Week 7: Constructive Research Strategies

Nate Bachmeier

TIM-7211: Research Design Methodologies

February 7, 2021

Northcentral University

# Constructive Research Strategies

Constructive design is one of the most common research methods for information systems and technology (Silvestrini et al., 2012). These studies identify a problem, build solution artifacts, and communicate the implementation’s unique value (Hevner et al., 2004). For example, high-speed broadband internet is not available within many developing countries. These challenges promote researches to create new compression algorithms and improve the existing infrastructure. Typically, these results (artifacts) originate from specific Proof-Of-Concept (POCs) or directed case studies.

# Literature Review

Five constructive design articles from Northcentral University’s Library were selected (see Table 1). These articles identify a specific problem within business and technology scenarios (e.g., networking and cybersecurity) and then produce reusable artifacts (e.g., business processes and hardware designs).

Table 1: Selected Articles

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Article | Problem Statement | Artifacts Produced | Effectiveness of Solution | Broader contributions |
| Emergency Communication | Communication systems are least reliable when they are most critical | Smartphone enhancements to address these scenarios | Addresses the problem with low power requirements | Reusable for other long-range / low-bandwidth scenarios |
| Measuring Cybersecurity | Comparing orgs. and prioritizing security posture is challenging | Qualitative bottoms-up framework | Reduces operational overhead | Applicable to any critical infrastructure project |
| Learning Strategies | Increasing student engagement produces better test results | Gamified curriculum for college courses | Student scores are one letter higher | Applicable to any instructor-led course |
| Menu Analysis | Customer-value and internal cost controls do not entirely overlap | An iterative process for optimizing menu design | Increased customer satisfaction and reduced wasted efforts | Applicable to any supply-chain scenario |
| Self-Service Analytics | Businesses want SSA but lack frameworks to measure its effectiveness | An iterative process for introducing SSA metrics | Increased insights into manufacturing processes | Applicable to any supply-chain scenario |

# Emergency Communication (2016)

## Problem Statement

Recently political and natural events have disrupted network communications during periods where system reliability is most critical. Abruawi et al. (2016) want to address these scenarios with a solution that is easy to deploy, operationally inexpensive, and supports many users across long ranges. They propose modifying conventional smartphones to include short wave radio transmitters that pair with receiving towers. Each short wave broadcast’s bandwidth is relatively low compared to other existing standards (e.g., 4G WiFi). However, in an emergency, the networking requirements are substantially lower than traditional multimedia use-cases.

## Artifacts Produced

The researchers demonstrate the effectiveness of their solution by building an Arduino-based receiver and transmitter. Arduino offers a standard interface for several hardware components and enables engineers to prototype solutions rapidly. While their proof-of-concept has several limitations, those issues are more akin to budgetary restrictions. For instance, their artifact draws power from an outlet versus a production version that would be battery-powered.

## Effectiveness of Design

External risks exist with the practicality of this system. First, it requires receivers deployed across vast geographic spaces, necessitating multiple governments working together. Second, military forces could disrupt the signal and reduce its effectiveness during political events. Third, sensitive information needs additional layers of protection as its broadcasted thousands of kilometers.

# Measuring Cybersecurity Wellness (2018)

## Problem Statement

Comparing the security posture and maturity levels between two organizations is complex (Jazri et al., 2018). Many industry standards, like ISO 27001, attempt to solve this problem through vital sign metrics. However, the quantitative metric values use internal business risk calculations that are meaningless to external audiences. These standards also focus heavily on top-down policies, making it challenging to identify all problem areas.

## Artifacts Produced

The researchers propose a framework for assessing the maturity level of security-critical functions (e.g., monitoring and incident response). Definitions of each level come from a qualitative investigation into twenty critical infrastructure facilities. Their framework also places a strong emphasis on bottom-up reporting to catch more issues. After an organization completes onboarding into the framework, it can identify vulnerabilities and consistently compare itself against other businesses.

## Effectiveness of Design

Jazri et al. (2018) state that the onboarding process touches on twenty-question areas, making it easy to adopt. However, they do not provide any evidence that this framework is superior to the numerous internationally recognized standard bodies (e.g., ISO and NIST). Another challenge comes from calibrating the definitions with twenty similar institutions. Without sufficient sampling entropy, there is a risk that other industries produce misleading results. For instance, a nuclear power plant versus a public blog has different expectations of what constitutes a mature identity system.

# Learning Strategies for Business Programs (2018)

## Problem Statement

Students that spend more time studying receive higher grades in school. This relationship encourages educational facilitators to promote extracurricular engagements. However, there are limits to the student’s attention and desire to complete additional work. Modern instructional training needs to incorporate Industrial Revolution 4.0 technologies that promote student engagement (Luna et al., 2018).

## Artifacts Produced

The researchers expand their solution-first approach to mean gamification of learning technologies. Luna et al. (2018) modified the curriculum for a business engineering course at a private university. These changes incorporate interactive online games that challenge the student’s knowledge of the lecture material. The course’s dashboard also exposes a leaderboard to inspire friendly competition between peers.

## Effectiveness of Design

Each iteration of the course takes roughly fifteen weeks to complete with ten to twenty learners. The researchers evaluated test scores from before (2013 to 2016) and after the program (2016 to 2017). They found that cohorts using the interactive material received a full letter grade higher and reduced the standard deviation of scores by 50%. These results suggest that the pupils are spending more time studying and gaining more value from the course.

Their experiment and its results are rational, but external factors are likely to skew the data. Luna et al. do not provide any information about the amount of time students spend with the online content. Additionally, there is no evidence that the complexity of the test is consistent between 2013 to 2017. Further, it is possible that changing the instructor and retaining the previous material also improves test scores. The researcher’s artifacts are promising, but better variable isolation could improve broader adoption.

# Menu Analysis (2020)

## Problem Statement

Successful restaurant owners leverage their menu to engage with customers and drive higher sales volumes. However, many owners are hesitant to make changes to their menus because they lack formal processes. When owners make changes, it often attempts to optimize individual products’ internal costs (Nemeschansky et al. 2020). Instead, these revisions need to produce more customer value and inspire larger orders across repeat business engagements.

## Artifacts Produced

The researchers define a Customer-Driven Menu Analysis (CDMA) model that actively collects customer feedback across several categories. For instance, one set of questions attempts to measure the influence of service personal versus service quality. Initially, the management thought customers wanted to see the same staff during repeated visits, creating scheduling challenges. However, the customers placed more value on the service quality and viewed the staff as a commodity. After observing this discrepancy, the leadership team invested more into training and allowed more scheduling flexibility.

Nemeschansky et al. also offer procedures for combining customer feedback with internal inventory data. For example, after the weekend, a business has left-over meats that can become a “Tuesday meal special.” Then, promoting the relaxing atmosphere with alcoholic beverages further improves customer value and offsets the discount.

## Effectiveness of Design

This constructive research measures progress in terms of weekly revenue at their restaurant. This location in Auckland, New Zealand, can host 90-guests and averages seventy-five thousand per week. Over the two years of experimentation, approximately four thousand customers have participated in their survey. During this time, they decreased waste from 22 to 12.5% and increased profit margins from 18 to 26%. These results demonstrate that their system is delivering the desired outcomes.

Their strategy of including the customer’s voice applies to numerous supply-chain scenarios. Other organizations that follow this iterative process will find its data-driven format consistently removes waste and focuses resources on improving the customer experience.

# Self-Service Analytics (2018)

## Problem Statement

Manufacturing processes are turning to Lean Six Sigma methodologies to reduce waste and improve efficiencies. A fundamental principle of Lean design requires a mechanism to measure processes before they can be improved. Traditionally, organizations utilized centralized teams that collect and analyze these metrics. However, this approach creates bottlenecks, causing those same businesses to pivot toward Self-Service Analytics (SSA). Despite a broad adoption of SSA, there is little research into its accuracy and effectiveness (Lizotte-Latendresse & Beauregard, 2018). This lack of formal training produces risks that garbage-in-garbage-out analysis occurs.

## Artifacts Produced

Two manufacturing plants required a formal measurement system, but their workers lacked the necessary training. Lizotte-Latendresse and Beuregard (2018) assisted those workers in implementing and verify these SSA use-cases. The researchers noticed repeatable patterns and began documenting their guidance as an official process. They iteratively refined the process into an effective workflow for general decisions, such as defining Key Performance Indicators (KPIs) and dashboard layouts.

## Effectiveness of Design

The decision process is generic and applicable to measuring any supply chain. However, the authors do not provide any metrics or quantitative values. Instead, they should have included data around the decrease in support tickets or the number of SSA-driven improvements. While these changes likely occurred favorably, a failure to validate results introduces risk. For instance, individuals could be missing critical issues due to inaccurately following the process.

# References

Aburawi, A., Salic, S., & Krampell, M. (2016). A new model of emergency communication for disaster relief in remote areas. *International Conference on Innovations in Information Technology*, *12*, pp. 1-5. Al-Ain, Omen. doi:10.1109/INNOVATIONS.2016

Hevner, A., March, S., Park, J., & Ram, S. (2004). Design science in information systems research. *MIS Quarterly, 28*(1), 75-105. doi:10.2307/25148625

Jazri, H., Zakaria, O., & Chiohora, E. (2018). Measuring Cybersecurity Wellness Index of Critical Organisations. *IST-Africa Week Conference*, (pp. 1-8). Gaborone, Botswana. Retrieved from https://search-ebscohost-com.proxy1.ncu.edu/login.aspx?direct=true&db=edseee&AN=edseee.8417299&site=eds-live

Lizotte-Latendresse, S., & Beauregard, Y. (2018). Implementing self-service business analytics supporting lean manufacturing: A state-of-the-art review. *IFAC PapersOnLine, 51*(11), 1143-1148. doi:10.1016/j.ifacol.2018.08.436

Luna, A., Chong, M., & Jurburg, D. (2018). Learning Strategies to Optimize the Assimilation of ITC2 Competencies for Business Engineering Programs. *International Conference on Teaching, Assessment, and Learning for Engineering (TALE)* (pp. 616-623). Wollongong, North-South Wales: IEEE. doi:10.1109/TALE.2018.8615444

Nemeschansky, B., v. d., & Kim, P. (2020). Customer-driven menu analysis (CDMA): Capturing customer voice in menu management. *International Journal of Hospitality Management, 91*, 1-14. doi:10.1016/j.ijhm.2019.102417

Silvestrini, R. P., & Sammito, G. (2012). Design of Experiments for Information Technology Systems. *Defense AT&L, 41*(5), 30-35. Retrieved from https://search-ebscohost-com.proxy1.ncu.edu/login.aspx?direct=true&db=bth&AN=80409129&site=eds-live