FORMULATE QUESTION

DESCRIPTION
- Contains **technology** in a **context** showing an **effect**.

GUIDELINES
▸ Create question using a structured approach such as PICOT[1].
▸ Validate question with FINER[1].

ACCEPTANCE CRITERIA
☐ Question systematically constructed
☐ Formulation of question validated

FORMULATE HYPOTHESIS

DESCRIPTION
- A testable prediction based on the question.

GUIDELINES
▸ Contains: two or more variables, context, relationship between the variables
▸ *'If I [do X], then [Y] will happen.'*[2]

ACCEPTANCE CRITERIA
☐ Hypothesis is formulated as prediction
☐ Prediction is testable
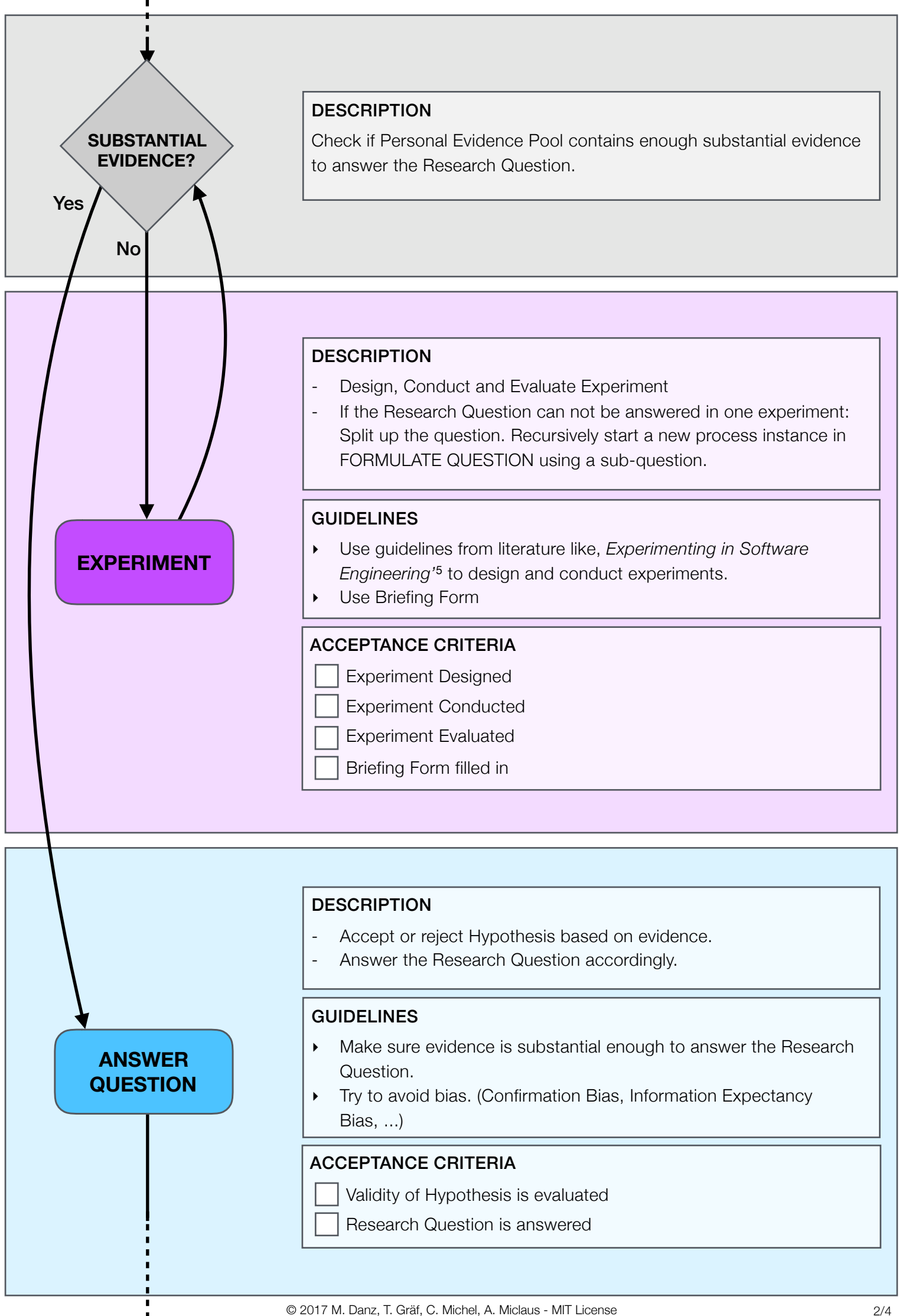
SEARCH FOR EXISTING EVIDENCE

DESCRIPTION
- Search for evidence related to the research question.
- Enlarge your Personal Evidence Pool.
- Deepen your understanding of the research domain.
- If necessary, incrementally refine the research question.

GUIDELINES
▸ Try to find as much relevant evidence as possible
▸ Use 'Cited by' function of search engines
▸ Read through found work's bibliography
▸ Refer to Systematic Literature Reviews for a wide comparison of related work
▸ Find similar work using classification systems such as CCS[3]
▸ Use EBSE Checklist[4] for critical appraisal of related work
▸ Note search strings for more structured search approach
▸ Too few search results? Make Research Question more general
▸ Too many/general search results? Narrow down Research Question

ACCEPTANCE CRITERIA
☐ Rough understanding/overview of research domain
☐ Deep understanding of research domain
☐ Critical appraisal of relevant related work

SUBSTANTIAL EVIDENCE?

Yes

No

DESCRIPTION

Check if Personal Evidence Pool contains enough substantial evidence to answer the Research Question.

EXPERIMENT

DESCRIPTION

- Design, Conduct and Evaluate Experiment
- If the Research Question can not be answered in one experiment: Split up the question. Recursively start a new process instance in FORMULATE QUESTION using a sub-question.

GUIDELINES

‣ Use guidelines from literature like, *Experimenting in Software Engineering'*[5] to design and conduct experiments.
‣ Use Briefing Form

ACCEPTANCE CRITERIA

☐ Experiment Designed

☐ Experiment Conducted

☐ Experiment Evaluated

☐ Briefing Form filled in

ANSWER QUESTION

DESCRIPTION

- Accept or reject Hypothesis based on evidence.
- Answer the Research Question accordingly.

GUIDELINES

‣ Make sure evidence is substantial enough to answer the Research Question.
‣ Try to avoid bias. (Confirmation Bias, Information Expectancy Bias, ...)

ACCEPTANCE CRITERIA

☐ Validity of Hypothesis is evaluated

☐ Research Question is answered

DISCUSSION

DESCRIPTION

- Discuss the whole study, suggest future approaches and limits.

GUIDELINES

‣ Critically assess study using EBSE Checklist[4]
‣ Put study in relation to larger context.

ACCEPTANCE CRITERIA

☐ Content of study critically assessed
☐ Study put in larger context

EVALUATE PROCESS

DESCRIPTION

- Reflect on your work in the previous steps and seek ways to improve your future performance.

GUIDELINES

‣ Use After Action Review and Postmortem Analysis[4]

ACCEPTANCE CRITERIA

☐ AAR done
☐ PMA done
☐ Conclusions drawn for future processes

REFERENCES
[1] *Farrugia, P., Petrisor, B.A., Farrokhyar, F., Bhandari, M.: Practical tips for surgical research: Research questions, hypotheses and objectives. Canadian journal of surgery. Journal canadien de chirurgie 53(4), 278–281 (2009)*
[2] *Buddies,S.: A Strong Hypothesis (2010), http://www.sciencebuddies.org/blog/ 2010/02/a-strong-hypothesis.php*
[3] *http://dl.acm.org/ccs/ccs.cfm*
[4] *Dybå, T., Kitchenham, B.A., Jorgensen, M.: Evidence-based software engineering for practitioners. IEEE Software 22(1), 58–65 (2005)*
[5] *Wohlin, C., Runeson, P., Höst, M., Ohlsson, M. C., Regnell, B., & Wesslén, A. (2012). Experimentation in software engineering. Springer Science & Business Media.*

Population	What specific population are you interested in?	**F**easible	▸ Adequate number of subjects ▸ Adequate technical expertise ▸ Affordable in time and money ▸ Manageable in scope
Intervention (Technology)	What is the investigational technology / intervention?	**I**nteresting	▸ Getting the answer intrigues investigator, peers and community
Comparison Group	What is the main alternative / baseline to compare with the intervention	**N**ovel	▸ Confirms, refutes or extends previous findings
Outcome	What do you intend to accomplish, measure, improve or affect?	**E**thical	▸ Amendable to a study that institutional review board will approve
Time	What is the appropriate follow-up time to assess outcome?	**R**elevant	▸ To scientific knowledge ▸ To clinical and health policy ▸ To future research

Study Appraisal Checklist
1. Is there any vested interest?
   - ▸ Who sponsored the study?
   - ▸ Do the researchers have any vested interest in the results?
2. Is the evidence valid?
   - ▸ Was the study's design appropriate to answer the question?
   - ▸ How were the tasks, subjects, and setting selected?
   - ▸ What data was collected, and what were the methods for collecting the data?
   - ▸ Which methods of data analysis were used, and were they appropriate?
3. Is the evidence important?
   - ▸ What were the study's results?
   - ▸ Are the results credible, and, if so, how accurate are they?
   - ▸ What conclusions were drawn, and are they justified by the results?
   - ▸ Are the results of practical and statistical significance?
4. Can the evidence be used in practice?
   - ▸ Are the study's findings transferable to other industrial settings?
   - ▸ Did the study evaluate all the important outcome measures?
   - ▸ Does the study provide guidelines for practice based on the results?
   - ▸ Are the guidelines well described and easy to use?
   - ▸ Will the benefits of using the guidelines outweigh the costs?
5. Is the evidence in this study consistent with the evidence in other available studies?
   - ▸ Are there good reasons for any apparent inconsistencies?
   - ▸ Have the reasons for any disagreements been investigated?

After Action Review (AAR)
- ▸ What was supposed to happen?
- ▸ What actually happened?
- ▸ Why were there differences?
- ▸ What did we learn?

Postmortem Analysis (PA)
- ▸ What went so well that we want to repeat it?
- ▸ What was useful but could have gone better?
- ▸ What were the mistakes that we want to avoid for the future?
- ▸ What were the reasons for the success or mistakes?

REFERENCES
FINER, PICOT: *Farrugia, P., Petrisor, B.A., Farrokhyar, F., Bhandari, M.: Practical tips for surgical research: Research questions, hypotheses and objectives. Canadian journal of surgery. Journal canadien de chirurgie 53(4), 278–281 (2009)*
Checklist, AAR, PA: *Dybå, T., Kitchenham, B.A., Jorgensen, M.: Evidence-based software engineering for practitioners. IEEE Software 22(1), 58–65 (2005)*