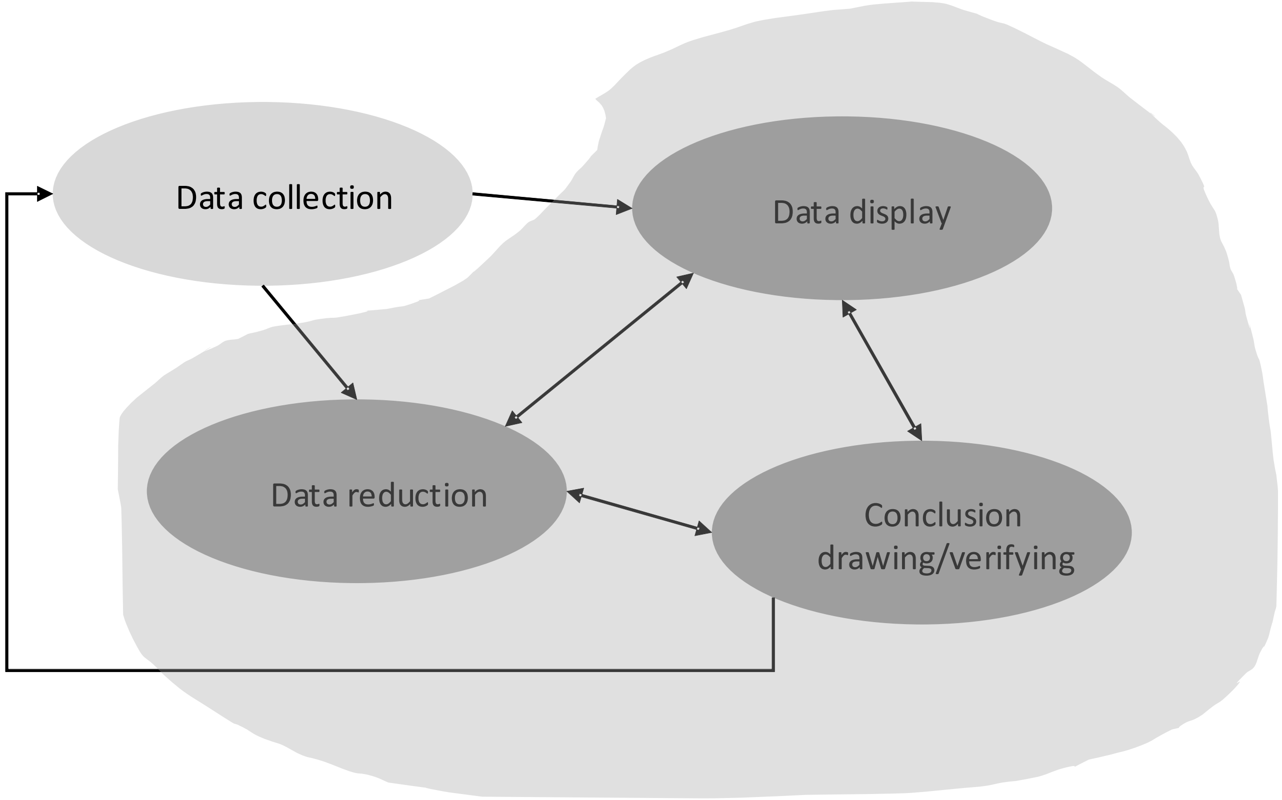
- Sequence of MS was vaguely identified from the interview which may be clearly distinguished from documentation (both public and private) and further interviews
- Integration of MS were identified that were deemed prominent by interviewee – further evidence from interviews and documentation will validate this finding
- Prominent role of MS with respect to the initiative's phases were loosely identified and may require triangulation from further interviews and documentation
- Revise public information in accordance to the years it was published via annual report, results presentation report, sustainability report, profit announcement report, and media releases from 2007 to current year – this will help provide a richer picture on how the initiative has progressed from inception to near completion

Observation #5: Case Study Requests

- Take note of who's who and ask for access to the relevant personnel
- Ask for the following documents
  - i. business case report/communication pack
  - ii. organizational chart
  - iii. organizational chart specifically for initiative
  - iv. measurement matrix
  - v. program charter/high-level Gantt chart
- Ask how will the documents be accessed, i.e. view on-site or obtain copies?

Qualitative Data Analysis

- **Data reduction**: organize and reduce massive qualitative data into key insights
- **Data display**: present rich data in accessible and varied form
- **Conclusion-drawing**: develop and verify conclusions based on data and notes



Example Data reduction

Table 4 Counts of 'general' citations of model constructs: by interviewee, within the nine process modelling projects

Success factors															
A priori												*New*			
F1 Top mgmt Support	*F2 Leadership*	*F3 Project mgmt*	*F4 Team structure*	*F5 User competence*	*F6 Modeller expertise*	*F7 User participation*	*F8 Communi-cation*	*F9 Modelling language*	*F10 Modelling method*	*F11 Modelling tool*	*F12 Complexity*	*F13 Importance*	*F14 Culture*	*F15 Information resources*	*F16 Need*
P1: Work request automation project: Technical Services Group (TSG)															
6	2	2	4	3	2	6	2	2	5	3	4				3
P2: Freight booking system project: Infrastructure Services Group (ISG)															
6	2	2	2	2	4	6	1	0	2	4	2		3		
P3: Train control transition project: across Queensland Rail															
3	2	3	2	3	3	2	2	1	1	2					
3	8	2	4	1	7	7	6	0	3	5					
P4: Rail Supply Chain Optimization (SCOR) Project: supply division															
2	0	4	1	1	2	2	3	2	1	2	1				
4	3	1	0	1	2	1	1	2	0	1			1		
24	17	14	13	11	20	24	15	7	12	17	7	0	4	0	3
P5: Knowledge-economy Project															
7	4	7	1	-	1	2	5	5	1	6	2	2	3	1	
2	2	12	2	2	3	3	2	2	6	5	2	3	2	—	
1	3	5	3	1	5	9	2	4	3	2	3	3	1	—	
4	2	17	7	1	2	6	4	3	4	5	5	—	1	—	
14	11	41	13	4	11	20	13	14	14	18	12	8	7	1	0
P6: IP Telephony Assurance Project															
4	2	7	0	2	2	2	3	2	4	4	2	1	2	9	
P7: Interim Mini-Stats Ordering Project															
7	4	11	1	1	7	2	5	2	2	2	2	2	2	12	
P8: Pay phone Faults Detection Project															
3	2	4	0	0	7	7	4	2	3	6	5	2	1	8	
P9: Supplementary Worker Project															
2	4	7	2	1	7	2	5	0	0	1	0	0	0	6	
16	12	29	3	4	23	13	17	6	9	13	9	5	5	35	0
54	40	84	29	19	54	57	45	27	35	48	28	13	16	36	3

Bandara, W., G. G. Gable, and M. Rosemann (2005) "Factors and Measures of Business Process Modelling: Model Building Through a Multiple Case Study", *European Journal of Information Systems (14)4, pp. 347-360*

Examples Data Display

ERPCo, with customers choosing alternate ERP packages. In return, the contributing partners have *a chance to learn about and develop expertise on the new product even before the product version is released*. This potentially results both in a competitive advantage (for the partner) once the product is officially available for the clients and in value to the client in terms of faster implementation of the new products.

We note that in the case of exchange, no value is generated because of any specific alignment of resources involved, nor is there any requirement regarding the kind of resource (outside-in or inside-out) that needs to be brought in by ERPCo or its partner.

Addition: Cocreating Value through Layering

This mode of value cocreation is evident in the way in which one of the two parties (i.e., ERPCo or its partners, especially those involved in sales, implementation, and customization) build on contributions of the other in order to develop revenue streams for both. ERPCo_M#2 explained how the additive model of cocreation works:

> They [the partners] actually get a vehicle for providing additional service…when they sell [ERPCo's products]....That is a value added service of a typical implementation.... [The partners] would …probably [gain] one-third to one-half license value but then the other value…actually comes from implementation services, training services, and ongoing maintenance services…this business would be much smaller if they did not actually have the opportunity to sell these…services to the customers. It is additive all the way through....The way revenue is split [in a way where] everybody gets a fair share of the cake.

In essence, for every sale that a partner makes, ERPCo receives its share of the license fee, without having to invest in building a worldwide sales force; likewise, with each sale, the partner receives a proportion of the licensing fee and the opportunity to sell additional consulting services, typically two to four times the amount of the license. Indeed, for P1, P2, and P4, this is the primary way to generate revenue for themselves and ERPCo and also create more value for their customers by providing them with a world class ERP-system customized to their clients' industry. As ERPCo_M#2 asserted,

> Customers in this [SME] segment, they want local advisors; they want someone who understands the local business....[For example,] we have no clue what the paint manufacturing industry in [NEC's neighboring country] needs.

In taking advantage of this mode of cocreation, all that ERPCo needs to do to sustain this model is keep their core ERP products technically sound and relevant to the marketplace and continue to sign up more partners capable of selling and providing consulting (of which there are many). Emphasizing the importance of this mode of value cocreation, P1_M#1 stated:

> We bring the product to life…without us, they [ERPCo] could not sell it…customers alone cannot kick-start the product and ERPCo does not have the capacity [to help customers kick-start the ERP system in the client organization].

While the scenario described above explains how partners add a layer of contribution to ERPCo's product in order to develop value for both sides, in some instances ERPCo does the same for the partners. For example, many ERPCo partners have packaged routine customizations that they need to perform in many different client sites. As ERPCo_M#2 explained,

> Whenever they go to a customer, they often have to do the same customizations and instead of doing the customization over and over again, they actually realize…"well let us create a small package of that, and then we can resell it…we can sell this to other [partners]…we can sell this to other countries."

Yet most partners, except for the truly global ones such as P2 and P4, simply do not have the means to obtain international exposure on these modules by themselves. ERPCo_M#2 noted that in such situations they try to "help partners who want to go international to do that…trying to connect them with partners in different countries," thereby making innovative add-ons available to client organizations across the globe that could potentially allow them to run their business better. Along these lines, ERPCo started the practice of listing the partners' solutions on ERPCo's website via a solution finder and distributing catalogs to partners globally. As we can see, the value here is cocreated by layering ERPCo's ability to provide global reach to products created by its partners.

It may be argued that, in the additive mode, the alliance partners bring unique, rare, and complementary resources to the alliance, thereby enabling the alliance and the firms involved to develop the capacity to earn Ricardian rents (Peteraf 1993). The concept of Ricardian rents highlights the

Figure 10.1 Example of Sociomateriality in Office Work.

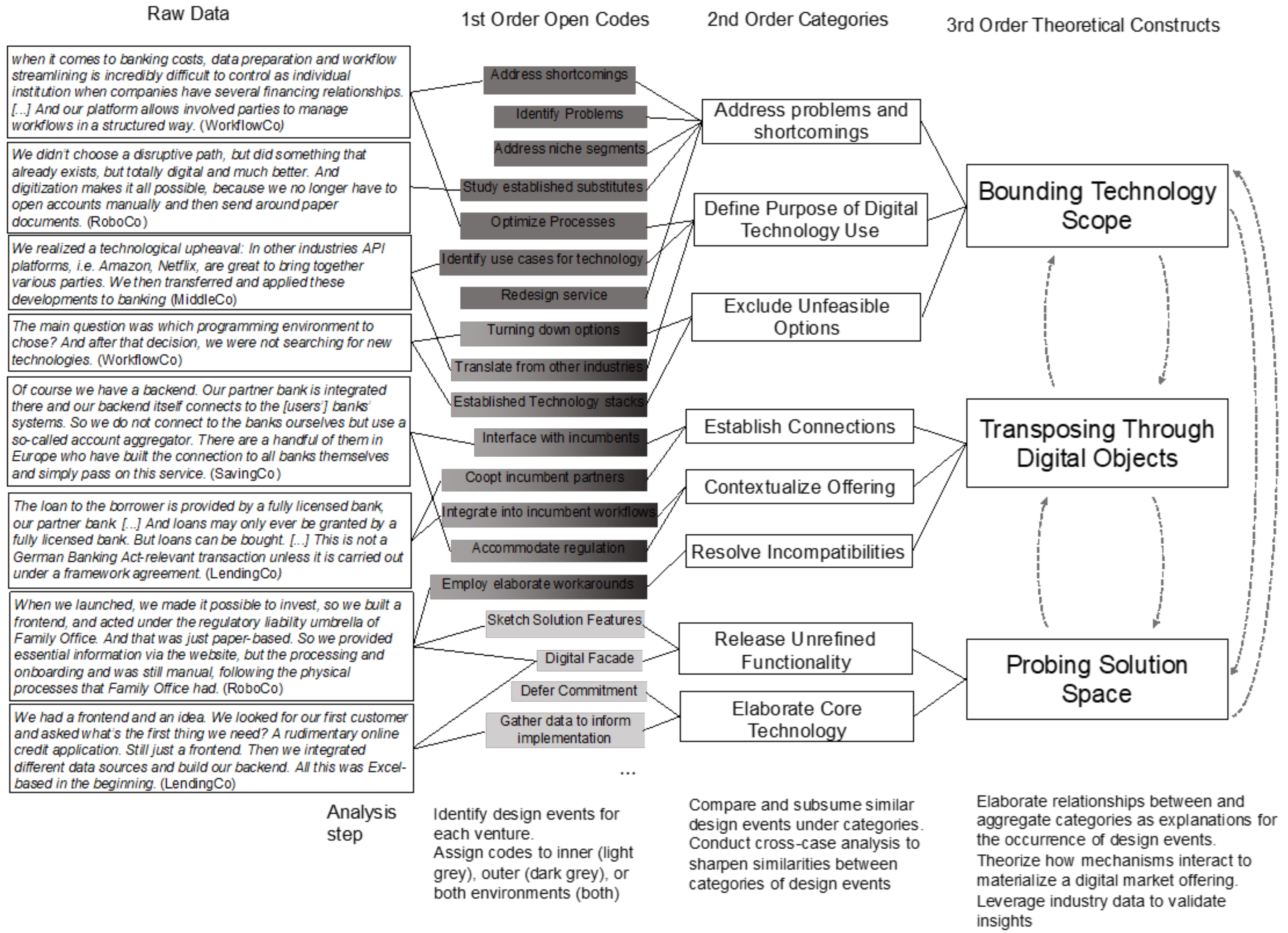
be performative if it contributes to the constitution of the reality that it describes (Callon, 1998).

The notion of performativity has been taken up by a number of social scientists. For example, Judith Butler (1990) has used the notion to study how gendered identities are not "naturally-given" but actively and materially constructed ("performed") through discourse. Other examples are evident in the sociology of technology and science, where scholars have used the notion of performativity to understand how financial models and economic theories produce the market conditions and effects that they attempt to represent and explain (Beunza & Stark, 2004; Callon, 1998; Callon & Muniesa, 2005; MacKenzie, 2006; MacKenzie & Millo, 2003). In this view, "economics creates the phenomenon it describes, rather than describing an already existing 'economy'" (MacKenzie, 2005, p. 64). In an example of this work, MacKenzie (2006) analyzes the Black-Scholes pricing model in options markets, showing how the Black-Scholes formula first described the world of options pricing, but how over time it came to enact that world through its inscriptions in com-

Orlikowski, W.J., and Scott, S.V. "Sociomateriality: Challenging the Separation of Technology, Work and Organization," *The Academy of Management Annals (2:1) 2008, pp 433-474.*

Sarker, S., Sarker, S., Sahaym, A., and Bjørn-Anderson, N. "Exploring Value Cocreation in Relationships Between an ERP Vendor and its Partners: A Revelatory Case Study," *MIS Quarterly (36:1) 2012, pp 317-338.*

Example: Conclusion-drawing



Lehmann, J., Recker, J., Yoo, Y., & Rosenkranz, C. (2022). Designing Digital Market Offerings: How Digital Ventures Navigate the Tension Between Generative Digital Technology and the Existing Environment. *MIS Quarterly*, (46:3), DOI: 10.25300/MISQ/2022/16026.

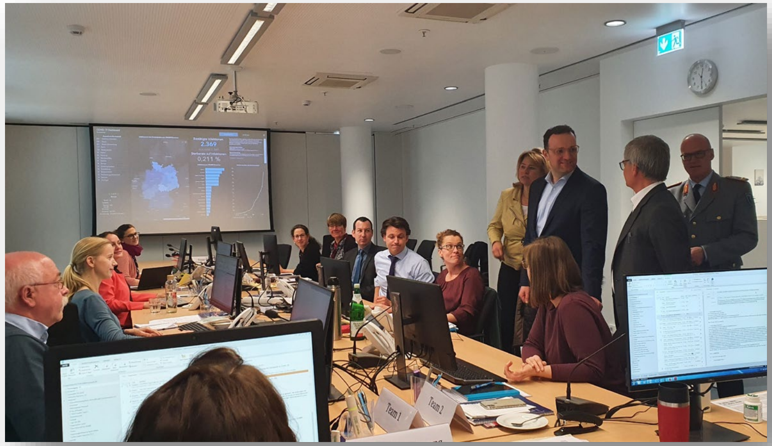
Design Methods

Design Methods

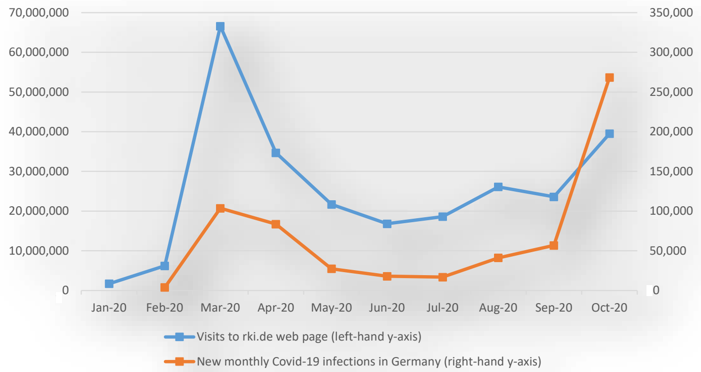
- Procedures that feature methods to build and evaluate novel and innovative artefacts (such as new models, methods or systems) as outcomes and which are characterized by an emphasis on the construction of the artefact and the demonstration of its utility.
- You can think of these procedures as having a focus on “artefacts”.

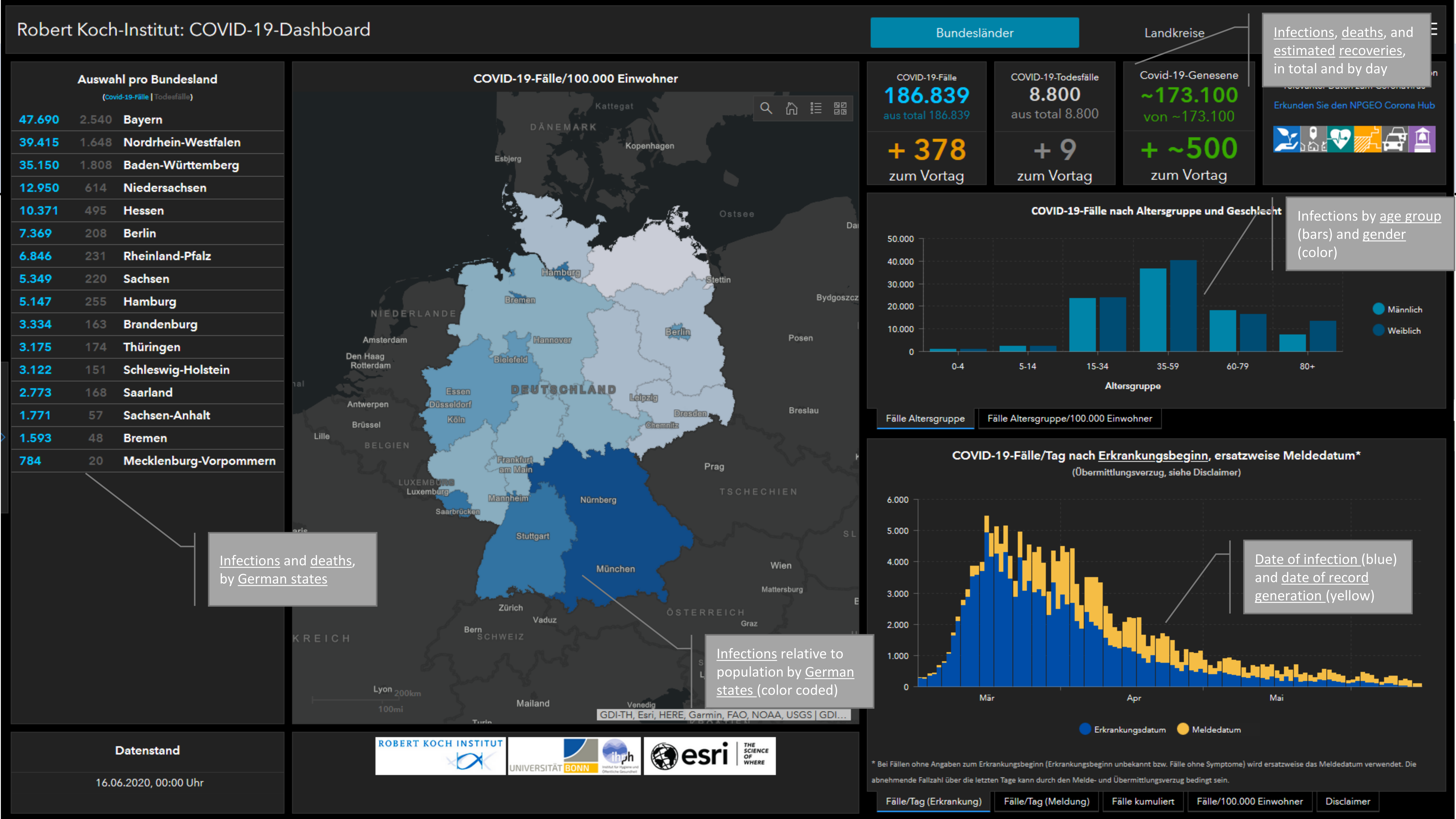
Example: Corona Dashboards

- *“We built this dashboard because we think it is important for the public to have an understanding of the outbreak situation as it unfolds with transparent data sources.”*



- Used by billions of citizens
- Source of decision-making by policymakers and health professionals
- How good are the dashboards? Can they be made better?




Robert Koch-Institut: COVID-19-Dashboard
Bundesländer
Landkreise
Infections, deaths, and estimated recoveries, in total and by day
Auswahl pro Bundesland
(Covid-19-Fälle | Todesfälle)
47.690 2.540 Bayern
39.415 1.648 Nordrhein-Westfalen
35.150 1.808 Baden-Württemberg
12.950 614 Niedersachsen
10.371 495 Hessen
7.369 208 Berlin
6.846 231 Rheinland-Pfalz
5.349 220 Sachsen
5.147 255 Hamburg
3.334 163 Brandenburg
3.175 174 Thüringen
3.122 151 Schleswig-Holstein
2.773 168 Saarland
1.771 57 Sachsen-Anhalt
1.593 48 Bremen
784 20 Mecklenburg-Vorpommern
Infections and deaths, by German states
Datenstand
16.06.2020, 00:00 Uhr
COVID-19-Fälle/100.000 Einwohner
DEUTSCHLAND
Infections relative to population by German states (color coded)
GDI-TH, Esri, HERE, Garmin, FAO, NOAA, USGS | GDI...
ROBERT KOCH INSTITUT
UNIVERSITÄT BONN
esri
THE SCIENCE OF WHERE
COVID-19-Fälle
186.839
aus total 186.839
+ 378
zum Vortag
COVID-19-Todesfälle
8.800
aus total 8.800
+ 9
zum Vortag
COVID-19-Genesene
~173.100
von ~173.100
+ ~500
zum Vortag
Erkunden Sie den NPGEO Corona Hub
COVID-19-Fälle nach Altersgruppe und Geschlecht
Infections by age group (bars) and gender (color)
50.000
40.000
30.000
20.000
10.000
0
0-4
5-14
15-34
35-59
60-79
80+
Altersgruppe
Männlich
Weiblich
Fälle Altersgruppe
Fälle Altersgruppe/100.000 Einwohner
COVID-19-Fälle/Tag nach Erkrankungsbeginn, ersatzweise Meldedatum*
(Übermittlungsverzug, siehe Disclaimer)
6.000
5.000
4.000
3.000
2.000
1.000
0
Mär
Apr
Mai
Date of infection (blue) and date of record generation (yellow)
Erkrankungsdatum
Meldedatum
* Bei Fällen ohne Angaben zum Erkrankungsbeginn (Erkrankungsbeginn unbekannt bzw. Fälle ohne Symptome) wird ersatzweise das Meldedatum verwendet. Die abnehmende Fallzahl über die letzten Tage kann durch den Melde- und Übermittlungsverzug bedingt sein.
Fälle/Tag (Erkrankung)
Fälle/Tag (Meldung)
Fälle kumuliert
Fälle/100.000 Einwohner
Disclaimer

Analysis of the RKI Dashboard

Dashboard element	What is represented?	What information is conveyed?	What is the representation useful for?
Top element on right hand side of Figure 1	Total infections, deaths, and recoveries (as numbers).	Numerical attributes convey the values of properties in general of the population of Germany (i.e., a system of things that share non-binding mutual properties).	**For representation**: they *summarize* the state of a collection of people (Germany's population) at some point in time (the time of visit).
Middle element on right hand side of Figure 1	Total infections (as numbers), by age group and gender (categories color coded).	Numerical and visual attributes convey the values of properties in general of some subsets of the population of Germany.	**For representation**: they *summarize* the state of a subset of the collection of people (Germany's population) that are of particular interest, because of presumed risk of infection, at some point in time (the time of visit).
Bottom element on right hand side of Figure 1	Sum of daily infections and daily reported data, by date (as numbers, the two types of data are separated visually through color cording).	Numerical and visual attributes convey the values of one property in general (infections) of the population of Germany by event (dates).	**For state-tracking**: The inclusion of temporal event data (successive dates) allows *following* the change in infection or reporting data over time.
Left hand side element in Figure 1	Total infections, by state.	Numerical attributes convey the values of one property in general (infections) in different subsets (states) of the population of Germany.	**For representation**: they *summarize* the state of the collection of people (Germany's population) decomposed into sub-sets (by state), at some point in time (the time of visit).
Middle element in Figure 1	Total infections relative to population (categorized through color coding), by state (visual).	Visual attributes convey the values of one property in general (infections) in two different subsets of the population (state and population density) of Germany.	**For representation**: they *summarize* the state of the collection of people (Germany's population) decomposed into sub-sets (by state and population density), at some point in time (the time of visit).

Recker, J. (2021). Improving the State-Tracking Ability of Corona Dashboards. *European Journal of Information Systems, 30(5), 476-495.*

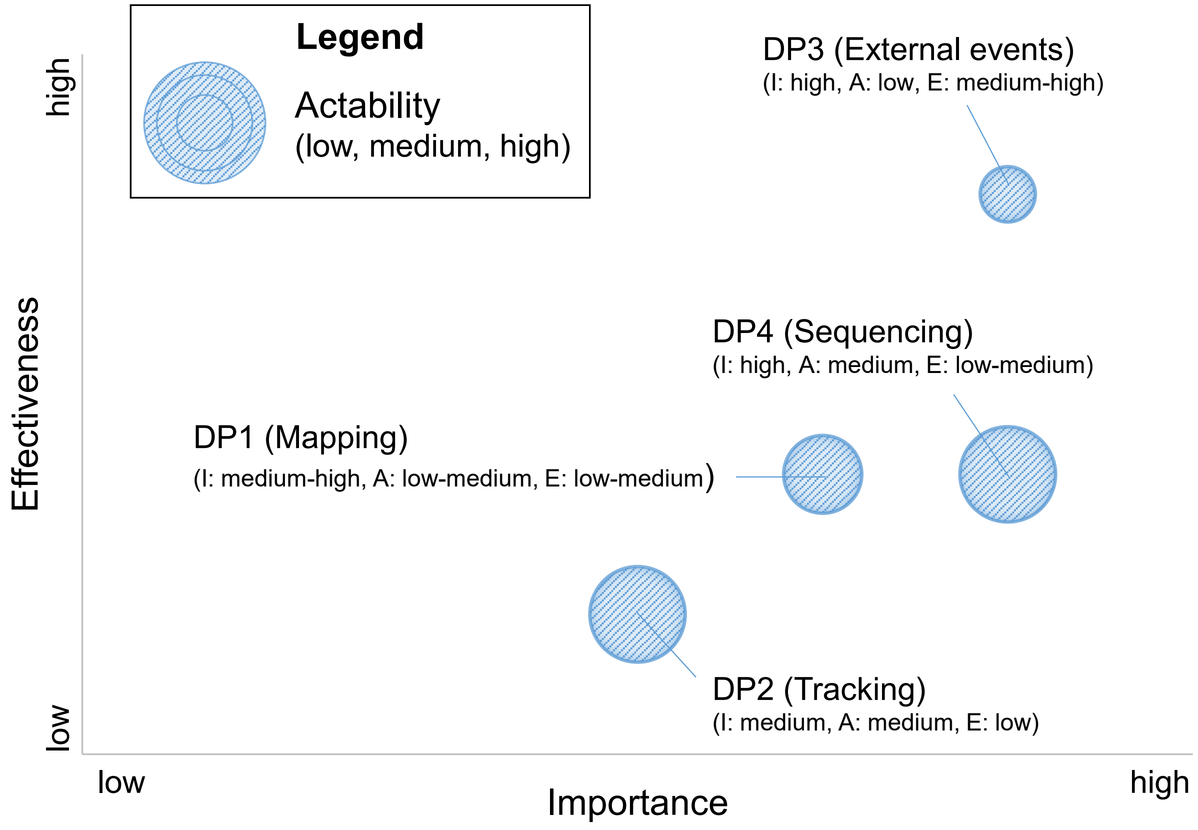
Recommendations to Esri and RKI

1. It must at all times be possible to observe **relevant status indicators** for *particular* collectives of people.

2. It should be possible to **project relevant future states** based on extant transformation laws.

3. It must at all times be possible to **track external events** (e.g., political interventions such as lockdowns, release of new technologies such as vaccines, or change in season) and **map changes in state variables** (e.g., infection rate, death rate, etc.) to the occurrence of those events.

4. It must be possible to **track the sequence of relevant events** that occur.



What is design science

“A research paradigm in which a designer answers questions relevant to human problems via the creation of innovative artefacts, thereby contributing new knowledge to the body of scientific evidence. The designed artefacts are both useful and fundamental in understanding that problem.“

Hevner, A. R., & Chatterjee, S. (2010). *Design Research in Information Systems: Theory and Practice (Vol. 22). Springer, p. 5.*

“The research paradigm is about ***problem solving****; it is about* ***presenting solutions through systems and IT artifacts****, broadly defined as constructs, models, methods, and instantiations. […] Design science is at the* ***center of innovation creation and solution building****.*

Paulo Goes, 2014: MISQ Editorial Comments.

Categorization Design Science Research

- Design Science Research is a **pragmatic**, **problem-solving** paradigm that seeks to contribute to human knowledge via the creation of innovative artifacts.
- DSR is a prominent form of **Engaged Scholarship**, in which multiple key stakeholders (researchers, users, clients, sponsors, practitioners) collaborate to understand and address an important, complex problem/opportunity.
  - Engaged scholarship: teaching and research that connect the resources of the university to our most pressing social, civic, and ethical problems.

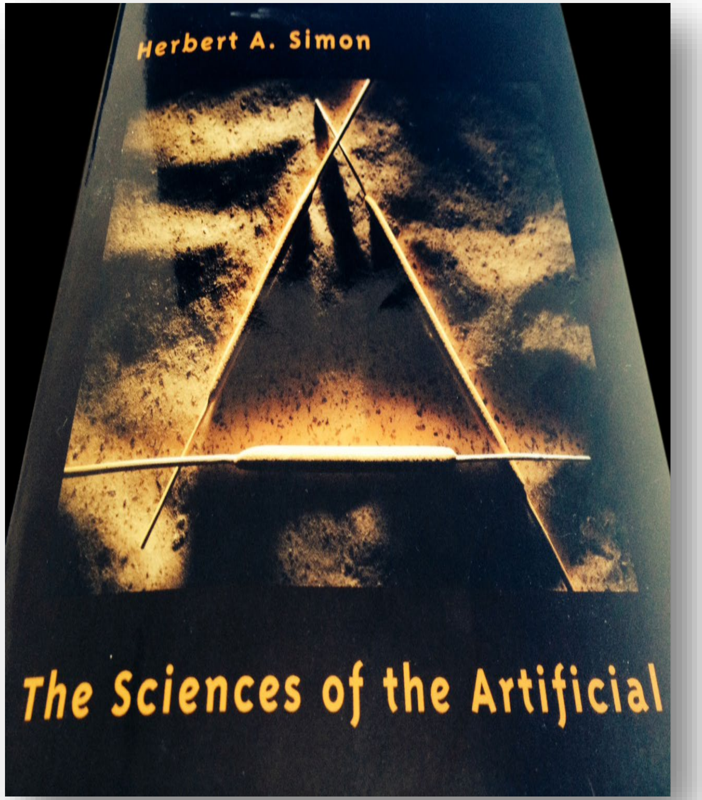
Van de Ven, A. H. (2007). *Engaged Scholarship: A Guide for Organizational and Social Research. Oxford University Press.*

Design Science Research

- Design Science is a creative, engaged research paradigm that informs multiple audiences:
  - Researchers: Design principles and mid-range design theories
  - Practitioners: Artifact (e.g., product and/or process) instantiations
  - Managers: Work and application system controls
  - Government: Economic and social welfare

History and Origins

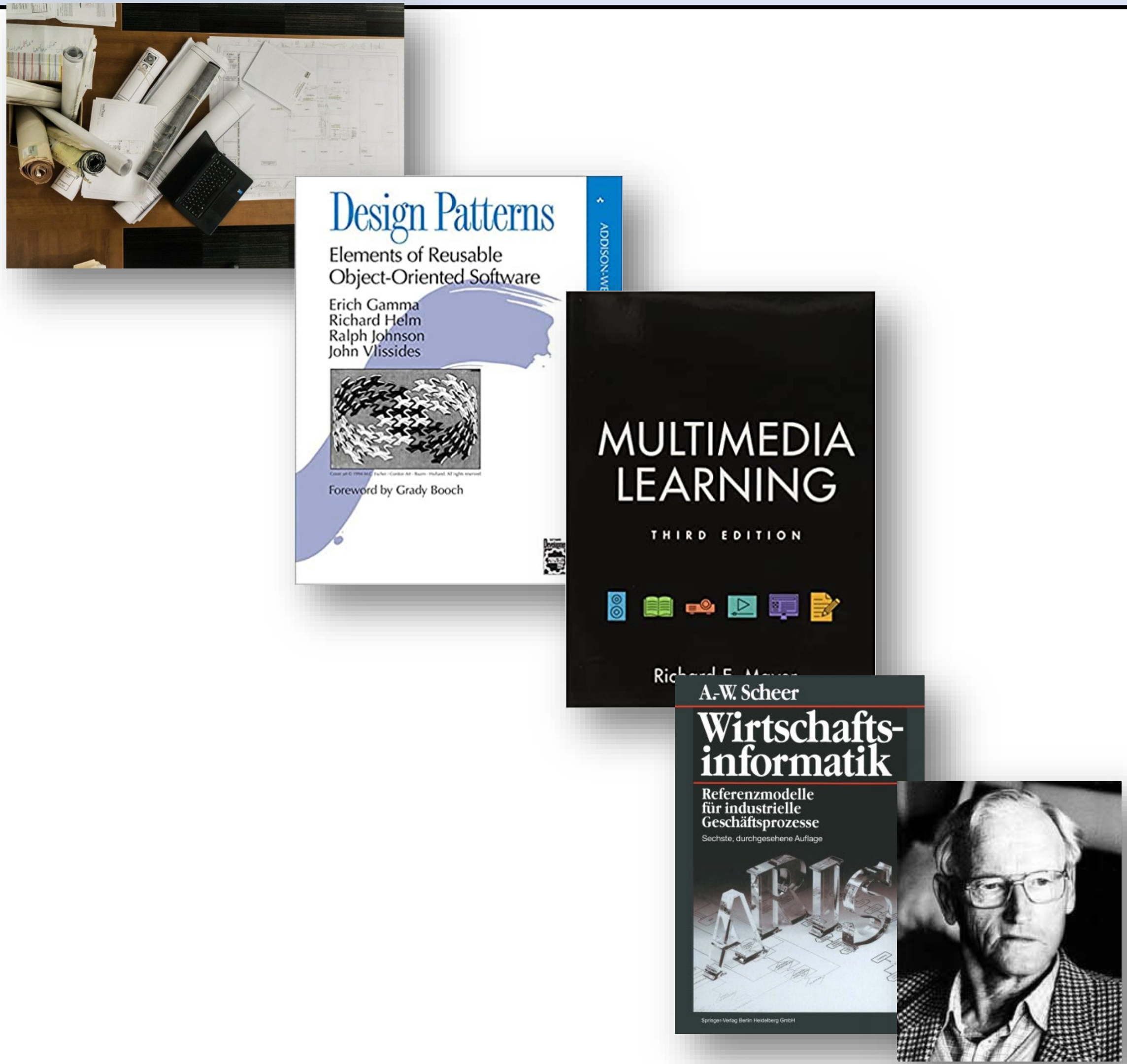
- Simon's Nobel-prize winning work:
- Our world is full with artefacts that are man-made, not naturally occurring.
  - Artefacts as empirical phenomena are "artificial" rather than "natural."
- Because the artificial artefacts are human-created, the science of artefacts involves the study of the designs used to perform tasks or fulfill goals and functions with the artefact.



Sciences of the Artificial, 3rd Ed. – Simon 1996

Historical Background

- Design has been prevalent throughout history
  - Engineering, Education, Anthropology, Architecture, Art, …
- Design received scientific legitimacy through Simon’s work
- Design in Information Systems
  - Always prevalent in many European countries such as Germany and Scandinavia
  - Received global attention in Information Systems in the 1990s and 2000s
    - Walls, J. G., Widmeyer, G. R., & El Sawy, O. A. (1992). Building an Information Systems Design Theory for Vigilant EIS. *Information Systems Research, 3(1), 36-59.*
    - March, S. T., & Smith, G. F. (1995). Design and Natural Science Research on Information Technology. *Decision Support Systems, 15(4), 251-266.*
    - Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly, 28(1), 75-105.*
    - Peffers, K., Tuunanen, T., Rothenberger, M. A., & Chatterjee, S. (2007). A Design Science Research Methodology for Information Systems Research. *Journal of Management Information Systems, 24(3), 45-77.*

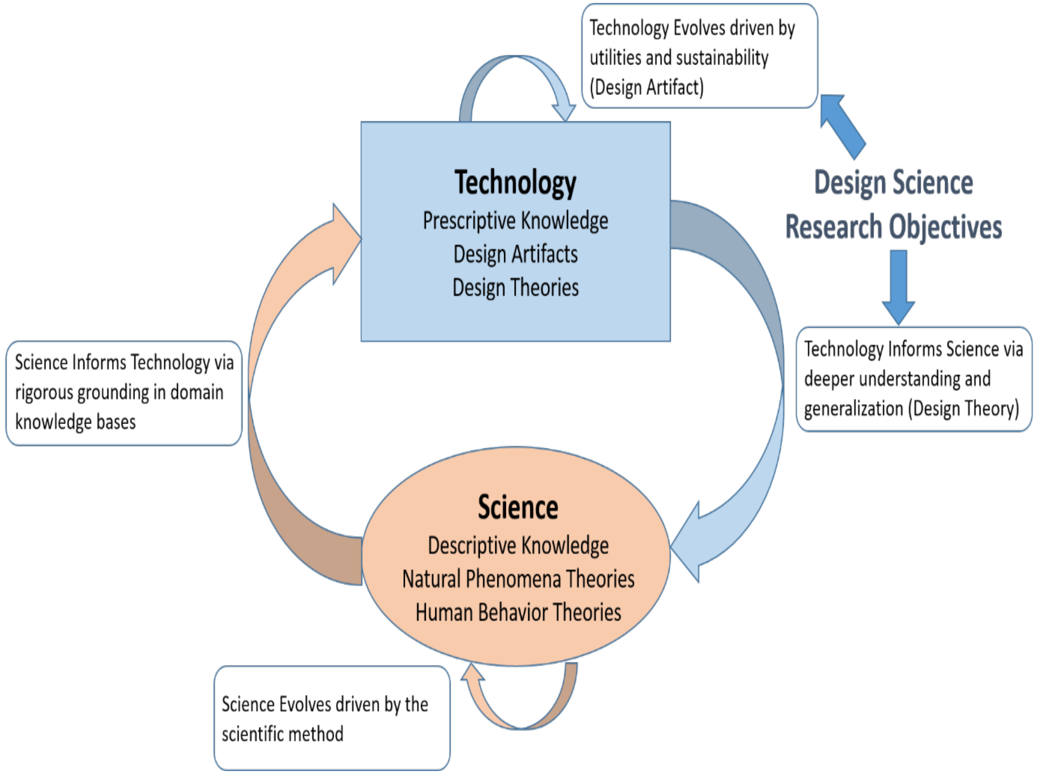


Main principle: Bridging SCIENCE ⇔ TECHNOLOGY

- Technology Evolution (TE)
  - Very Rapid, marked by continuous improvements
  - Process driven by human and economic utilities
  - See (Arthur, *The Nature of Technology*, 2009)

- Science Evolution (SE)
  - Slow, marked by paradigm shifts
  - Process driven by evaluation, gathering of empirical evidence, and hypothesis testing
  - See (Kuhn, *The Structure of Scientific Revolutions*, 1996)

- Technology Evolutions precede and drive Science Evolutions
- Science Evolutions ground and direct Technology Evolutions



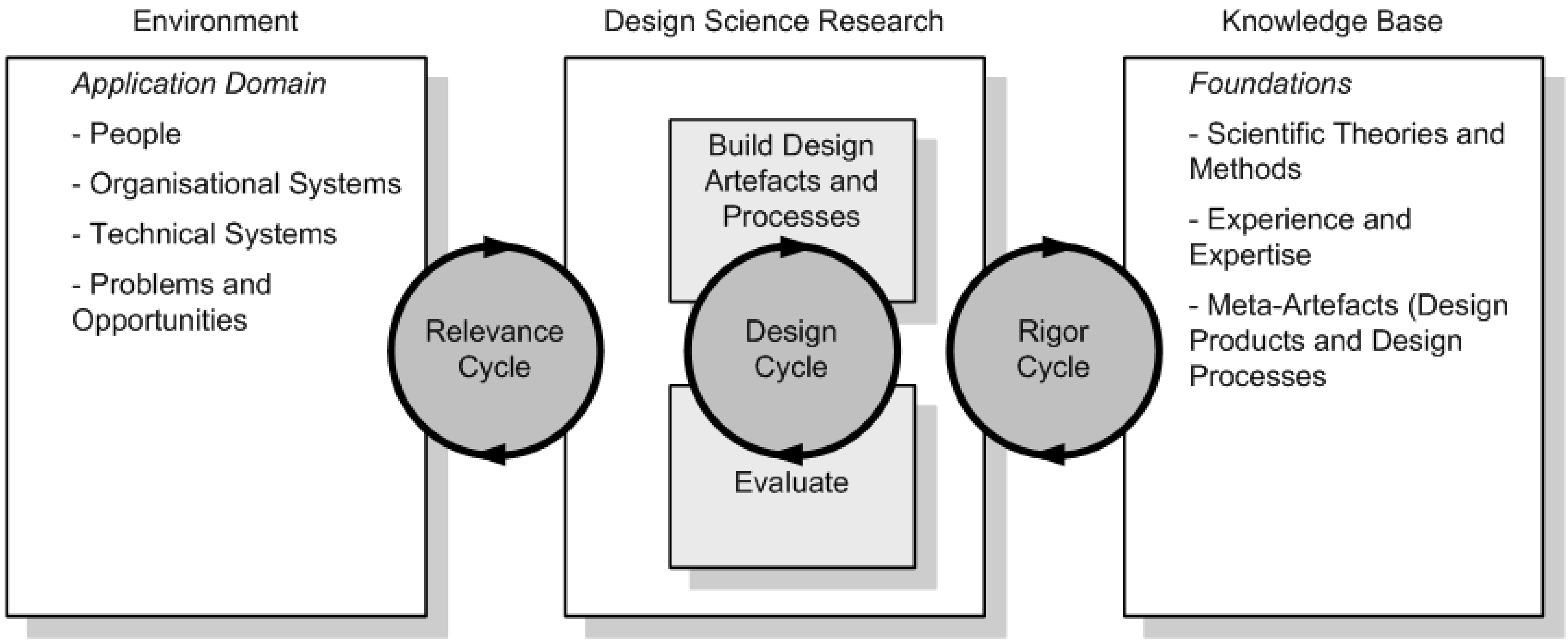
Focus of Design Methods: The artefact

- the research interest is on creating or changing such artefacts with the aim of improving on existing solutions to problems or perhaps providing a first solution to a problem.
- Different types of artefacts are conceivable:
  - Constructs (vocabulary and symbols)
  - Models (abstractions and representations)
  - Methods (algorithms and practices)
  - Instantiations (implemented and prototype systems)
  - Design theories (improved models of design or design processes)

Key evaluation criterion: demonstrated utility

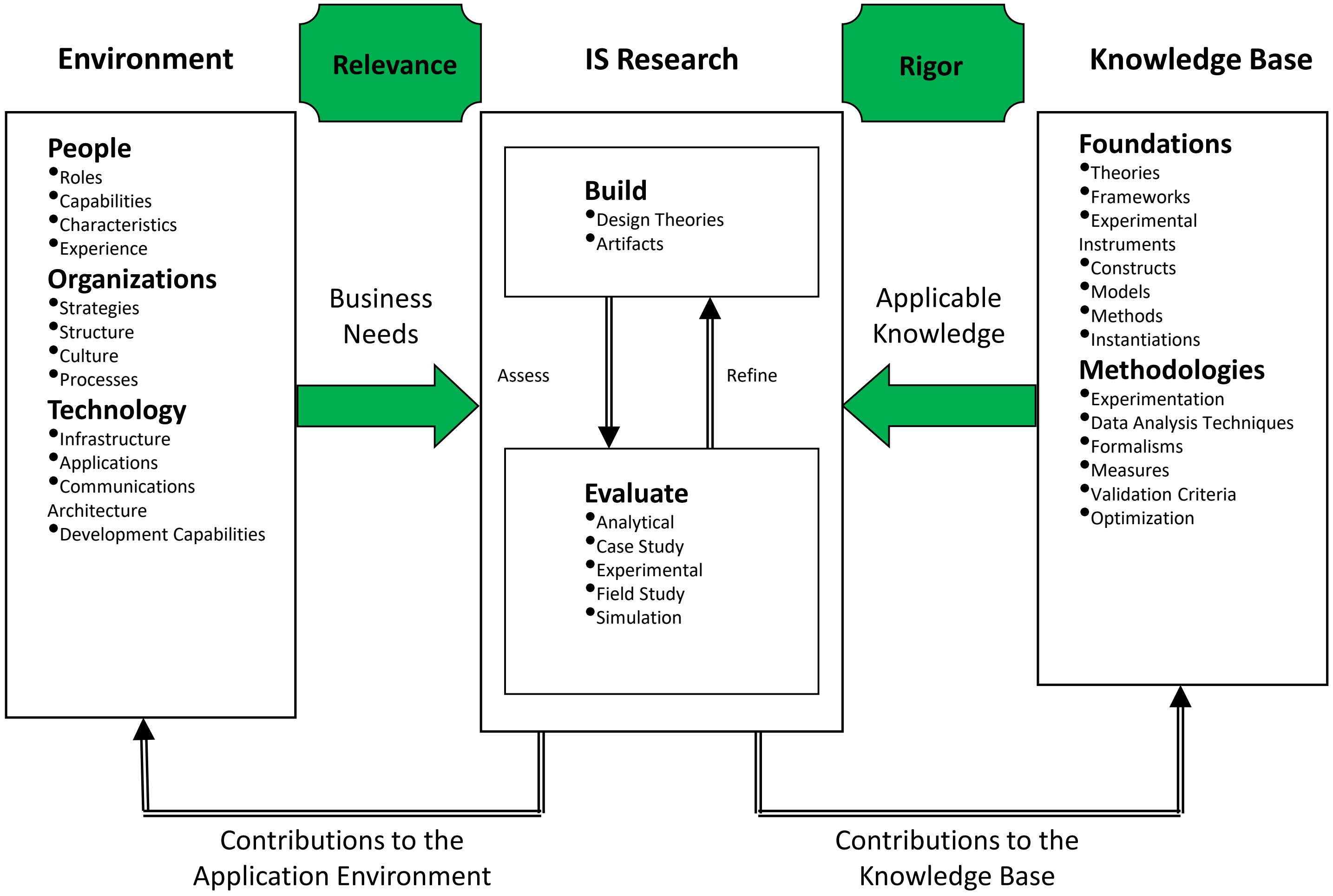
- The designed artefact created through design research must provide **improved utility** beyond the current state of utility.
- Three implications:
  a) the artefact's demonstrated utility is novel.
  b) the utility of an artefact in comparison to existing work makes a positive difference.
  c) a thorough evaluation provides decisive evidence of the artefact's superior utility.
- Definition of utility can vary (e.g., performance, effectiveness, efficiency).

Design research framework (overview)



Hevner, A.R. "A Three Cycle View of Design Science Research", *Scandinavian Journal of Information Systems (19:2) 2007, pp. 87-92.*

Design research framework (detailed)



Components of the framework

- **Build** (constructing the artefact) and **evaluate** (testing the artefact) are the core research processes in design research.
- **Environment**
  - the problem space in which the phenomena of interest reside.
  - E.g., people, organizational structures, and existing digital information or communication technologies and infrastructures.
  - Ensures relevance of the artefact
- **Knowledge base**
  - provides the materials from and through which design science research is accomplished;
  - I.e., prior research and results from reference disciplines provide foundational theories, frameworks, instruments, constructs, models, methods, and instantiations that are available for use in the design phase.
  - Ensures rigor of design science

Components of the framework

- The **relevance cycle** bridges the research project’s contextual environment and the design science activities.
- The **rigor cycle** connects the design science activities with the knowledge base of scientific foundations, experience, and expertise that inform the research project.
- The **design cycle** iterates between the core activities of building and evaluating the design artefact and the research processes.
- All **three cycles must be present and clearly identifiable** in a design science research project.

Guidelines in design science

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Hevner, A.R., March, S.T., Park, J., and Ram, S. "Design Science in Information Systems Research", *MIS Quarterly (28:1) 2004, pp. 75-105.*

The Artifact as Knowledge

	Contribution type	Examples
More abstract, complete, and mature knowledge	Level 3. Well-developed design theory about embedded phenomena	**Design theories** (mid-range and grand theories)
↕ ↕ ↕ ↕	Level 2. Nascent design theory – knowledge as operational principles/architecture	Constructs, methods, models, **design principles**, technological rules.
More specific, limited, and less mature knowledge	Level 1. Situated implementation of artifact	**Instantiations** (software products or implemented methods)

Gregor, S. and Hevner, A.R. "Positioning and Presenting Design Science Research for Maximum Impact", *MIS Quarterly (37:2) 2013, pp. 337-355.*

Example level-1 contribution

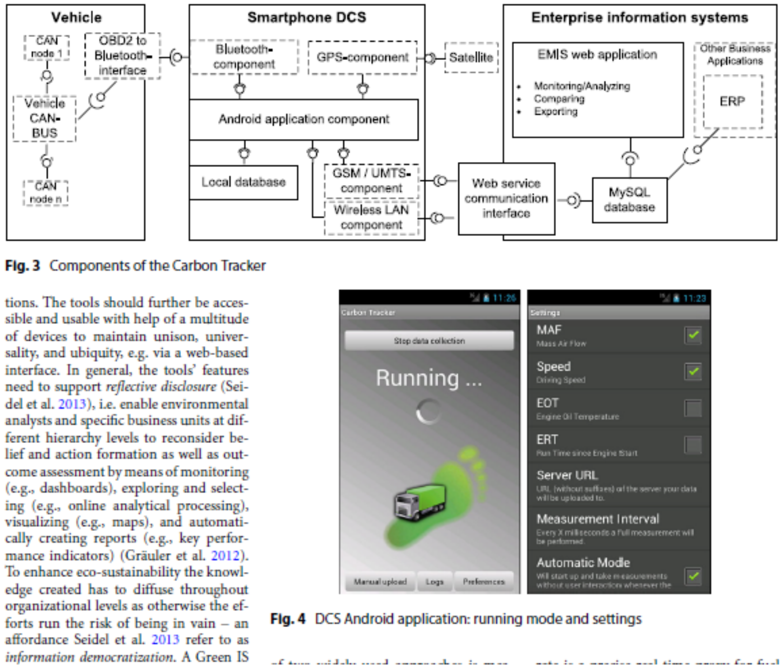


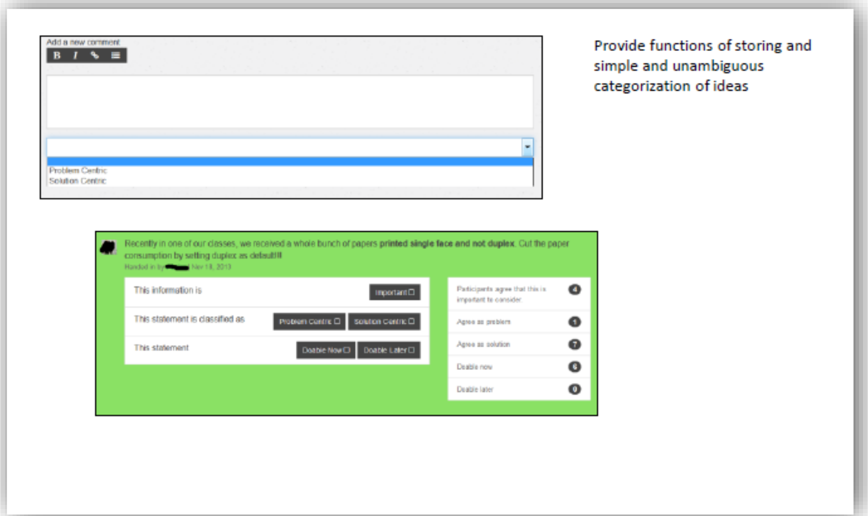
Fig. 3 Components of the Carbon Tracker

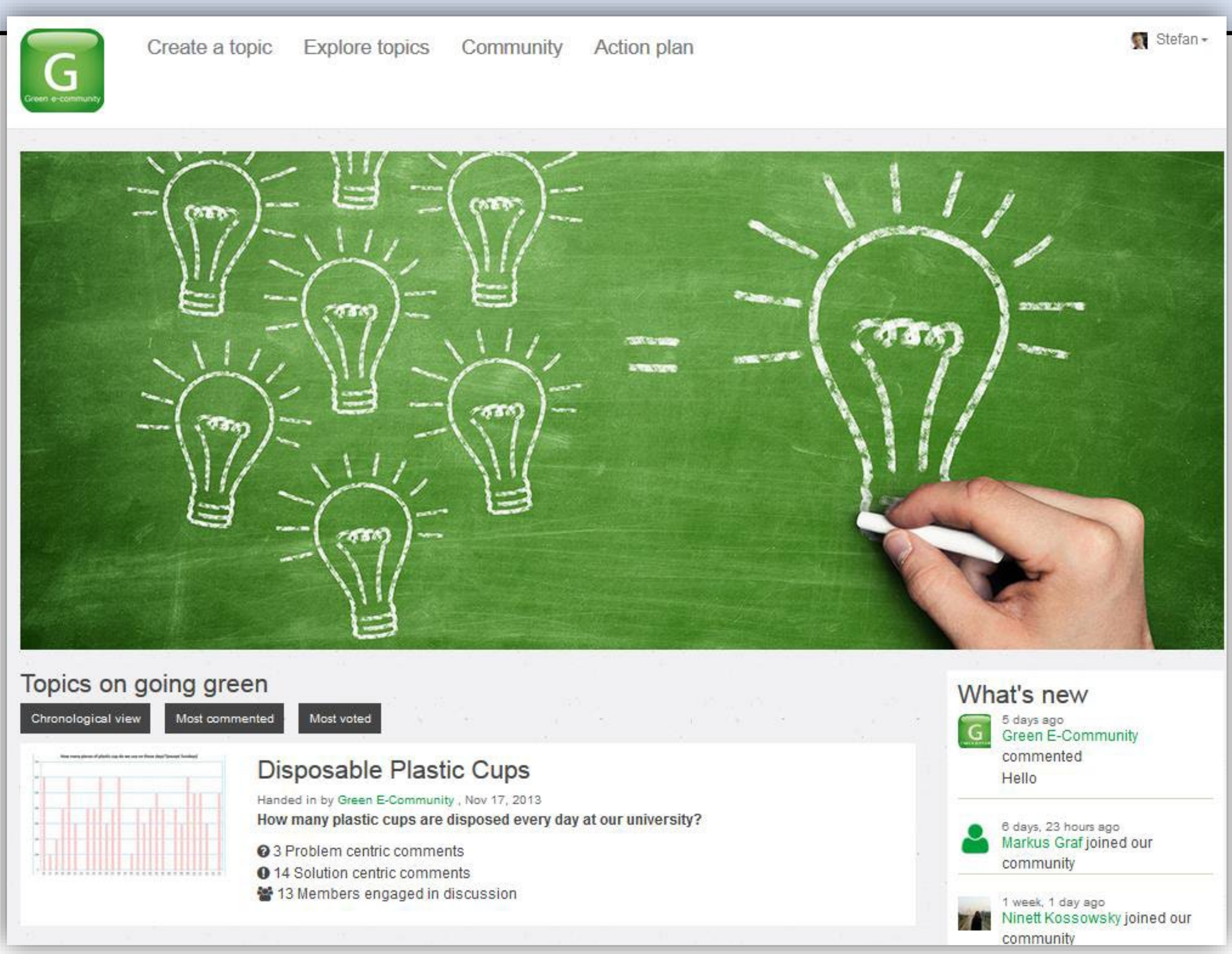
tions. The tools should further be accessible and usable with help of a multitude of devices to maintain unison, universality, and ubiquity, e.g. via a web-based interface. In general, the tools' features need to support *reflective disclosure* (Seidel et al. 2013), i.e. enable environmental analysts and specific business units at different hierarchy levels to reconsider belief and action formation as well as outcome assessment by means of monitoring (e.g., dashboards), exploring and selecting (e.g., online analytical processing), visualizing (e.g., maps), and automatically creating reports (e.g., key performance indicators) (Gräuler et al. 2012). To enhance eco-sustainability the knowledge created has to diffuse throughout organizational levels as otherwise the efforts run the risk of being in vain – an affordance Seidel et al. 2013 refer to as *information democratization*. A Green IS

Fig. 4 DCS Android application: running mode and settings

Hilpert, H., M. Schumann, and J. Kranz (2013) "Leveraging Green IS in Logistics: Developing an Artifact for Greenhouse Gas Emission Tracking", *Business & Information Systems Engineering (5)5, pp. 315-325*

Example level-2 contribution





Seidel, S., Chandra Kruse, L., Székely, N., Gau, M., & Stieger, D. (2018). Design principles for sensemaking support systems in environmental sustainability transformations. European Journal of Information Systems, 27(2), 221-247.

Example level-2 contribution

DP 1: Provide novel information in the form of environmental facts, observations, or general behavior , so that the system affords users disruptive ambiguity and surprise in environmental sustainability transformations.

DP 2: Provide functions of storing and simple and unambiguous categorization of ideas, so that the system affords noticing and bracketing to users in environmental sustainability transformations.

DP 3a: Provide features for interactive communication, so that the system affords users to engage in an open and inclusive discussion in environmental sustainability transformations.

DP 3b: Provide users with an overview of all other users along with features for direct communication between users, so that the system affords users to engage in an open and inclusive discussion in environmental sustainability transformations.

DP 3c: Provide features to relate comments to other comments so that the system affords users to comprehend circumstances and turning them into words and categories on a social ground in environmental sustainability transformations.

DP 3d: Provide features to assign roles to users so that the system affords user specific actions, such as moderation of discussions in environmental sustainability transformations.

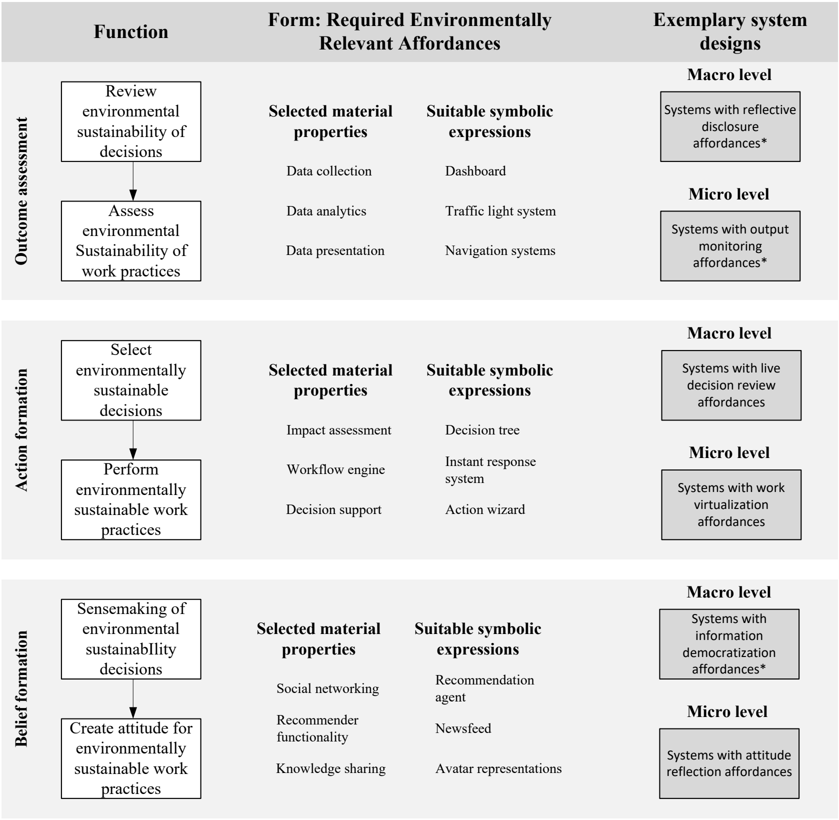
DP 4a: Provide features for categorization of action possibilities to distinguish presumptions from actual planed actions, so that the system affords users presumption and action planning in environmental sustainability transformations.

DP 4b: Provide features for dedicated feedback about the implementation and consequences of the implementation of actions in environmental sustainability transformations.

Seidel, S., Chandra Kruse, L., Székely, N., Gau, M., & Stieger, D. (2018). Design principles for sensemaking support systems in environmental sustainability transformations. European Journal of Information Systems, 27(2), 221-247.

Example level-3 contribution

- **Belief formation** captures how beliefs, desires, orientations etc. about the natural environment are formed.
  - Macro-level: the ways an organization coordinates and divides labor and how the organization defines environmental expectations of its agents.
  - Micro-level: how an individual forms beliefs about the natural environment
- **Action formation** describes how psychic states about the natural environment translate into actions.
  - Macro-level: actions taken by an organization to affect the actions taken by its agents.
  - Micro-level: actions taken by agents
- **Outcomes** describe what the consequences of the actions are.
  - Macro-level: the measure of the environmentally functioning of organizations.
  - Micro-level: the measure of the environmental behavior of agents
- **Meta-requirement 1**: A Green IS must perform one or more of these functions.



Recker, J. (2016). *Toward A Design Theory for Green Information Systems 49th Hawaiian International Conference on Systems Sciences, Kuaui, Hawaii.*

Propositions of the Design Theory

- **Scope of operation**
  1. Any Green IS instantiation needs to operate at the level of belief formation, action formation, or outcome measurement.
  2. Green IS instantiations will be more effective if they operate at the level of belief formation, action formation, and outcome measurement rather than one of the levels only.
- **Level of operation**
  3. Any Green IS instantiation needs to operate at least at the macro or the micro level of organizations.
  4. Any Green IS instantiation will be more effective if they operate at both the macro and micro level rather than one level only.

Propositions of the Design Theory

- **Effective utility**

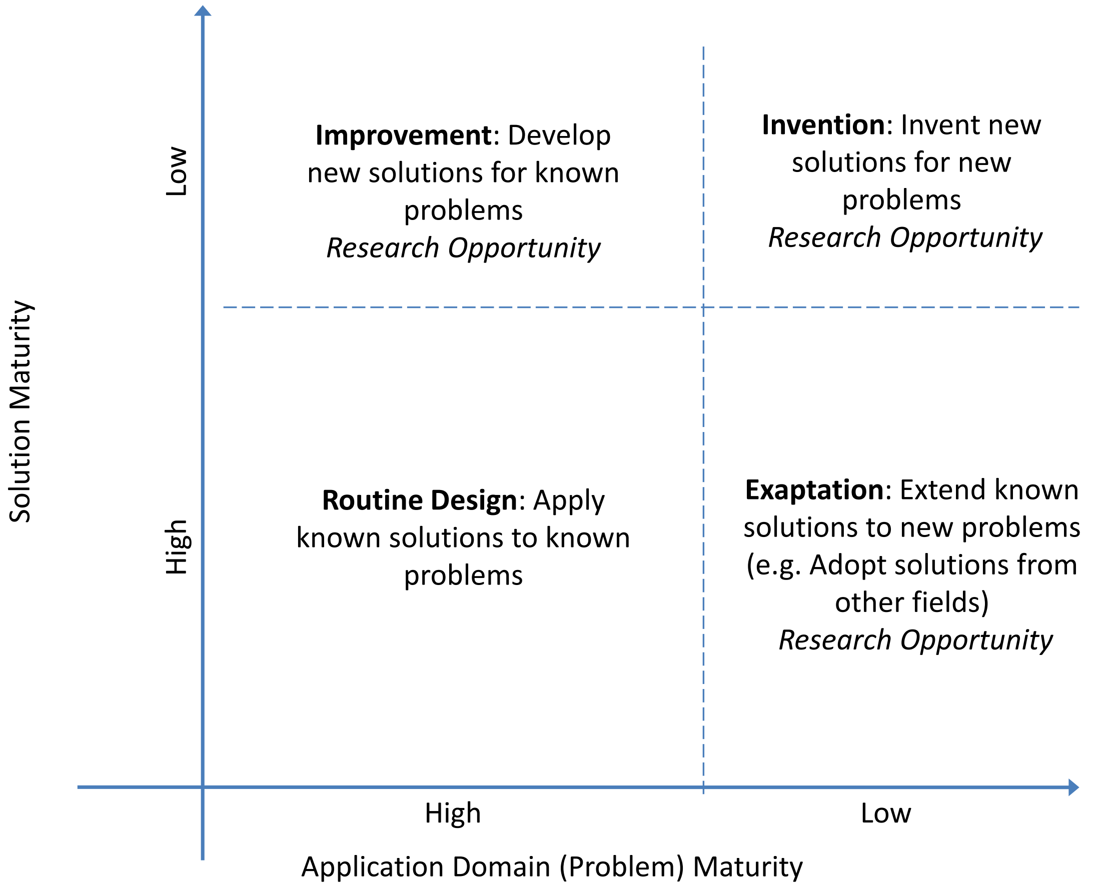
5. To provide effective utility, any Green IS instantiation requires the provision of actualizable environmentally relevant functional affordances at either the macro or micro level.
6. In any Green IS instantiation, environmentally relevant functional affordances need to be designed such that required material properties are accompanied by suitable symbolic expressions appropriate for the intended user groups.

How powerful are current “Green Systems”?

- We searched all publications on “green/sustainability information systems”, across all sorts of publication databases

- We found 416 in total since 2010; 74 that presented some sort of **digital system artefact**.
  - 36 of these were able to **measure and report environmental data**.
  - Only 6 of these can be used to **change people’s attitudes and beliefs**.
  - Only 11 of these allowed the users to actually **make green actions or decisions**.

What are the knowledge contributions that are possible?



Gregor, S. and Hevner, A.R. "Positioning and Presenting Design Science Research for Maximum Impact", *MIS Quarterly (37:2) 2013, pp. 337-355.*

Invention Quadrant

- An invention is a radical breakthrough; a departure from accepted ways of thinking and doing
- DSR projects in which little understanding of the problem context exists and no effective artifacts are available as solutions
- Research contributions are usually novel artifacts or inventions, i.e., **level 1 artifacts**
- The newness of artifact makes this research difficult
  - Insufficiently grounded in theory
  - Design is incomplete and not fully evaluated
  - Understanding is insufficient to provide new contribution to theory via the design

Invention Example

- Agrawal, R., Imielinski, T. and Swami, A. (1993). “Mining Association Rules between Sets of Items in Large Databases”, Proceedings of the 1993 ACM SIGMOD Conference, Washington DC, May.
  - Aim: produce an algorithm that generates all significant association rules between items in the database
  - Practical importance: Allows organizations to find interesting relationships (e.g. shopping patterns)
  - Theoretical significance (newness): Shows (Sect 5) that no other work has done same thing
  - Description of new method: Shows requirements (Sect 1), new concepts (association rule, support, confidence), Formal Model (pseudocode) (Sects 2-3)
  - Proof: Experiments (Sect 4)

Improvement Quadrant

- An improvement is a **better** artifact solution in the form of more efficient and effective products, processes, services, technologies, or ideas.
- DSR projects in which the problem context is mature but there is a great need for more effective artifacts as solutions
- Improvement DSR is judged by:
  - Clearly grounding, representing, and communicating the new artifact design
  - Convincing evaluation providing evidence of improvements over current solutions
- All levels of artifact knowledge contribution can be made

Improvement Examples

- Many DSR projects in IS are in the Improvement Quadrant, for example:
  - Better data mining algorithms for knowledge discovery (extending the initial ideas invented by Agrawal et al. (1993)); for example, (Fayyad et al. 1996; Zhang et al. 2004; Witten et al. 2011)
  - Improved recommendation systems for use in e-commerce; for example (Herlocker et al. 2004; Adomavicius and Tuzhilin 2005)
  - Better technologies and use strategies for saving energy in IT applications; for example (Donnellan et al. 2011; Watson and Boudreau 2011)
  - Improved routing algorithms for business supply chains; for example (van der Aalst and Hee 2004; Liu et al. 2005)

Exaptation Quadrant

- An exaptation is the expropriation of an artifact in one field to solve problems in another field
- DSR projects in which the problem context is not well understood but there exist mature artifacts in other fields that can be exapted as effective solutions
- Exaptation DSR is judged by:
  - Clearly grounding, representing, and communicating the exapted artifact design
  - Convincing evaluation providing evidence of how well the new artifact solves the given problem
- All levels of artifact knowledge contribution can be made

Exaptation Examples

- Exaptation DSR is employed when new technologies provide opportunities to solve new and/or different IS problems; for example:
  - Codd's exaptation of relational mathematics to the problem of database systems design leading to relational database concepts, models, methods, and instantiations (Codd, 1970; Codd, 1982)
  - Berners-Lee original concept of the World Wide Web was one of simply sharing research documents in a hypertext form among multiple computers. In short time, however, many individuals saw the potential of this rapidly expanding interconnection environment to exapt applications from old platforms to the WWW platforms. These new Internet applications were very different from previous versions adding many new artifacts.
  - Research by Berndt et al. (2003) on the CATCH data warehouse for health care information. Well-known methods of data warehouse development (e.g. Inmon, 1992) were exapted to new and interesting areas of health care systems and decision-making applications.

Routine Design Quadrant

- Professional design or system building to be distinguished from DSR
- However, evolving or best practices may be observed and documented in “extractive case study” work (Van Aken)
  - Study of best practices in routine design may lead to empirical generalization
  - Example – Davenport’s observation of BPR (Davenport & Short SMR 1990)

MISQ Papers mapped to Framework

Knowledge Contribution	Article	Knowledge Contribution Claims
Improvement	A Multilevel Model for Measuring Fit Between a Firm's Competitive Strategies and Information Systems Capabilities (McLaren et al., 2011)	There is a need for a more fine-grained model for diagnosing the individual IS capabilities that contribute to the overall fit or misfit between a firm's competitive strategies and IS capabilities (p.2) (See also Table 4).
Improvement	Guidelines for Designing Visual Ontologies to Support Knowledge Identification (Bera et al., 2011)	There could be several ways to address OWL's inability to show state changes… We have taken a different path, taking the view that we can keep the existing OWL syntax and improve the extent to which it support s knowledge identification (pp. 885-886).
Exaptation	Co-creation in Virtual Worlds: The Design of the User Experience (Kohler et al., 2011)	While Nambisan and his colleagues provide a useful framework for the online environment in general, little is known about designing co-creation experiences in virtual worlds (p. 774).
Exaptation	Design Principles for Virtual Worlds (Chaturvedi et al., 2011)	ABVWs comprise a new class of information systems… Thus, they require an extension of the corresponding information system design principles (p. 675)
Improvement	Correlated Failures, Diversification, and Information Security Risk Management (Chen et al., 2011)	While our model to estimate security loss due to unavailable (i.e., system downtime) is based on well-established queuing models, one innovation of our model is that the distribution from which the number of requests sent to the queue is drawn is endogeneous to system variables (p. 399).
Exaptation	The Effects of Tree-View Based Presentation Adaptation on Mobile Web Browsing. (Adipat et al., 2011)	Presentation adaptation has been studied in the desktop environment and has been proven beneficial … However, research on adaptation of Web content presentation for mobile handheld devices is still rare (p. 100).
Improvement	Improving Employees' Compliance Through Information Systems Security Training: An Action Research Study. (Puhakainen and Sipponen 2010)	There is a need for IS security training approaches that are theory-based and empirically evaluated. … (p. 757). To address this deficiency … this paper developed a theory-based training program … This paper then tested the practical workability through an action research intervention (p. 776).
Improvement	Detecting Fake Websites: The Contribution of Statistical Learning Theory. (Abbasi et al., 2010)	Systems grounded in SLT can more accurately detect various categories of fake web sites (p. 435).
Improvement	The Design Theory Nexus. (Pries-Heje and Baskerville, 2008)	The work suggests that the design theory nexus approach is more universal than previous approaches to contingency theory, because it can operate in both symmetrical and asymmetrical settings (p. 748).
Improvement	Process Grammar as a Tool for Business Process Design. (Lee et al., 2008)	The method improves on existing approaches by offering the generative power of grammar-based methods while addressing the principal challenge to using such approaches … (p. 757).
Improvement	Making Sense of Technology Trends in the Information Technology Landscape: A Design Science Approach. (Adomavicius, et al., 2008)	Our approach may complement existing technology forecasting methods … by providing structured input and formal analysis of the past and current states of the IT landscape (p. 802).
Improvement	CyberGate: A Design Framework and System for Text Analysis of Computer-Mediated Communication. (Abbasi and Chen 2008)	The results revealed that the CyberGate system and its underlying design framework can dramatically improve CMC text analysis capabilities over those provided by existing systems (p. 811).
Improvement	Using Cognitive Principles to Guide Classification in Information Systems Modeling. (Parsons and Wand 2008)	Despite the importance of classification, no well-grounded methods exist .. (p. 840). We provide empirical evidence…that the rules can guide the construction of semantically clearer and more useful models (p. 858).

Challenges in doing design research

- Design research projects are usually:
  - Team-based
  - Longitudinal
  - Goal-driven

- All of these are difficult.

Challenges in doing design research

- Attempting to do good design research is an audacious venture
- It is not for those that value **optimal** and **repeatable** results
- Relying on existing theories often does not produce **predictable** results
- Multiple, rapid cycles of build and evaluate produce **emergent** and **satisfactory** results
- Even the most useful results might become eclipsed by rapid changes in the problem and solution spaces

Some Challenges to Doing Good DSR

1. Complexity
2. Confidence
3. Contribution

Complexity

- IS Research studies Complex Socio-Technical Systems (Sarker et al. MISQ 2019)
- Information systems are complex artefacts :
  - Diverse
  - Interdependent
  - Connected
  - Adaptive
- We attempt to Manage Complexity by Capturing/Representing the DSR Problem Space:
  - Context (Domain, Stakeholders, Time, Space)
  - Goodness Criteria (Goals, Evaluation Measures)
  - Dancing Landscape (Emergent Behaviors, Self-Organization, Change)

Manging complexity: Representing the problem space

- The first step of any DSR project is understanding and representing the *Problem*.

  - “Every problem-solving effort must begin with creating a representation for the problem – a problem space in which the search for the solution can take place. … Occasionally, however, we encounter a situation that doesn’t seem to fit any of the problem spaces we have encountered before, even with some stretching and shaping. Then we are faced with a task of discovery that may be as formidable as finding a new natural law.” Simon 1996, p. 108
  - “This view can be extended to all of problem solving – solving a problem simply means representing it so as to make the solution transparent.” Simon 1996, p. 132

- But: Problem of “The Dancing Landscape” – The introduction of a design solution into a problem space changes the problem space. The next DSR cycle faces a new problem.

DSR Goals and Evaluation Measures

- The identification of DSR goals and their transformation into well-defined evaluation measures are understudied topics.
  - What are the important goals of the different stakeholders and how do we reconcile conflicting goals?
  - How can we prioritize and weigh goals in a problem ‘utility’ function?
  - How do we measure the achievement of these goals?
  - How do we evaluate the “goodness of fit” of a designed artifact as a solution in an application environment?
  - How do we rank potential design candidates so as to select the best one for implementation as a solution?
- Such questions require the DSR project team to define the goals and evaluation measures for the project and design rigorous methods for evaluating the design artifacts under these criteria. The rigor and credibility of a DSR project is determined by these evaluation decisions.

Design Evaluation Methods – The Toolbox

1. Observational	Case Study – Study artifact in depth in business environment
	Field Study – Monitor use of artifact in multiple projects
2. Analytical	Static Analysis – Examine structure of artifact for static qualities (e.g., complexity)
	Architecture Analysis – Study fit of artifact into technical IS architecture
	Optimization – Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior
	Dynamic Analysis – Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment – Study artifact in controlled environment for qualities (e.g., usability)
	Simulation – Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing – Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing – Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument – Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact's utility
	Scenarios – Construct detailed scenarios around the artifact to demonstrate its utility

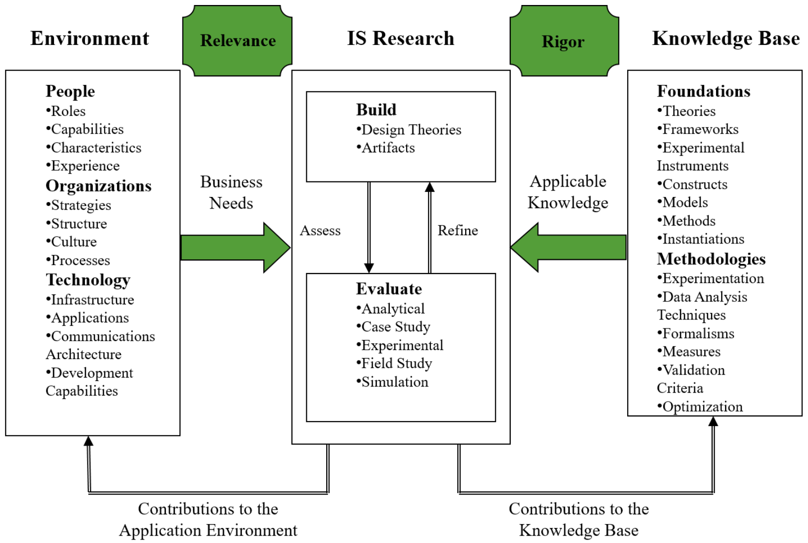
Selection of Evaluation Methods

- Match Evaluation Methods to:
  - Research Question
  - Goals and Evaluation Measures
  - Hypotheses and Dependent Variables
  - Application Context
    - Controls in the Application Context
  - Availability of Data Sources
    - Qualitative
    - Quantitative
    - Primary vs. Secondary
  - Research Team Evaluation Skills
  - Research Evaluation Tools

- Evaluation Methods will be different for Evaluation in Lab (Formative) vs. Evaluate in Context (Summative)

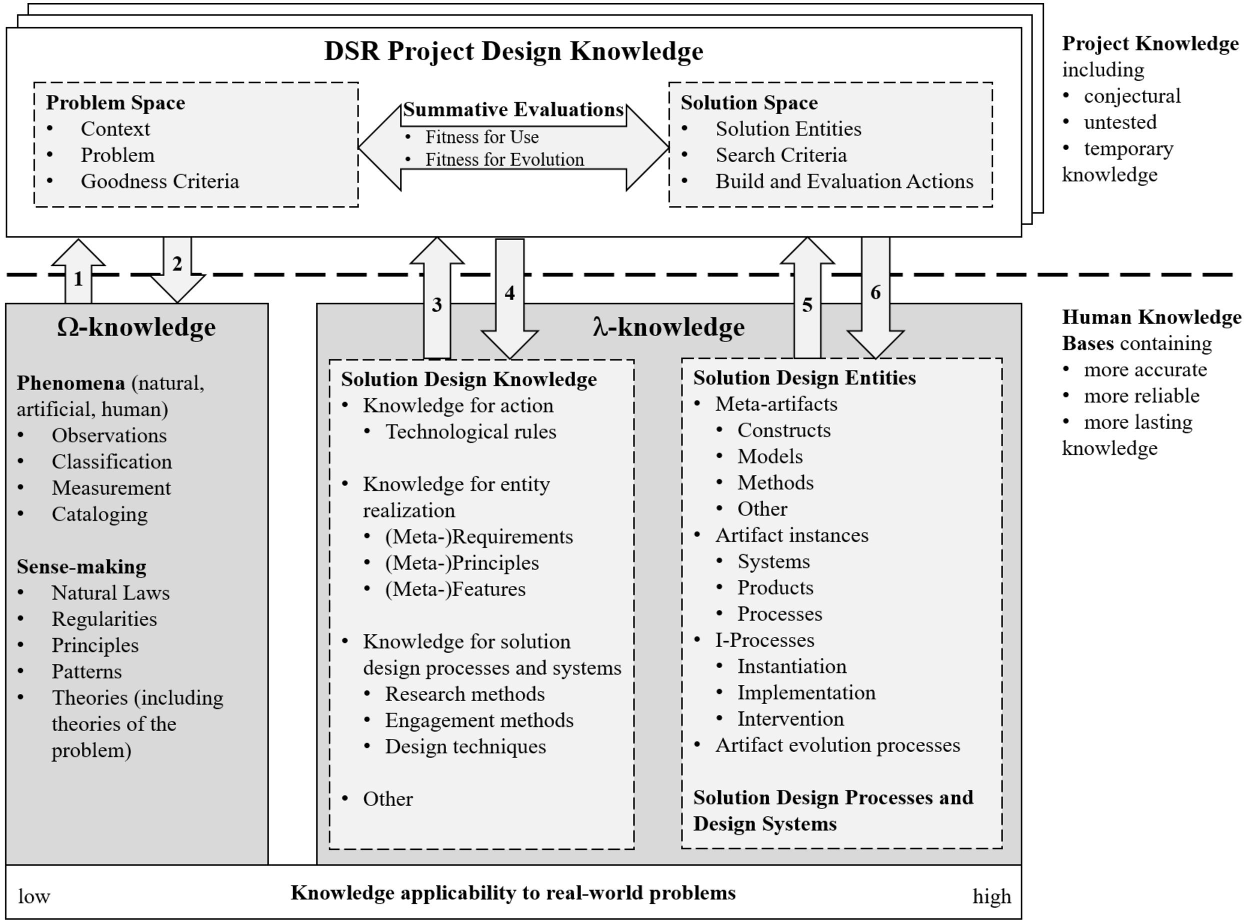
Contributions

- DSR must make contributions to the application environment and to the knowledge base (Hevner et al. 2004).
- The design artifact embodies new knowledge at varying levels of abstraction (Gregor and Hevner 2013).
- Design is also a verb, so we learn something about designing, as well.



	Contribution type	Examples
More abstract, complete, and mature knowledge	Level 3. Well-developed design theory about embedded phenomena	Design theories (mid-range and grand theories)
↕ ↕ ↕ ↕	Level 2. Nascent design theory – knowledge as operational principles/architecture	Constructs, methods, models, design principles, technological rules.
More specific, limited, and less mature knowledge	Level 1. Situated implementation of artifact	Instantiations (software products or implemented methods)

Producing and Consuming Knowledge



A. Drechsler and A. Hevner, (2018) Utilizing, Producing, and Contributing Design Knowledge in DSR Projects, *DESRIST 2018*, India.

Computational Methods

Computational Methods

- An umbrella term that describes a variety of software tools that assist with such research processes as data generation or discovery, data processing or cleansing, and data analysis or interpretation.
- You can think of these procedures as having a focus on “**digital trace data**”.

Digital trace data

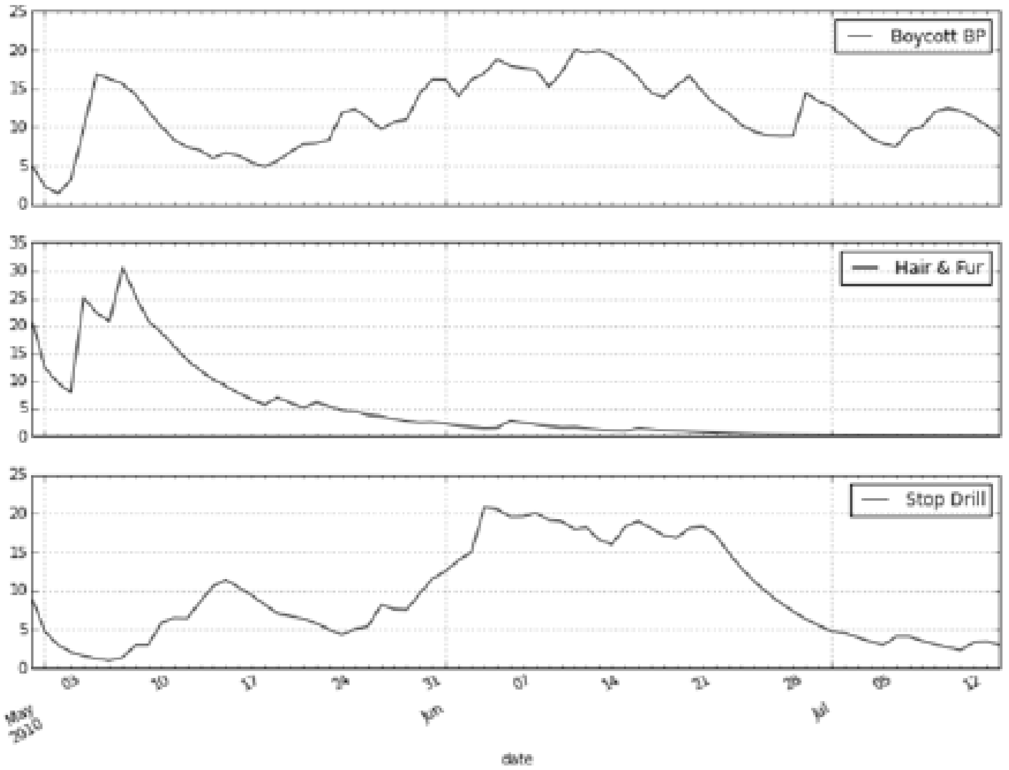
- Evidence of activities and events that are logged and stored digitally.
  - Many things people do these days involves or is mediated by digital technologies.
- Historically, text data such as emails, transaction data from enterprise systems, and posts and comments on social media and networking platforms are all forms of digital trace data.
- Today, bio health data recorded by wearables, logs produced by digital objects such as toothbrushes and energy meters, and traces generated by digital objects such as electric vehicles are also forms of digital trace data.

Examples: research with digital traces

- Vaast, E., Safadi, H., Lapointe, L., & Negoita, B. (2017). Social Media Affordances for Connective Action: An Examination of Microblogging Use During the Gulf of Mexico Oil Spill. MIS Quarterly, 41(4), 1179-1205.
- analyzed more than 23,000 tweets that carried the hashtags #oilspill or #bpoilspill
- First study that showed that individuals engaged in collective action by coproducing and circulating social media content based on an issue of mutual interest.

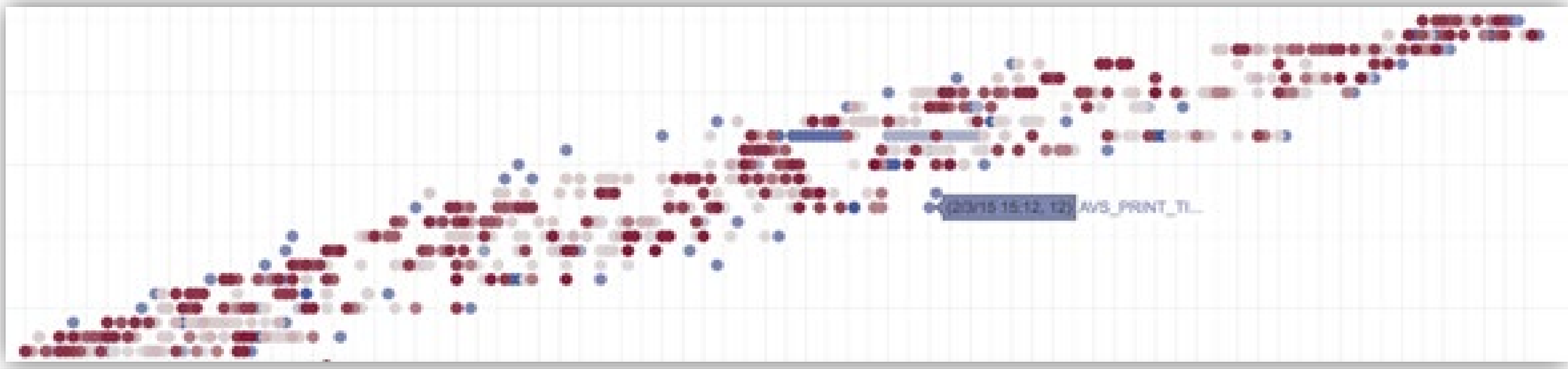
Examples: research with digital traces

Stop the drill	Boycott BP	Hair and Fur
Encouraging efforts to stop offshore drilling, often via the signature of online petitions.	Encouraging people not to remain customers of the company widely perceived as at the origin of the oil spill.	Encouraging the collection of hair and fur to create boons that absorb oil spreading in the sea.
“#oilspill knows no mercy for anyone or anything – national parks threatened by #oil http://bit.ly/bLijyf #stopthedrill” “Yes! to a permanent FL drilling ban - Video: http://youtu.be/8L9ML1Q_wvs #oilspill #sayfie”	“Declare your Oil Independence on Independence Day Weekend. Boycott #BP. Oil Spill #boycottbp #oilspill” “If only the seafood in the Gulf/Keys were basting in olive & not crude oil. But nooooo. #oilspill #FAIL #BoycottBP”	“Fight the #oilspill: cut your hair http://bit.ly/bWCqhi RT” “GREAT to SEE! People R clicking the link to donate hair or fur to save Gulf Coast wetlands http://bit.ly/oilboomhair #oilspill”
701 tweets, 500 tweeters	897 tweets, 602 tweeters	284 tweets, 258 tweeters

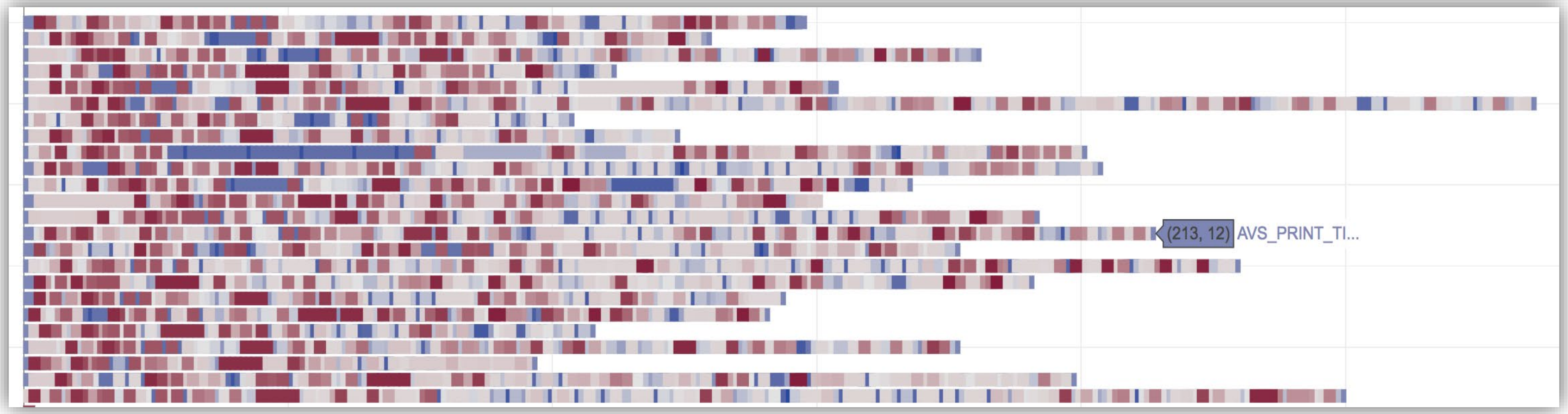


One day at the U. of Rochester dermatology clinic

Pentland, B. T., Recker, J., Ryan Wolf, J., & Wyner, G. (2020). Bringing Context Inside Process Research With Digital Trace Data. *Journal of the Association for Information Systems, 21(5), 1214-1236.*



Clock time



Event time

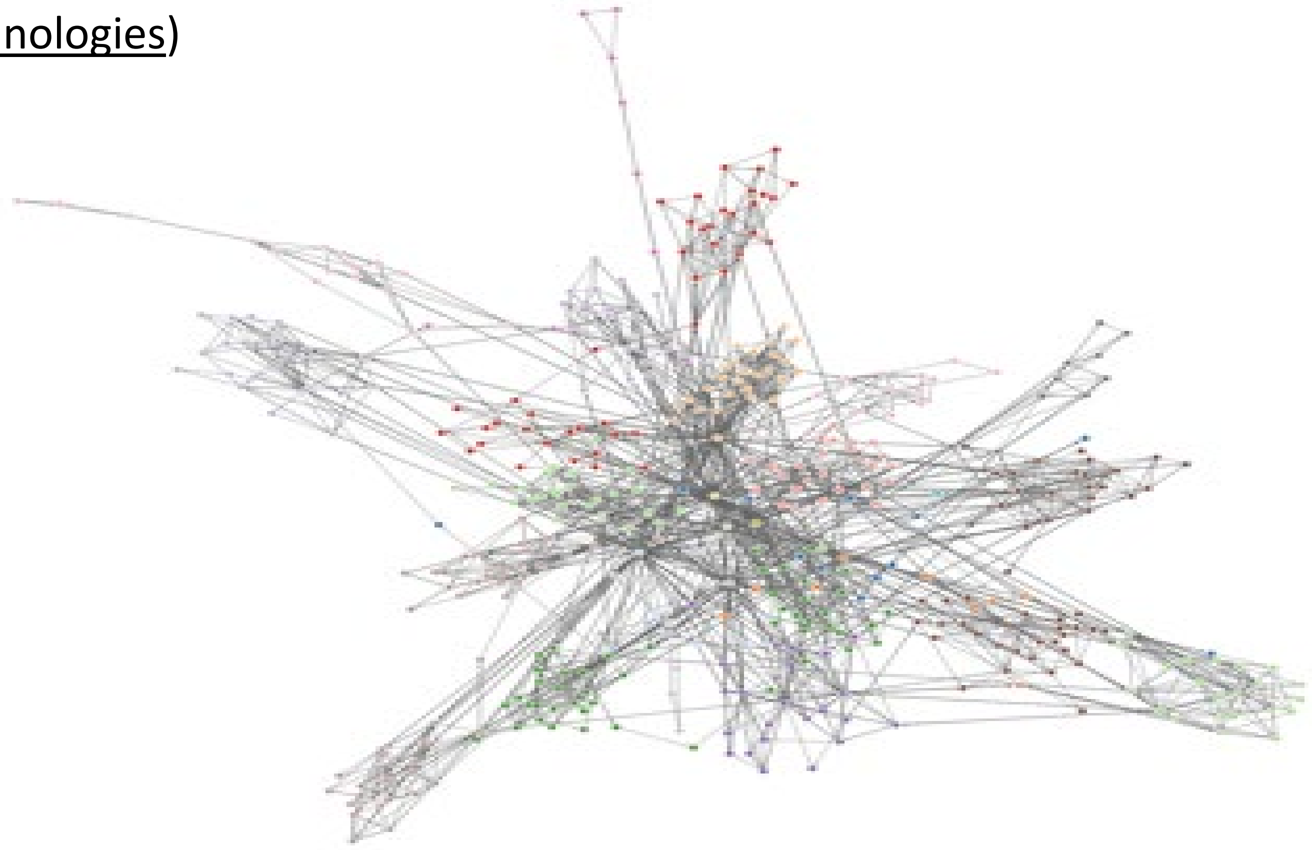
Figuring out what‘s going on.

Social Network
(relationships between involved <u>actors</u>)

Narrative Network / Process model
(relationships between involved <u>actions</u>)

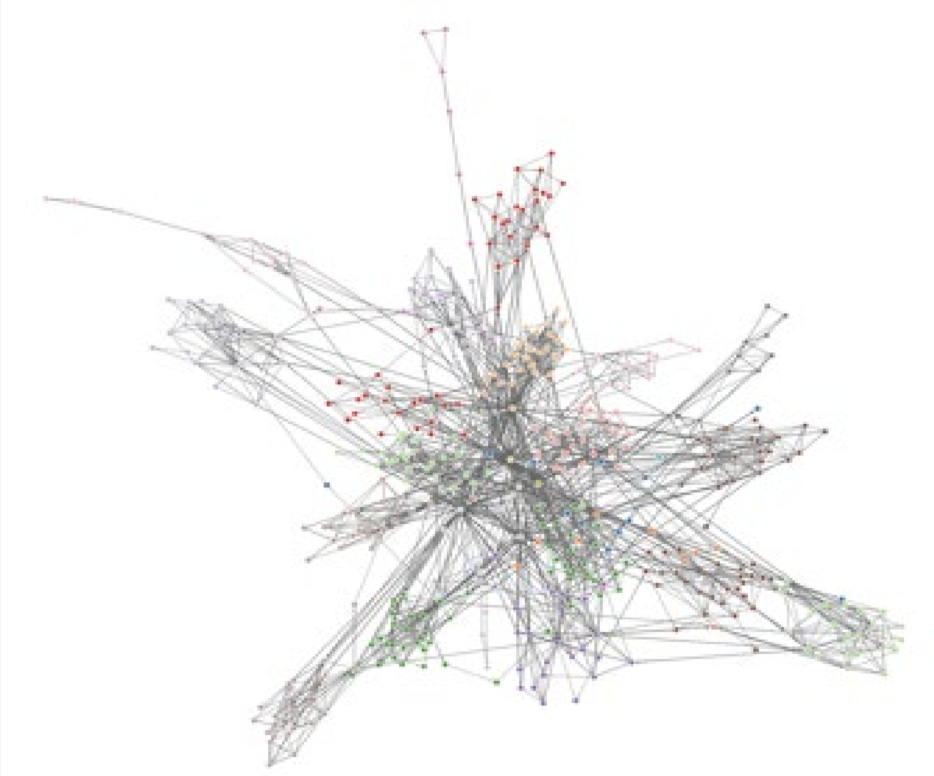
Figuring out what‘s going on.

Affordance Network
(actions carried out by actors using technologies)

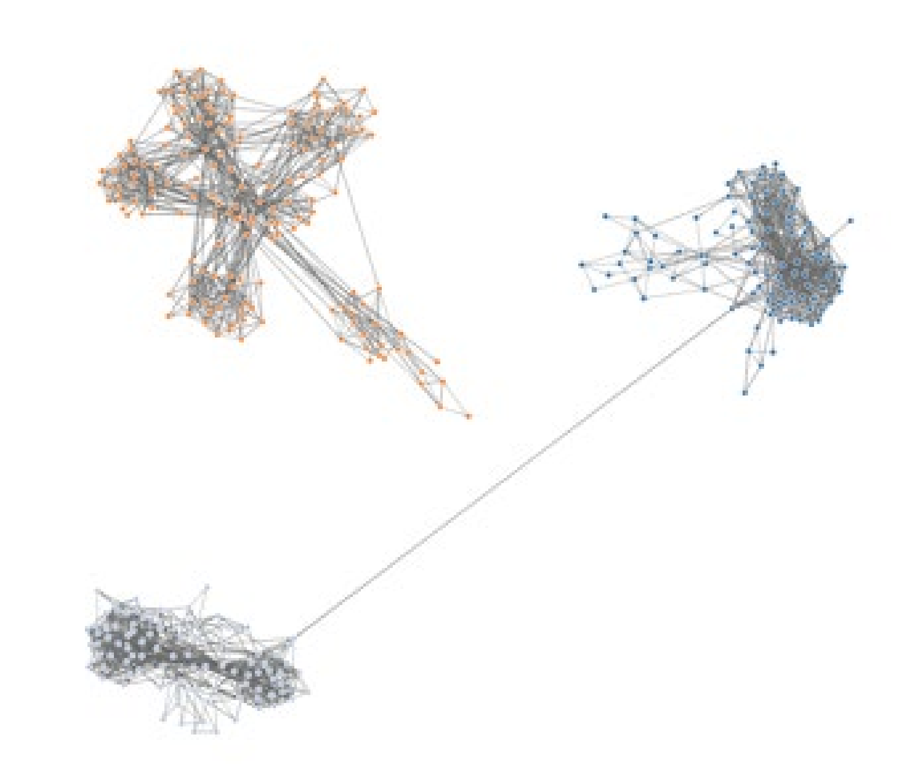


Adding context unravels the graph.

(a) Affordance network



(b) Affordance network plus “location”



Digital trace data is difficult research data

- Digital trace data is **organic, not designed**: a byproduct of activities, not data generated for the purpose of research.
  - They appear organically and researchers “find” and collect them.
  - Researchers have less control over the validity of organic data than they do over designed research data because the data-generation process is opaque (or even unknown), and we have little to no control over that process.
  - For example, we do not know why, how, or in what context some Twitter posts in a conversation were made.

Digital trace data is difficult research data

- Digital trace can be both **heterogeneous and unstructured**: they often include text, images, video, or sound.
  - The richness of such data can be a strength because it expands the number of perspectives of a phenomenon
  - But it also makes the data more difficult to analyze.

Digital trace data is difficult research data

- Digital trace can be **enormous in volume**: it typically records fine-grained events and actions such as individual clicks, posts, and comments.
  - provides a more precise view of behaviors and occurrences than traditional modes of collection
  - But the sheer size of the data can also quickly become overwhelming for scholars.
    - Example: it is not feasible to manually code comments made by the 257 million followers of Christiano Ronaldo on Instagram.

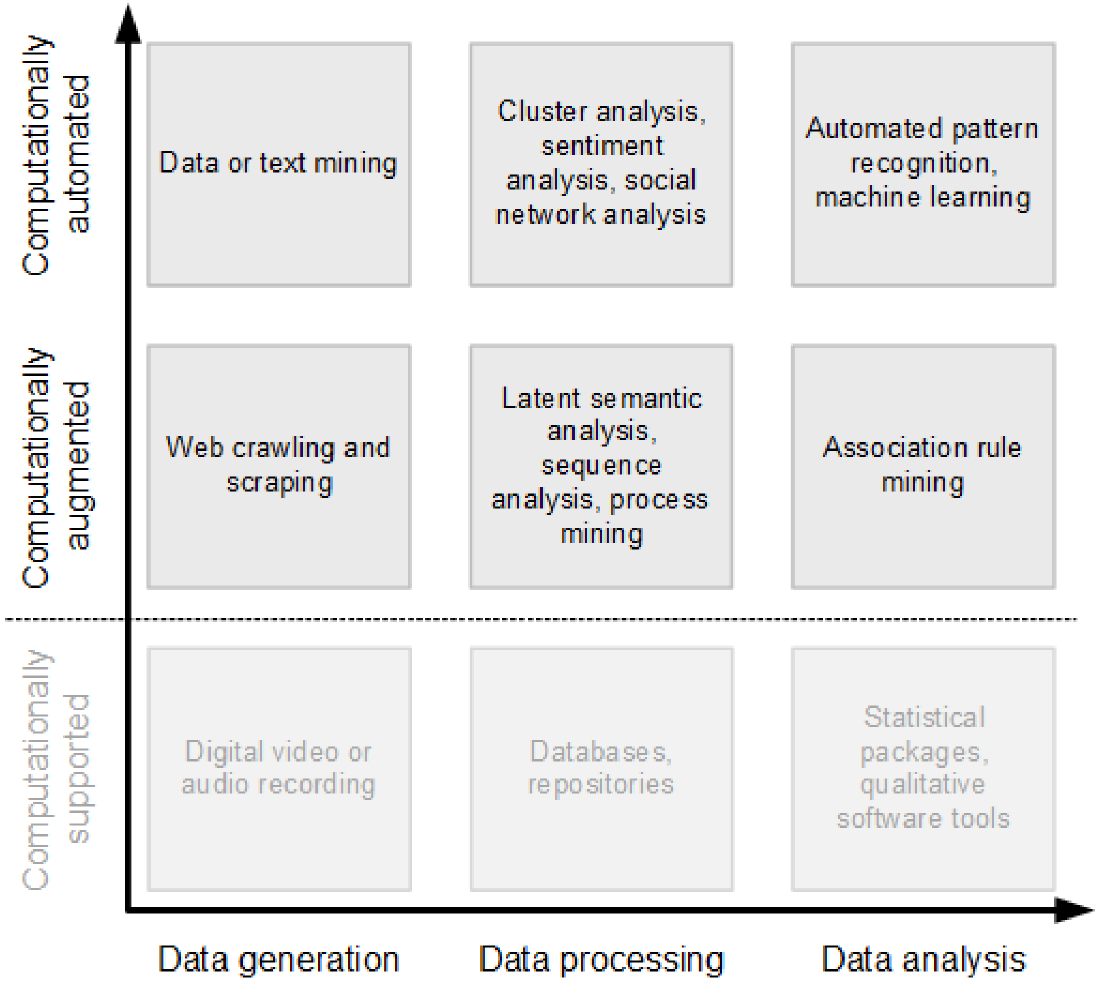
Digital trace data is difficult research data

- Digital trace is **inherently event-based**: it connects actions and behaviors that are enabled or mediated by digital technologies as they unfold at various points in time.
  - Time-stamps are great because they allow analysis of temporal aspects (dynamics, change, transformation, exceptions, etc.)
  - But it is also notoriously difficult to analyse with standard scientific analysis tools.

Computational Data Processing and Analysis

- Techniques and tools that have in common that certain steps during data generation, processing, or analysis are carried out through—or with the help of—algorithms that either augment manual work or fully automate an otherwise manual activity.

Overview



Computationally automated
Computationally augmented
Computationally supported
Data or text mining
Cluster analysis, sentiment analysis, social network analysis
Automated pattern recognition, machine learning
Web crawling and scraping
Latent semantic analysis, sequence analysis, process mining
Association rule mining
Digital video or audio recording
Databases, repositories
Statistical packages, qualitative software tools
Data generation
Data processing
Data analysis

Computational support tools

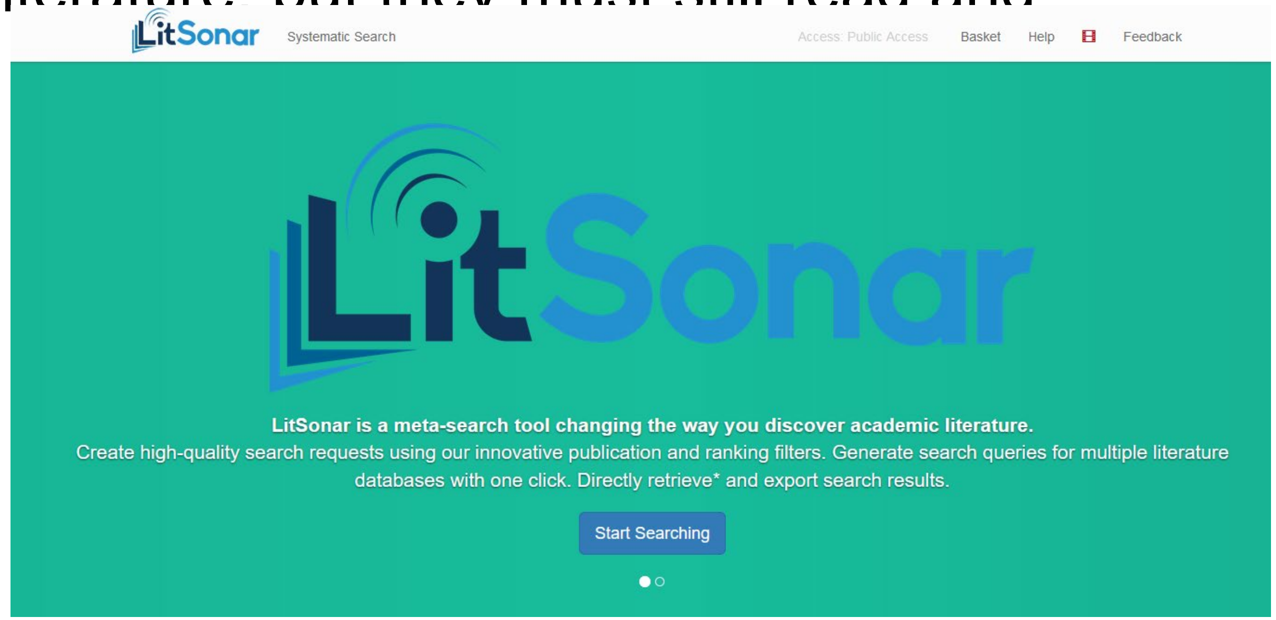
- Assist researchers in carrying out their work through dedicated research computer software.
- The software tools do not carry out the steps involved in the research but support scholars in carrying them out in the sense that they assist manual activities and make them easier or faster to complete.
- Examples for data generation: Skype and Zoom can record video and audio streams digitally
- Examples for data analysis: R, SPSS, LISREL, Nvivo, Atlas.TI

Computational augmentation tools

- Software that is used to complement and amplify human activity, rather than to supplant it.
- Example data analysis:
  - statistical software packages such as LISREL automatically make suggestions for (re-) specifying a hypothesized model based on shared correlations between the latent constructs it discovers in the covariance matrix of observed data.
  - Researchers may implement these suggestions or not; because the suggestions are empirically based, they may or may not be conceptually logical or plausible.
- Example data generation:
  - researchers often write scripts that help them process a web document and extract information from it (scraping) or assist them in iteratively finding and fetching web links beginning with a list of seed web domains (crawling).

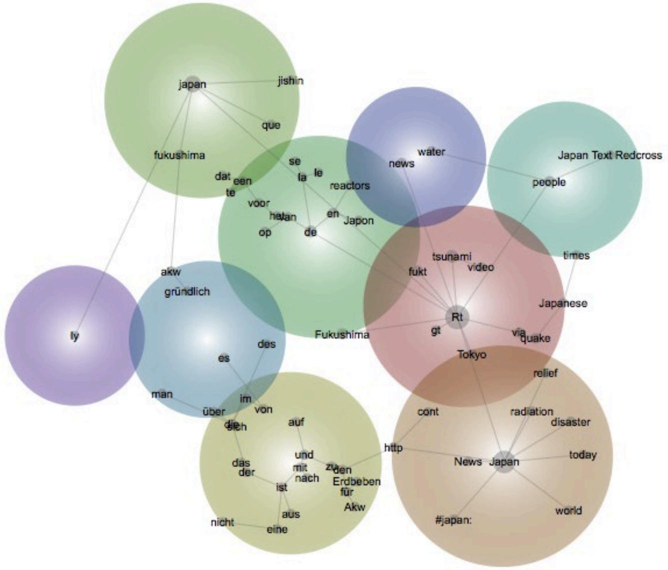
Computational augmentation tool: Example LitSonar

- http://www.litsonar.com/
- A literature search algorithm that can scan millions of documents for the presence of keywords
- Helps researchers to identify related literature, but they must still read and assess the papers for relevance.



Computational augmentation tool: Example Leximancer

- https://www.leximancer.com/
- A text analysis for in-depth analysis of the text.
- Produces concepts mads that allows researchers to explore a concepts in texts.
- Researchers must still interpret the outcomes.



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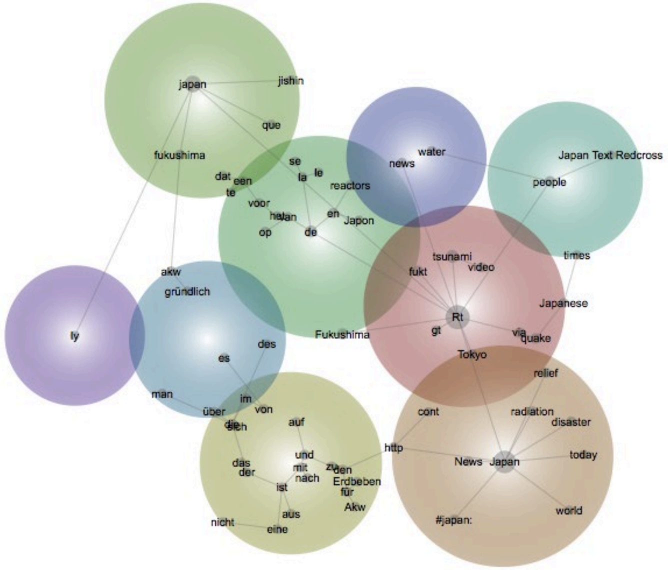


Automated Concept Analysis: Example Leximancer

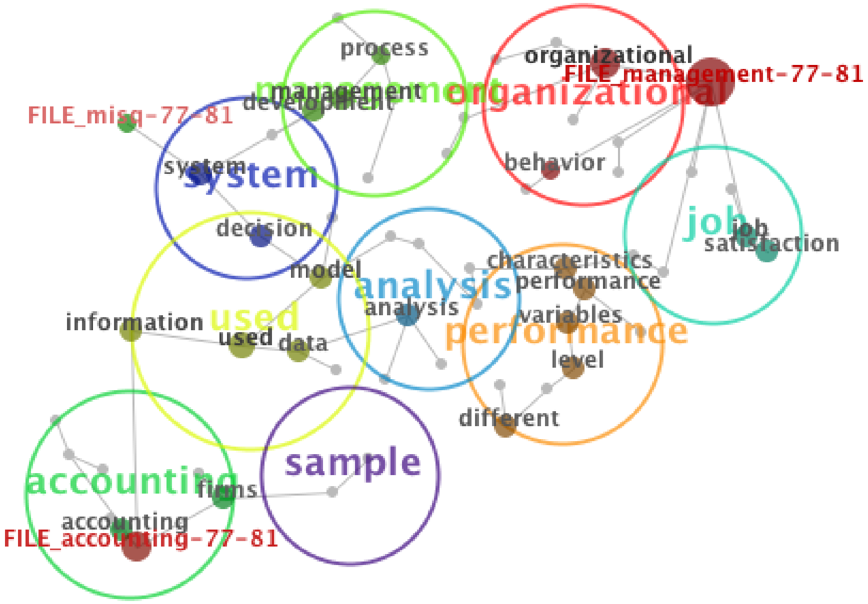
What do business journals publish?

Fields and Journals	Years	No of Abstracts
Information Systems		
Information Systems Research [ISR]	1990-2001	258
MIS Quarterly [MISQ]	1977-2001	607
Management		
Academy of Management Journal [AMJ]	1977-2001	1938
Academy of Management Review [AMR]	1977-2001	1236
Administrative Science Quarterly [ASQ]	1977-2001	736
Strategic Management Journal [SMJ]	1980-2001	1167
Accounting		
Accounting Review [AR]	1977-2001	1200
Journal of Accounting & Economics [JAE]	1977-2001	442
Journal of Accounting Research [JAR]	1977-2001	960
Total	**1977-2001**	**8544**

Indulska, M., Hovorka, D.S., and Recker, J. "Quantitative Approaches to Content Analysis: Identifying Conceptual Drift Across Publication Outlets," *European Journal of Information Systems (21:1) 2012, pp 49-69.*

Movement of themes over time

In IS journals 1977-1981



Theme	Connectivity	Relevance
organizational	100%	
performance	97%	
used	95%	
management	88%	
accounting	68%	
job	68%	
analysis	63%	
system	47%	
sample	14%	

THEME: organizational
(organizational)

organizational ***(Hits: 777***

For organizational questions, ceremonial citation should be turned into substance. ***Heavy*** reliance on self-report has excluded crucial populations from organizational inquiry, postponed cross-checking of propositions, inflated the apparent effects of minor irritations in the workplace, and imposed a homogeneity of method that raises the notion that the findings of the field are method-specific.

more...

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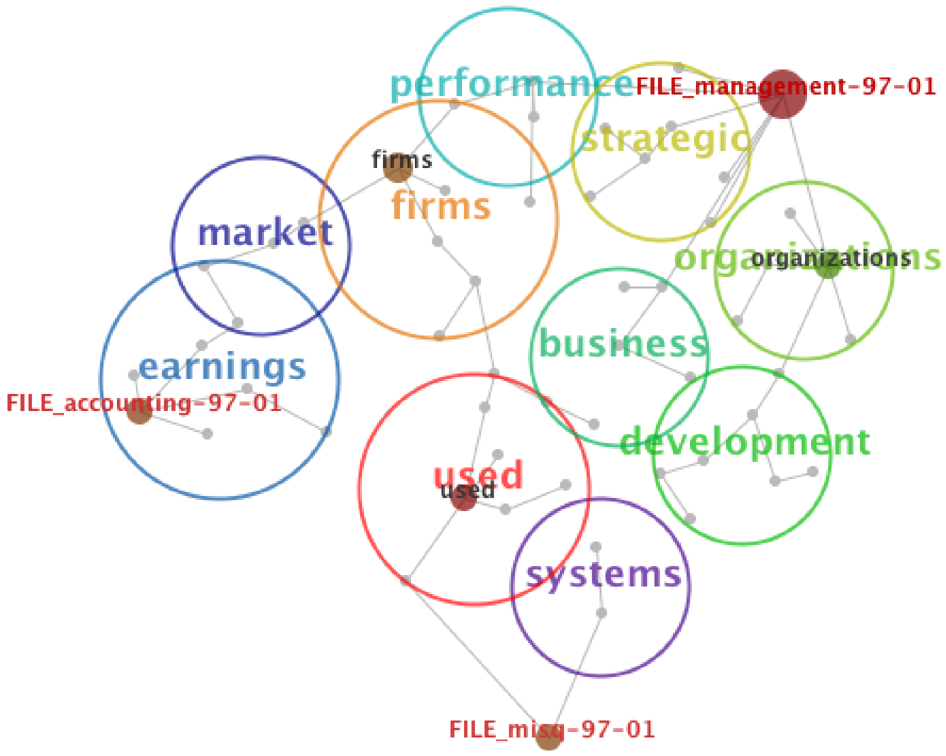
THEME: performance
(performance)

Movement of themes over time

In IS journals 1997-2001



Theme	Connectivity	Relevance
used	100%	
firms	82%	
strategic	53%	
organizations	53%	
development	53%	
business	46%	
performance	44%	
earnings	39%	
market	23%	
systems	21%	

THEME: used
(used)

used ***(Hits: 724)***

COLUMN: drawing-on-propositions-from-social-identity-theory-and-signaling-theory,-a-study-hypothesized-that-firms'-corporate-social-performance-(csp)-is-related-positively-to-their-reputations-and-to-their-attractiveness-as-employers.-the-results-indicate-that-independent-ratings-of-csp-are-related-to-firms'-reputations-and-attractiveness-as-employers,-suggesting-that-a-firm's-csp-may-provide-a-competitive-advantage-in-attracting-applicants.-such-results-add-to-the-growing-literature-suggesting-that-csp-may-provide-firms-with-competitive-advantages.
Is the ***Internet*** a superhighway to information or a high-tech extension of the home telephone? We address this question by operationalizing information acquisition and entertainment as the use of the ***World Wide Web*** and interpersonal communication as the use of electronic mail (e-mail), and examine how 229 members of 110 households used these services during their first year on the ***Internet***.

Identifying concept drift

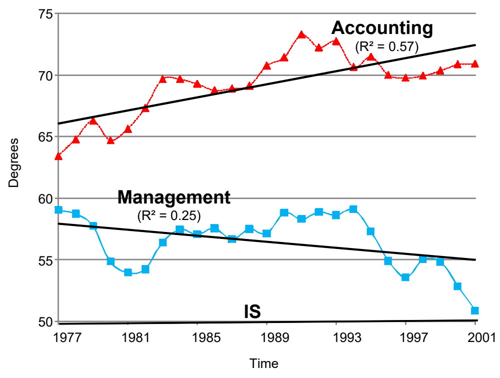


Figure 3a: Information Systems vs. Accounting and Management Journal Abstract Samples

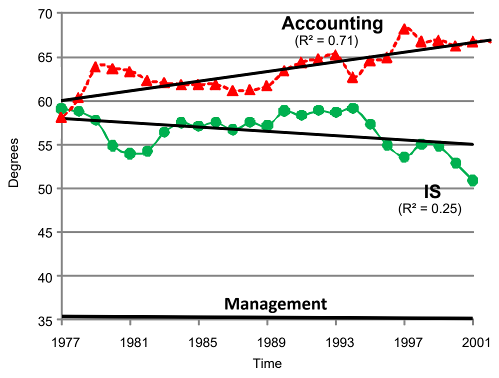


Figure 3b: Management vs. Information Systems and Accounting Journal Abstract Samples

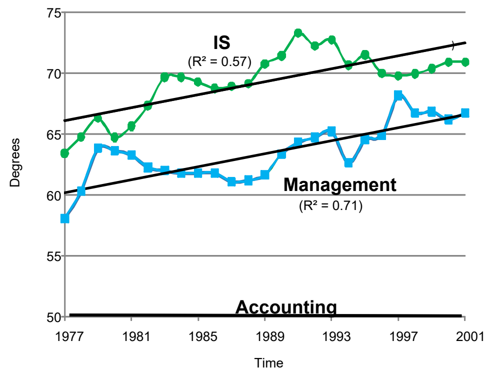


Figure 3c: Accounting vs. Information Systems and Management Journal Abstract Samples

Computational automation tools

- Software tools that carry out **algorithmic data generation, processing, or analysis** with little to no human intervention or oversight.
- Examples:
  - Text mining automatically extracts information from text through algorithms that extract and parse text, classify text, derive patterns in text, and evaluate and display text using statistics, graphs, and/or visual diagrams.
  - Social network analysis uses algorithms that automatically parse person-relational data, categorize them based on statistical properties, and display the information statistically and/or graphically.
  - Supervised or unsupervised machine learning algorithms can automatically find patterns and relationships in the data that would be unlikely to find manually.

Advantages and Challenges of Computational Methods

- **Advantages**
  - can substantially expand the reach and scope of research
  - can take substantially less time than manual execution of research tasks
  - can increase the reproducibility of data processing and analysis and help reduce human biases in these tasks
- **Challenges**
  - few clear and robust methodological guidelines available
  - make it challenging to focus on and account for the context(s) in which digital trace data were generated
  - Data validity threats from errors in algorithmic outputs, benign errors from relying on probabilistic algorithms such as random search, and lack of generalizability and replicability

Mixed Methods

Mixed Methods

- A type of inquiry that features the sequential or concurrent combination of methods for data collection and analysis.

  - Historically: mixing of methods from quantitative and qualitative research traditions
  - Nowadays: increasingly also mixing of methods from other traditions, such as design plus quantitative methods or computational plus qualitative methods.

Aims of Mixing Methods

1. Strengthening inferences,
2. Providing a greater diversity of views, and
3. Enabling researchers to answer confirmatory and exploratory questions simultaneously (verifying and generating theory at the same time)

- In other words: Mixing methods tries to
  - leverage the complementary strengths of research methods and mitigate their weaknesses
  - offer deeper insights into a phenomenon than each of the methods alone could provide

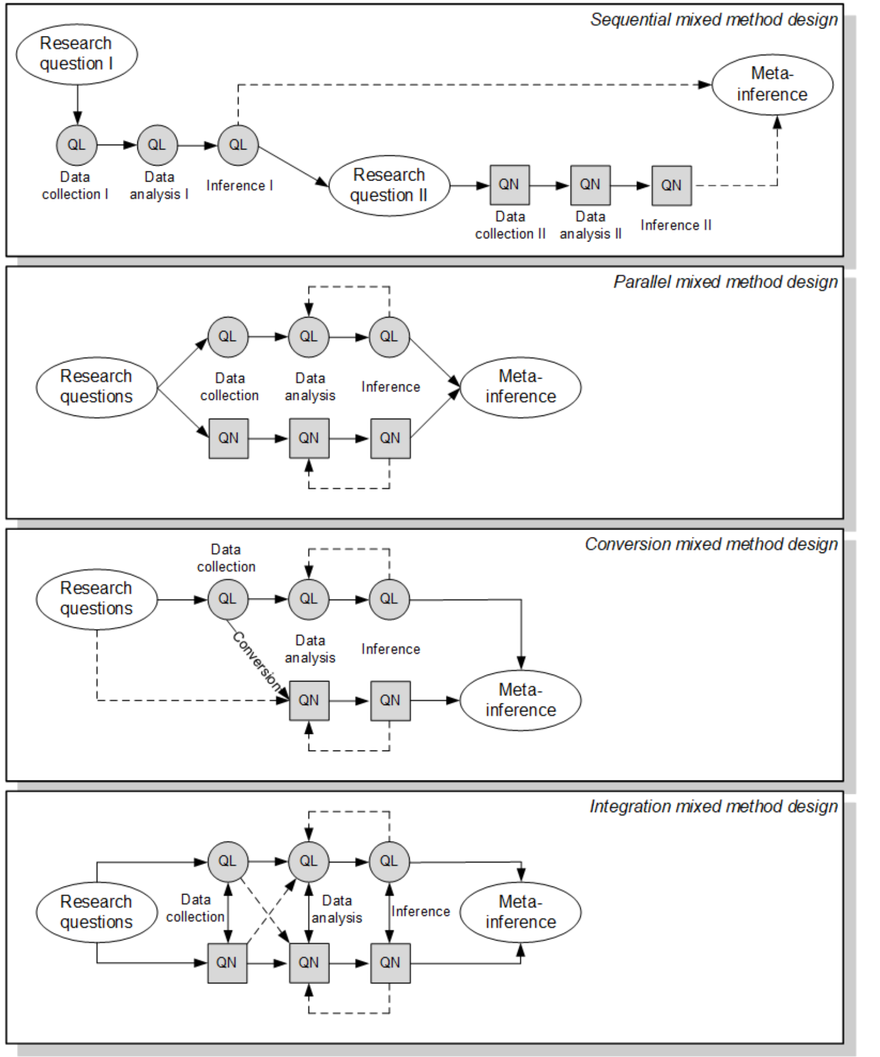
Five Main Different Purposes of Mixing Methods

- **Triangulation**
  - establish convergence of, and corroborate results from, multiple methods and designs used to study the same phenomenon
- **Complementarity**
  - elaboration, enhancement, illustration, and clarification of the results from one method with results from another method
- **Initiation**
  - finds paradoxes and contradictions in one study that lead to a re-framing of the research questions using a different method
- **Development**
  - uses the findings from one method to help inform the other method.
- **Expansion**
  - used to expand the breadth and range of research by using different methods for different components of an inquiry

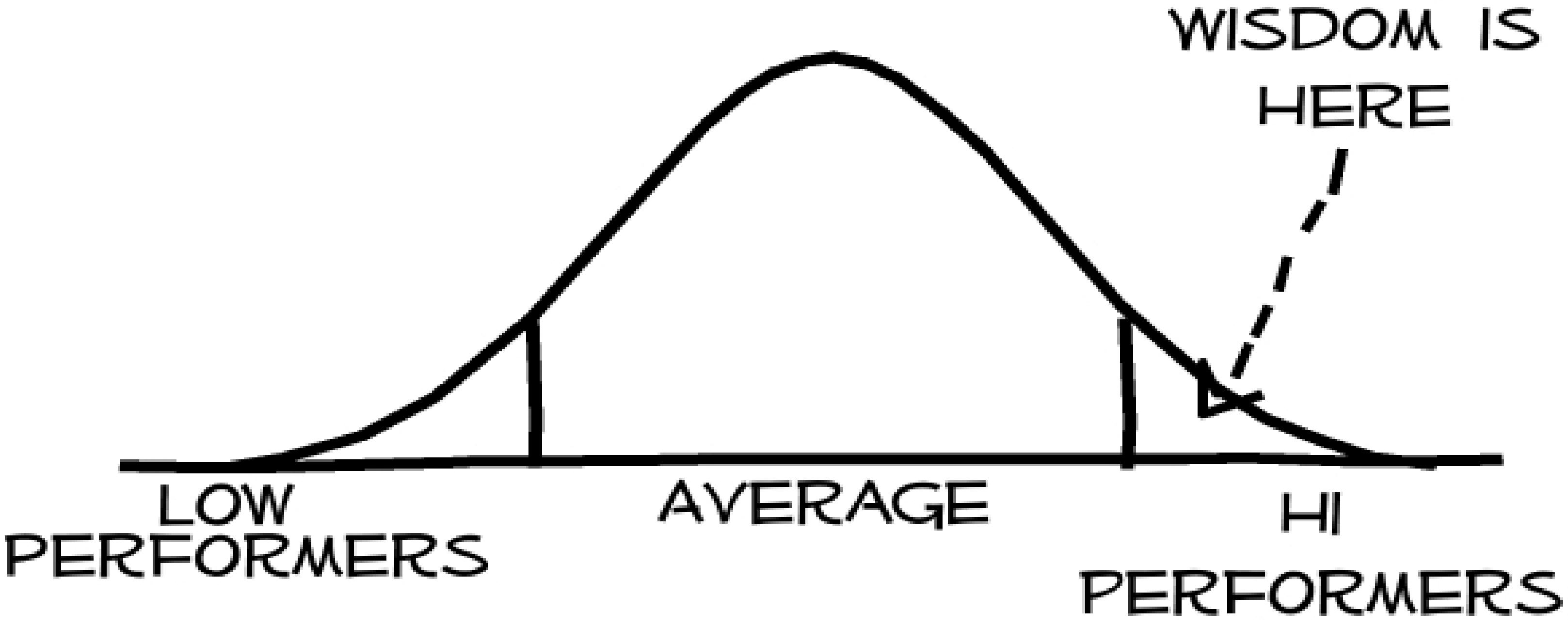
Venkatesh, V., Brown, S.A., and Bala, H. "Bridging the Qualitative-Quantitative Divide: Guidelines for Conducting Mixed Methods Research in Information Systems," *MIS Quarterly (37:1) 2013, pp 21-54.*

Mixed Method Designs

- Key design component: *Timing*
- the temporal ordering of the phases in which the methods are carried out:
  - **sequential** (one after another),
  - **parallel** (both separately but concurrently),
  - **conversion** (data from one method is transformed to be used with another method),
  - or **fully integrated** (all at once).

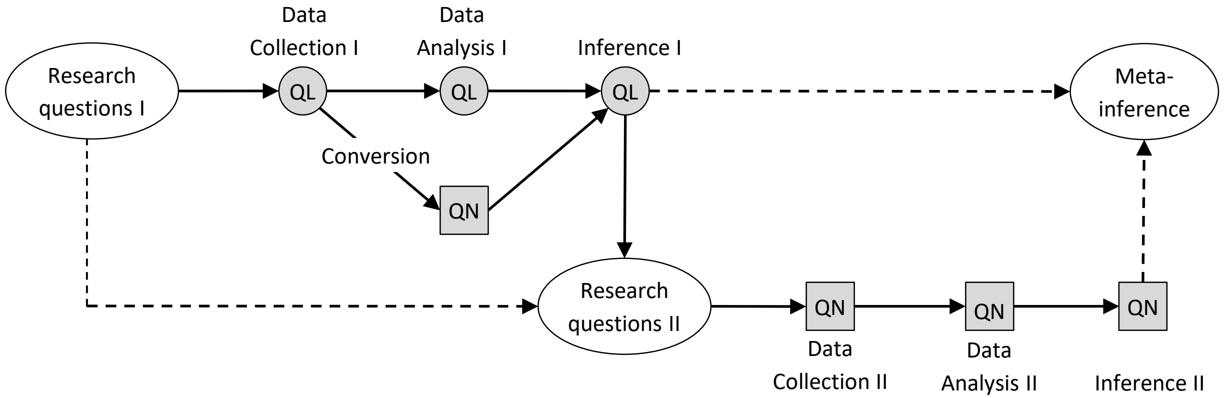


Remember: Positive Deviance

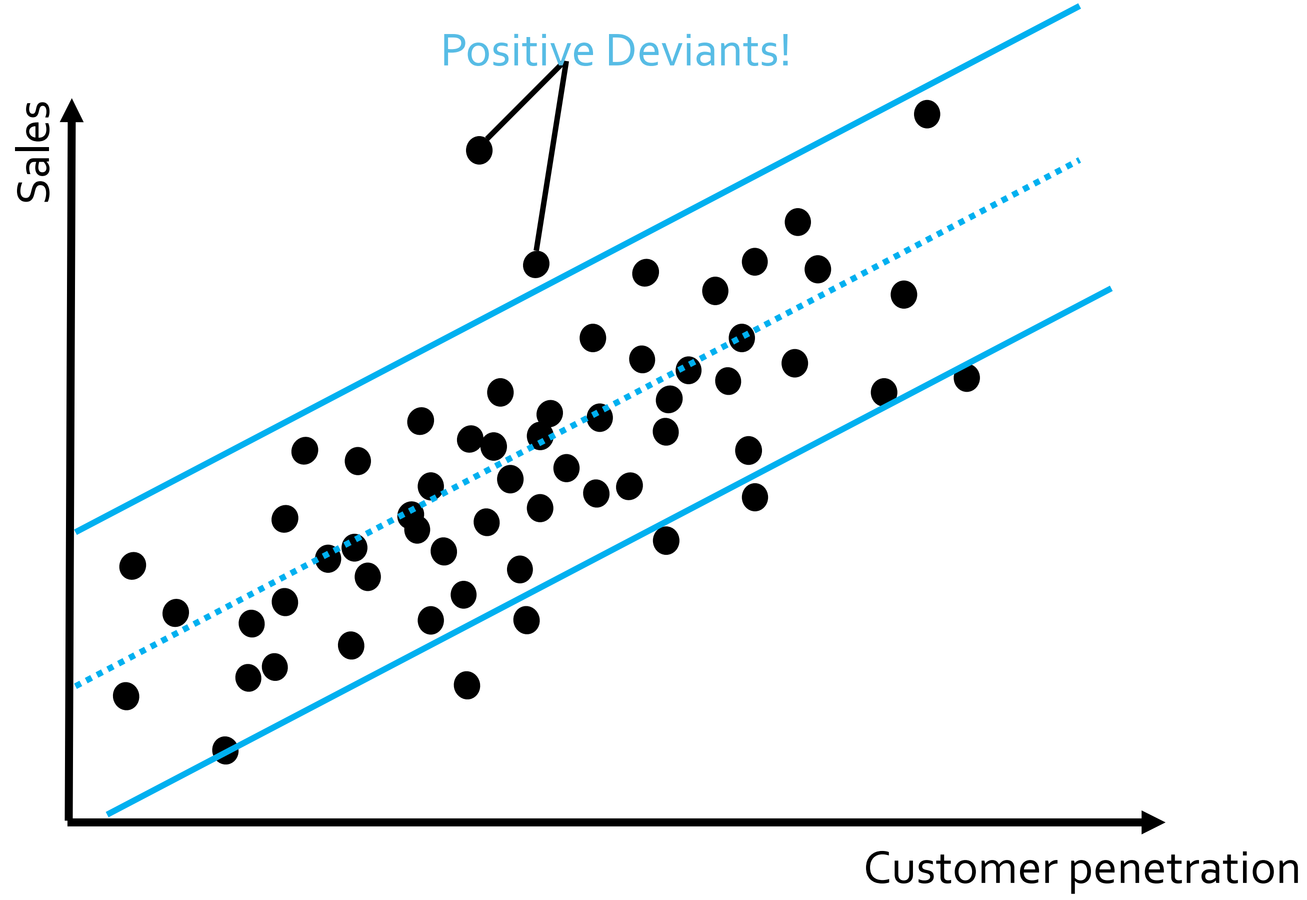


Mixed Method Design

- Study of Positive Deviance, Management and Leadership
- Involved qualitative exploration of 19 stores across Australia
- Measurement development and theorizing through engagement with literature
- Cross-sectional multi-level survey (managers and dept. managers)



Sampling



Conduct

Mixed Method Findings

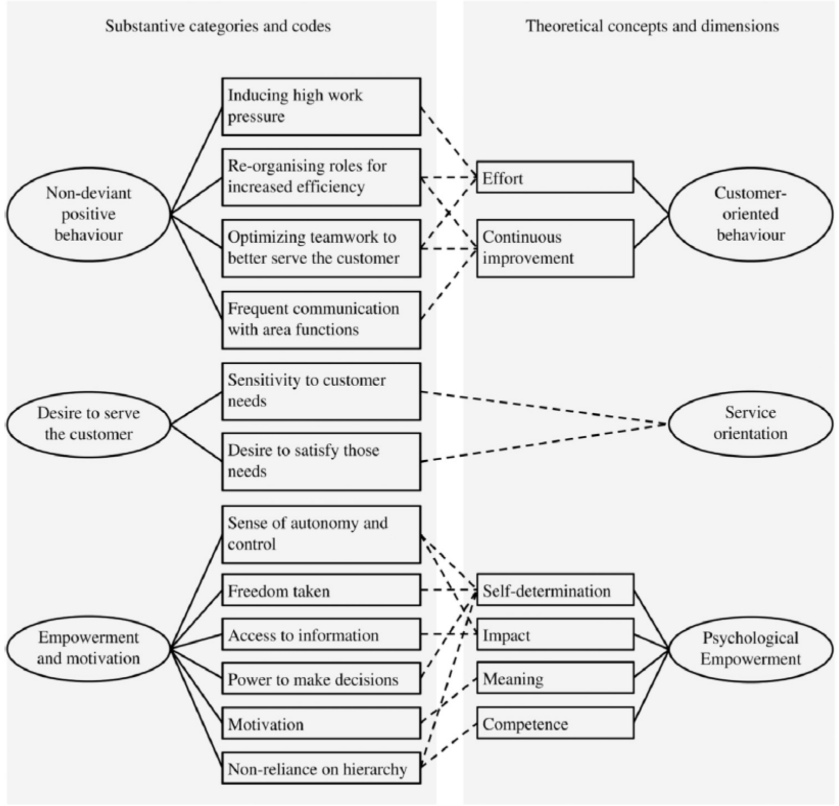


Fig. 2. Mapping of substantive categories and open codes to the dimensions of the identified theoretical constructs derived from the lite

Table 6
MANCOVA results.

Effect type	Factor	Statistic	Multivariate effect	Contribution to store sales	Customer penetration
Fixed factors	Progressive price reduction	Roy's largest root	0.13		
		$F(2,97)$–$F(2,97)^a$	6.05**	5.77**	4.06*
	Actively exchanged knowledge	Roy's largest root	0.13		
		$F(4,97)$–$F(4,97)$	3.08*	2.52*	1.02
	Education: baker by trade	Roy's largest root	0.00		
		$F(2,96)$-$F(1,97)$	0.07	0.06	0.15
Covariate	Reduced bread on shelf towards the end of the day	Roy's largest root	0.10		
		$F(2,96)$–$F(1,97)$	4.62*	8.26**	1.41
Interaction effects	Education × price reduction	Roy's largest root	0.09		
		$F(2,97)$–$F(2,97)$	4.39*	2.34	0.03
	Education × knowledge exchange	Roy's largest root	0.11		
		$F(4,97)$–$F(4,97)$	2.57*	2.05	0.92
	Education × on-shelf reduction at end of day	Roy's largest root	0.10		
		$F(2,96)$–$F(1,96)$	0.49	0.38	0.98

[a] The first F(df1, df2) refers to the multivariate F-test, the second to the univariate tests of between-subject effects.
* $p < .05$.
** $p < .01$.

Mertens, W., Recker, J., Kummer, T.-F., Kohlborn, T., Viaene, S. (2016): Constructive Deviance as a Driver for Performance in Retail. Journal of Retailing and Consumer Services, Vol. 30, pp. 193-203.

Mixed Method Designs

- Other important design decisions:
  - **Weighing** (deciding whether to give the quantitative and qualitative components of a mixed study equal status or to give one paradigm the dominant status);
  - **Mixing**, which can form a continuum from mono-method to fully mixed methods; and
  - **Placing**, that is, deciding where mixing should occur (in the research questions, data collection, data analysis, or data interpretation).

Mixed Method Design Particularities

- **Data transformation**
  - Data must be transformed between data formats to suit the differing analysis techniques
  - Typically needed in concurrent, conversion, and integration mixed method research
  - Examples:
    - qualitative data (e.g., codes) may have to be quantified (e.g., by counting the frequency of occurrence in text)
    - quantitative data may have to be qualified (e.g., annotated with text)

Mixed Method Design Particularities

- **Data correlation**
  - Data about the same phenomenon collected using multiple methods must be compared with a view to identifying triangulation outliers that may require further analysis.
  - often achieved using a data matrix that combines a quantitative axis and a qualitative axis to identify similarities and differences.

Mixed Method Design Particularities

- **Legitimation**
  - the description of the steps undertaken to ensure the validity, accuracy, and/or plausibility of meta-inferences.
  - The quality of meta-inferences depends on the strength of inferences that emerge from the study's individual methods.
    - The individual inferences can be divergent, convergent, or complementary, each of which require legitimation.

Strengths and Weaknesses of Mixed Method Research

Strengths	Weaknesses
Words, pictures, and narrative can be used to add meaning to numbers.	It can be difficult for a single researcher to carry out both qualitative and quantitative research, especially if two or more approaches are to be used concurrently.
Numbers can be used to add precision to words, pictures, artefacts, and narrative.	The researcher has to learn about multiple methods and approaches and learn how to mix them appropriately.
The research can benefit from the individual strengths of different research methods.	Methodological purists contend that one should always work within either a qualitative or a quantitative paradigm.
The researcher can more easily generate and rigorously test a theory.	Mixed method research is typically more resource-intensive than research that uses a single method and may require a larger research team.
Mixed method research can answer a broader and more complete range of research questions.	Mixed method research is typically more time consuming than mono method research.
Mixed method research can be used to provide stronger evidence for a conclusion.	Some of the details of mixed research remain to be worked out fully by research methodologists.
Mixed method research can be used to increase the generalisability of results.	Mixed method research can be difficult to publish (e.g., because it requires more space).

Examples of mixed method research

- Wunderlich, P., Veit, D. J., & Sarker, S. (2019). Adoption of Sustainable Technologies: A Mixed-Methods Study of German Households. *MIS Quarterly, 43(2), 673-691.*

- Spiegel, O., Abbassi, P., Zylka, M. P., Schlagwein, D., Fischbach, K., & Schoder, D. (2016). Business Model Development, Founders' Social Capital and the Success of Early Stage Internet Start-Ups: A Mixed-Method Study. *Information Systems Journal, 26(5), 412-449.*

- Califf, C. B., Sarker, S., & Sarker, S. (2020). The Bright and Dark Sides of Technostress: A Mixed-Methods Study Involving Healthcare IT. *MIS Quarterly, 44(2), 809-856.*

- Mertens, W., Recker, J., Kummer, T.-F., Kohlborn, T., & Viaene, S. (2016). Constructive Deviance as a Driver for Performance in Retail. *Journal of Retailing and Consumer Services, 30, 193-203.*

End of Chapter 5