Week 1: Evaluate Cybersecurity

Nate Bachmeier

TIM-7211: Research Design Methodologies

December 20th, 2020

Northcentral University

# Compare Research Methods

Quality research begins with a well-defined set of questions, such as ‘can an autonomous vehicle safely navigate city streets?’ Next, the researcher needs a plan to answer the question by collecting evidence and observations. Executing that plan requires a collection of quantitive and qualitative methods. Each of these methods is a tool that comes with its inherent strengths and weaknesses (Jason & Glenwick, 2016). These attributes necessitate researchers to understand when a hammer is more appropriate than a screwdriver (see Table 1). Consider the difference when the vehicle study’s objective is (a) to identify safety requirements versus (b) modeling the limitations of the braking system. Under (a), qualitative methods best support the open exploratory nature of the problem. With (b), the answer needs a quantitative method that describes the relationship of multiple variables, such as the car’s speed and the number of objects on the road. However, a more comprehensive study could answer both (a) and (b) by first uncovering the importance of braking enhancements, then describing the limitations in greater detail.

Table 1: Research Approaches

|  |  |  |
| --- | --- | --- |
| Approach | Description | Example Use Case |
| Quantitative | Statistical modeling of a scenario | * Estimate the probability of an event * Stating a broad generalization * Cause and effect analysis |
| Qualitative | Non-numerical representation of a scenario | * Open-ended surveys * Exploration of needs * Investigating a local issue |
| Mixed | Combination of both quantitative and qualitative | * Examining the breadth and depth of a topic * Examining a scientific idea then mapping it to use cases |

## Influence of World Views

While performing these various methods, researchers need to be cognizant of their biases and worldviews (Creswell, 2014). These perspectives (see Table 2) influence data interpretation and can result in radically different conclusions.

Table 2: World Perspectives (Creswell, 2014)

|  |  |
| --- | --- |
| View | Perspective |
| Postpositivims | Theory verification |
| Constructivism | Theory generation |
| Transformative | Change-oriented |
| Pragmatism | Reality-centric |

For instance, the Washington Post (2020) maintains a record of every victim of police violence. When Pierce (2019) studied this dataset, he found statistical evidence that confirmed his view of systematic racism. Later, Harald Uhlig, an economist professor at the University of Chicago, used the same public dataset to conclude the opposite (Derby, 2020). Despite using the same quantitative approach with the same data, these two professionals came to radically different results due to being transformative versus pragmatic. This challenge arises because statistics describe a specific context (Denis, 2015). Both researchers chose a context that aligns with their narrative. Pierce examines the victims’ raw ratios versus the *national* population. In contrast, Uhlig uses demographically adjusted values based on the individual *state*’s populations (e.g., California or Texas). The subtle change to the calculation method drastically changed the results.

## Enhancing with Qualitative Methods

Instead of relying solely on quantitative methods, these researchers could incorporate qualitative information to avoid solving the wrong problem (type III error) (Crabtree & Miller, 1999). From examining the fatality context upfront, both parties might have realized that the victim is armed is more influential than demographics. With nearly 75% of all incidents involve the suspect having a gun or knife—the better question asks, ‘how can society address this safety issue?’ However, that point does not fit into either researcher’s motive of demanding social change or discrediting reform efforts.

# Examples across Risk Management

Choosing the correct research method is critical for all publications, even areas outside of sociology. Consider the variability of approaches that can effectively co-exist across a broad topic like risk management (see Table 3).

Table 3: Risk Management Papers

|  |  |  |
| --- | --- | --- |
| Author | Approach | Rationale |
| Abdullah et al. (2016) | Qualitative | * An abstract decision tree * Business-specific trade-offs make general scoring impractical |
| Al-Haidari and Al-Dahasi (2019) | Quantitative | * A purely statistical decision engine * Qualitative would have more false positives |
| Kozlov and Noga (2018) | Mixed | * The framework is not abstract * Prioritization is statistical |

## Using Qualitative Methods

Many significant problems, such as aspects of risk management, are not generalizable and contain fuzzy rules. Today, businesses are unable to address every risk due to having finite resources. Instead, prioritization of governance and risk mitigation policies must occur in a personalized manner. In “A conceptual framework for integrating information privacy protection,” Abdullah et al. (2016) approach this issue by providing a hierarchical framework for positioning different aspects of the problem. They acknowledge that it does not make sense to directly compare one branch’s value over another due to organizations having different requirements. Alternatively, through a series of open-ended questions, the authors guide the reader to the correct choice.

## Using Quantitative Methods

Other risk management qualities are generalizable, such as detecting Distributed Denial of Service (DDoS) attacks. In “New approach to Determining DDoS,” Al-Haidari and Al-Dahasi (2019) feed two traffic metrics into a classification engine. These metrics summarize network protocol metadata (Layer-4) to predict the likelihood that the source is legitimate. This use case is ideal for pure quantitative methods. Under a qualitative approach, the classification engine would have rules that lack a statistical model’s sophistication.

## Using Mixed Methods

One of the challenges with Abdullah et al.’s (2016) purely qualitative approach is ensuring prioritization consistency across the organization. Consider the skills variability between different engineering teams and how training inconsistency impacts their ability to make informed decisions. In “Risk Management for Information Security,” Kozlov and Noga (2018) also group risks into a hierarchical structure before assigning weights through a statistical model. Their model contains rules for deriving an expected loss under the likelihood that Confidentiality, Integrity, or Availability (CIA) is compromised.

# Conclusions

Many people erroneously believe that quantitative methods are superior to qualitative alternatives (McCusker & Gunaydin, 2015; Creswell, 2014; Jason & Glenwick, 2016). This naïve perspective incorrectly assumes that a hammer is always the right tool. When researchers treat screws like nails, it results in publications making erroneous claims. For instance, qualitatively exploring the Washington Posts data set would have signaled that both Pierce and Uhlig were looking in the wrong places. Instead, both authors quit looking after the results aligned with their worldviews (seeking change versus discrediting reform).

While politically sensitive journals are rife with ethical challenges, other areas like risk management are not. Consider how different problems, such as prioritizing risk to identifying traffic anomalies, demand different tooling (research methods). The authors of these three articles effectively chose methods that play to the strengths of their specific problem. Other methods might be impractical or require information that is not yet available. For instance, DDoS detection needs to identify protocol anomalies, which lends itself toward numerical modeling.

Ultimately, researchers need to be cognizant of the specific research question they are investigating. Answering that question will contain open-ended aspects, which require discovery through qualitative methods. Other attributes will need numerical modeling to describe the relationships between variables and lend themselves to quantitative methods. Neither approach is universally better and is entirely dependent on the task at hand.

# References

Abdullah, H., Labuschagne, L., & Young, J. (2016). A conceptual framework for integrated information privacy protection. *Advances in Computing and Communication Engineering* (pp. 242-248). doi:10.1109/ICACCE.2016.8073755

Al-Haidari, F., & Al-Dahasi, E. (2019). New Approach to Determine DDoS Attack Patterns on SCADA System Using Machine Learning. *International Conference on Computer and Information Sciences* (pp. 1-6). Sakaka, Saudi Arabia. doi:10.1109/ICCISci.2019.8716432

Crabtree, B., & Miller, W. (1999). *Doing qualitative research (2nd edition).* London, England: Sage Publications.

Creswell, J. (2014). *Research design: Qualitative, quantitative, and mixed methods approach.* Thousand Oaks, CA: Sage Publishing, Inc.

Denis, D. (2015). *Applied Univariate, Bivariate, and Multivariate Statistics* (1st ed.). John Wiley & Sons, Incorporated.

Derby, M. (2020). *Chicago Fed Ends Ties With Scholar Who Criticized Black Lives Matter*. Retrieved from Wallstreet Journal: https://www.wsj.com/articles/chicago-fed-ends-tie-with-scholar-who-criticized-black-lives-matter-11592003706

Jason, L., & Glenwick, D. (2016). *Handbook of methodological approaches to community-based research : qualitative, quantitative, and mixed methods.* Oxford University Press.

Kozlov, A., & Noga, N. (2018). Risk Management for Information Security of Corporate Information Systems Using Cloud Technology. *Management of Large-Scale System Development* (pp. 1-5). doi:10.1109/MLSD.2018.8551947

McCusker, K., & Gunaydin, S. (2015, October). Research using qualitative, quantitative, or mixed methods and choice based on the research. *Perfusion, 30*(7), 537-542. doi:10.1177/0267659114559116

Pierce, A. (2019, October 25th). Whose lives matter? The black lives matter movement and the contested legacy of philosophical humanism. *Journal of Social Philosophy, 51*(2), 261-282. doi:https://doi-org.proxy1.ncu.edu/10.1111/josp.12305

Washington Post. (2020, August 1st). *Data police shootings*. Retrieved from GitHub: https://github.com/washingtonpost/data-police-shootings/commit/2ea87a4ed725b164be1489878e20827fb5944d1b