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IN5140

Smart processes and agile methods in Software Engineering

Group session 6

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Agenda

First hour:

- Recap

Second hour:

- Previous exam questions

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Recap from the lecture

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Emprical Research & Evidence-Based Software Engineering (EBSE)

- What is emprical research?
- How should we interpret empirical evidence while recognizing both its possibilities and its limitations?
- Why is falsifiability important in research?
- Why do we use EBSE?
- What are the five steps of EBSE?
- Explain research synthesis.

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Empirical Research Methods

- Give a clear definition along with its advantages and disadvantages.
  - Controlled Experiments
  - Case studies
  - Surveys
  - Action Research (AR)

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Validity and Reliability & Importance of context

- Explain Reliability and why is it important in research?
- What are the four types of Validity?
- Name three methdological features that influences resarch results, and explain how they matter?
- Why does context play such a big role in interpreting reserach findings?

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15 minute ☕ break

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Previous exam questions

2

[2016]Describe strengths and shortcoming of a survey in research?

Strength: Easy to get high quantity Weakness: Little to no depth in answers

Many answers give a broader generalisation, but people might lie or misunderstandings regarding the questions might occur.

Can be conducted remotly and on a large sample size. Difficult to ensure that people answer truthfully

Strength: you get a wide range of data covering a big population Shortcoming: the data is not necessarily in-depth, and you can never be sure that people answered 100% honestly

Strengths: a lot of data relatively quickly and from a lot of different people Shortcoming: not much depth in the data, and unable to aks follow-up questions

With a survey we can get results from a wide population and get an understanding of the general feelings. The disadvantege is that is limited and the answer can be less detailed

strength: can reach a large amount participants across countries and continents. shortcoming: cant control if the participants answers are based on bias/feelings or based on facts

Surveys are cost-effective and can reach large samples quickly, providing standardized and quantifiable data. However, they may yield superficial, biased, or unreliable self-reports, and results depen

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Describe strengths and shortcomings of a survey in research?

Strengths:

- Survey is a powerful tool which can provide insight on phenomenon(s), but lacks details and does not allow to drill into observed data
- Can reach a lot of people

Shortcomings:

- Does not reveal meanings, and the important details behind each answer
- Participants might rush through

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Surveys

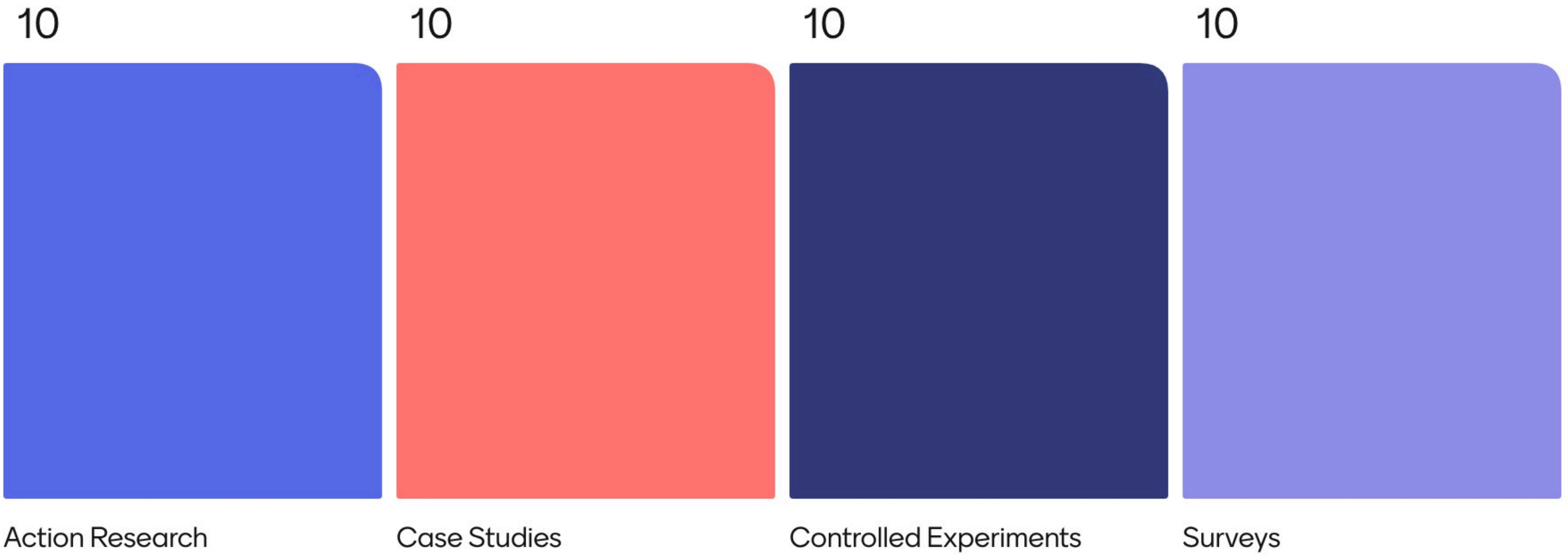
Advantages

- They provide a wide an inclusive coverage of people or events
- They can be administered from remote locations using mail, email or telephone
- They can provide a lot of data in a short time at a reasonable cost
- They lend themselves to quantitative analysis
- They can be replicated
- Usually, high reliability is easy to obtain

Disadvantages

- They lack depth
- They tend to focus on what can be counted or measured
- They do not establish cause and effect
- They cannot judge the accuracy or honesty of people's responses by observing their body language

[2023]From the list below, select all the emprical reserach methods



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[2019]What is construct validity?

Construct validity is the extent to which a test or survey actually measures the concept (construct), it is intended to measure, rather than something else

Construct validity is how well a test or measurement actually measures the concept it is intended to measure.

How good are the constructs for different concepts and are the measurements reliable

Checking if the the methodology the research or experiments up to the point of getting conclusion are valid or not?

does the method actually measure the concept it is meant to measure

good question... If the research represent the problem

how much the measurments in a study represents what they are meant to measure

Construct validity is how well a measurement actually measures the concept intended to measure

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[2019]What is construct validity?

It's about whether you measure what you are supposed to measure

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Reliability, Validity

Reliability and validity of empirical studies

- **Reliability**
  - Can the study can be repeated (i.e., by other researchers) and yield the same results?
- **Statistical conclusion validity**
  - Is the statistical inference valid?
- **Internal validity**
  - Does the observed covariation between *A* (the presumed treatment) and *B* (the presumed outcome) reflects a causal relationship from *A* to *B*?
- **Construct validity**
  - Do the measures in the study represent the (abstract, possibly theoretical) constructs they are intended to measure?
- **External validity**
  - Does the cause–effect relationship hold over variations in persons, settings, treatment variables, and measurement variables?

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[2022]briefly explain the difference between reliability and validity of emprical studies

Reliability = consistency.
validity = accuracy

If a study is reliable, it is reproduceable - you get approx the same result if in same environment. Validity is about wheter the study covers/measures what it is actually supposed to measure

Reliability is whether the reasearch can be repeated. Validity is if the reaserch was conducted correctly/measures what it is supposed to

reliability = can the study be replicated? Would the same method within the same context yield the same results if repeated? validity = are we actually measuring what we intend?

Reliability is about the reconstruction of a study and whether you get the same data if you replicate it, while validity relate to whether your measurements actually say something about the concept

Reliability is the consistency of a study's results. Validity is whether the study measures what it claims. A study can be reliable without being valid, but valid results must be reliable.

reliability is based on wether the study and result can reliably can be replicated and the results would, somewhat, match. validity is based on how accurately the studies study what it is meant to

Reliability is getting the same result if the study is repeated and validity is if the study actually measures what it claims to measure.

9

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[2022]briefly explain the difference between reliability and validity of emprical studies

A reliable study can be replicated, the results are representable. The validity represent the correctness of the study

Reliability: about replicability. If the data is possible to reproduce, it is more valuable. Validity: about how accurate and trustworthy the data is

9

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Reliability, Validity

Reliability and validity of empirical studies

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- **External validity**
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[2016]What is case study?

a study where you observe a real life case of what you are studying, not in a simulated environment

A case study is a study done in a realistic environement, which is one of its strengths. It can be chaotic and somewhat uncontrolled, but often produce realistic results if done correctly.

Meant to measure a real life phenomenon within a real life setting. Uses different methods

An in-depth study of a specific case in its real-life context.

A case study is an comptehensive examination of a single individual, group, organization, or event to explore its complexities and gain detailed insights.

Case study is the study individual cases and conclude thoery from observations

A case study is about investigating a phenomenon in its actual real-life context. It could for instance be to study an actual development team on site. Then you get realistic data about a chaotic syst

A case study is a study which scientifically measure something without controlling all the variables. E.g a study on public health, where some people are measured every year

[2016]What is case study?

A case study is a in depth real life study. focusing on real life context. Values the real life vs. the lab

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What is a case study?

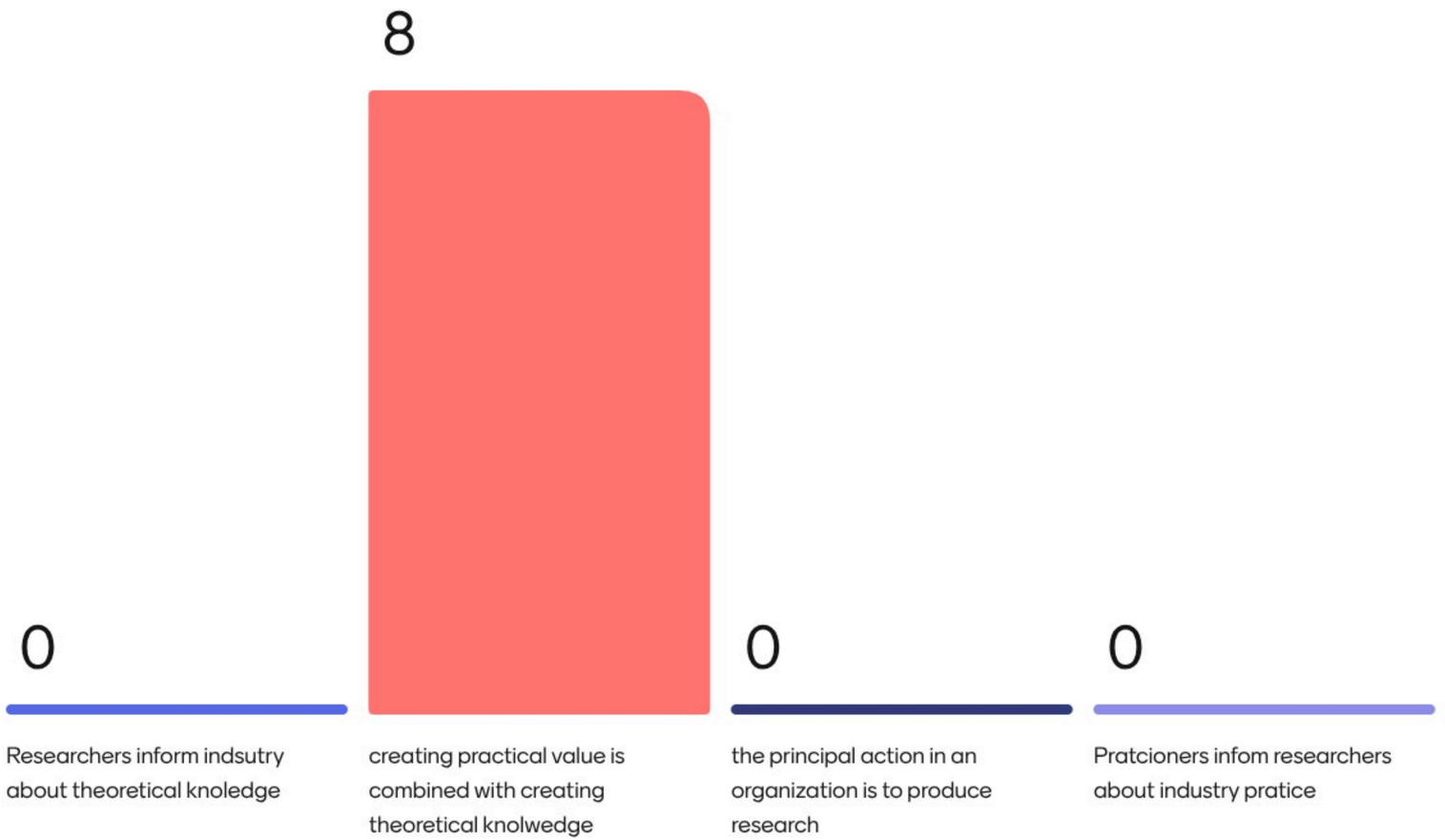
- Case studies are often used in qualitative research
- Case study is a research method which goes deeply into **one** phenomenon in the context of the real world

2019

1.1 IN5140-H19 Exam Task 1.1

Action research is a research method where:

- researchers inform industry about theoretical knowledge
- creating practical value is combined with creating theoretical knowledge
- the principal action in an organization is to produce research
- practitioners inform researchers about industry practice



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Action Research

- Simultaneously contribute to the practical concerns in a concrete situation and to the goals of science.
- Dual commitment to study a system and concurrently to collaborate with members of the system in changing it.
- Active collaboration between researchers and practitioners underlines the importance of co-learning as a primary aspect of the research process.

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Action Research

Action Research attempts to provide

practical value

to the client organization while simultaneously contributing

to the acquisition of

new theoretical knowledge

Criticisms of Action Research

- Action Research has been criticized for:
  - its lack of methodological rigor
  - its lack of distinction from consulting, and
  - its tendency to produce either

'research with little action or action with little resea h

Describe strengths and shortcoming of "experiment" in research

In relation to the context, it may not be representable. It can be too controlled and not relate to the real-life practice.

Strength: Very precise data for measurement and analysis. Also one of the most recognised forms of research. Weakness: Can become to controlled and distance itself from real-world scenarios.

Experiment can provide answers closer to the truth. But can be costly, difficult to conduct, there are also element of bias.

Experiments are great for testing hypotheses an gather specific and reliable data. However, experiments can often be quite synthetic for the sake of e.g. reproducability

Strength: you can find causality because it is easier to control the variables Limit: ethical limitations can occur, the environment can become artificial

Strength: Can control variables and get indepth knowledge. Shortcoming: might not apply in real life

Shortcoming: context can affect results, if it is conducted in a lab, it may be different in the real world. Strength: can measure causalities

strength: precise outcome and data weakness: might not be realistic

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Describe strengths and shortcoming of "experiment" in research

Strengths: Experiments allow researchers to establish cause-and-effect relationships and control variables to reduce bias. Shortcomings: They can be artificial, limiting real-world applicability

Strength: can prove causal relationships. Shortcoming: difficult to control all the relevant variables.

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Describe strengths and shortcomings of an experiment in research?

- Experiments enable researchers to observe phenomenon in isolated, controlled environments.
- Experiments can eliminate variables which are not relevant and can set a focus on the subject of the research.
- On the other hand, experiments might not reflect reality due to their artificial nature (e.g. if it is representative outside of the controlled environment).

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Case study

One of the directors in the executive management team has recently discovered a comprehensive case study that was reported in a prestigious scientific journal. The challenges for the company in the reported case study were similar to those faced by Global Finance. In one of the management meetings, the director recommends that Global Finance should make several large changes in the project to better align with empirical-based best practices and knowledge about companies replacing their IT systems.

Highlight the main problems with the director's recommendation from a research-method perspective when using

- a **case study** and
- a **single study**

as the basis for making important decisions. Use a maximum of two sentences for each point above.

[2024]

1

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Case Studies

Case study research is an empirical inquiry that:

- Investigates a contemporary phenomenon within its real-life context, especially when
- the boundaries between phenomenon and context are not clearly evident.

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Case Studies

Case study research is an empirical inquiry that:

- Investigates a contemporary phenomenon within its real-life context, especially when
- the boundaries between phenomenon and context are not clearly evident.

Advantages

- It can deal with complex situations where it is difficult to study a single factor in isolation
- It is appropriate for situations where the researcher has little or no control over events
- It is suitable for both theory building and theory testing
- It allows the researcher to show complexities and to explore alternative meanings and explanations
- It produces data that is close to people's experience

Disadvantages

- It is sometimes seen as lacking rigor and leading to generalizations with poor credibility
- It can be difficult and time-consuming to negotiate access to the necessary settings, people and documents
- The presence of the researcher can affect how people behave
- There aren't really any rules to follow

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Example of correct answer:

1) A case study has the benefit of being realistic for a concrete situation, but with limitations with respect to generalizability as well as causality. There are concerns as to whether the cases are sufficiently overlapping or similar to be usable.
2) A research synthesis of several studies (for example, systematic literature reviews or meta-analyses) is stronger evidence than a single study. Multiple case studies that are all relevant to the company and that all recommend the same would be good.

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- Empirical research
- Evidence-based software engineering
  - The steps of EBSE
  - Research synthesis
- Empirical research methods
  - Controlled experiments
  - Case studies
  - Surveys
  - Action research
  - Validity
- The importance of context

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Five steps of EBSE(Evidence-based software engineering)

1. Converting a relevant problem or information need into an answerable question.
2. Searching the literature for the best available evidence to answer the question.
3. Critically appraising the evidence for its validity, impact, and applicability.
4. Integrating the appraised evidence with practical experience and the values and circumstances of the customer to make decisions about practice.
5. Evaluating performance and seeking ways to improve it.

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Thank you for today!